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A Comparison of Intervention Approaches Using the iPad

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Abstract

Research has indicated that an interactive, naturalistic style of instruction facilitates vocabulary learning (Armbruster, Lehr, & Osborn, 2010; Beck, McKeown, & Kucan, 2005; Brett, Rothlein, & Hurley, 1996). Evidence also suggests that direct instruction is effective for children with language impairment (Jenkins, Pany, & Schreck, 1978; Boehm, 1986; Siefert & Schwarz, 1991). A reduced fast-mapping ability is characteristic of children with language impairment (Rice, Buhr, & Nemeth, 1990), necessitating additional support when providing vocabulary instruction (Steele & Mills, 2011). As many forms of technology are being integrated into educational settings, it is imperative to consider the effects of technology on vocabulary instruction. Little evidence comparing approaches to using the iPad as an intervention tool exists. The purpose of this study was to compare the effects of two intervention approaches using the iPad: using the device alone versus pairing the device with scaffolding. Basic concepts provide the foundation for advanced language learning and are imperative for academic achievement; therefore, basic concepts were chosen as targets for the intervention. Four children who were receiving speech/language therapy services for a language delay participated in this study. A single-subject modified alternating treatment design was used. Intervention was provided to each subject individually in two 30-minute sessions per week for five weeks. Both treatment approaches were used with each student. The current study revealed using the iPad in intervention was an effective strategy for teaching basic concepts to children with a language delay. However, due to a limited number of subjects and a limited amount of time for the study, the results were not sufficient enough to determine the efficacy of different intervention approaches using the iPad.

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CHAPTER I

Introduction

Children enter school with varying amounts of vocabulary knowledge, depending upon socioeconomic status, quality of parent/child interactions, and intellectual ability (Hart & Risley, 1992). Biemiller (2004) highlighted the importance of early identification and intervention efforts in order to close the knowledge gap. Research has indicated that an interactive, naturalistic style of instruction best facilitates vocabulary learning (Armbruster, Lehr, & Osborn, 2010; Beck, McKeown, & Kucan, 2005; Brett, Rothlein, & Hurley, 1996). Evidence also offers support for direct instruction of vocabulary (including basic concepts), which introduces terms and teaches word learning strategies (Boehm, 1986; Jenkins, Pany, & Schreck, 1978; Siefert & Schwarz, 1991).

Vocabulary acquisition consists of two phases, fast-mapping and slow-mapping. Fast-mapping refers to the basic representation formed after initial exposure to a word. Slow-mapping follows, as information is added to that representation with each subsequent exposure to the word (Carey & Bartlett, 1978). A reduced fast-mapping ability is characteristic of children with language impairment (Rice, Buhr, & Nemeth, 1990), necessitating additional support when providing vocabulary instruction (Steele & Mills, 2011).

It is imperative to consider the effects of technology on vocabulary instruction, as many forms of technology are being integrated into educational settings. Studies have acknowledged the educational value of technologies such as computers and interactive whiteboards (Bruce, McPherson, Sabeti, & Flynn, 2011; Fish, Li, McCarrick, Butler, Stanton, Brumitt, Bhavnagri, Holtrop, & Partridge, 2008; Ponce, Lopez, & Mayer, 2012), but little evidence exists on using the iPad as a teaching tool. Flores, Musgrove, Renner, Hinton, Strozier, Franklin, & Hil (2012)

conducted a study which examined the effectiveness of the iPad as a form of alternative and augmentative communication (AAC) compared to a non-electronic picture-based system. Although the student results were inconclusive, it was noted that the iPad was deemed more efficient for the staff members providing intervention. Acha (2009) indicated that the effects on the cognitive load must also be considered, since including a simultaneous presentation of word and picture representations may require more processing effort.

Although evidence suggests that direct instruction is effective for children with language impairment, little research incorporating the iPad into direct instruction exists. The current study compared two instructional approaches to using the iPad as an intervention tool: pairing the iPad with scaffolding from a speech-language pathologist (SLP) and using the iPad alone. Since basic concepts, which provide the foundation for advanced language learning, are imperative for academic achievement, they were chosen as targets for vocabulary intervention.

CHAPTER II

Review of Literature

Vocabulary Development

Infants begin to intentionally communicate at approximately 8 months, using gestures, eye contact, facial expression, and babbling. By the age of 12 months, children are capable of communicating with language and have a receptive vocabulary consisting of approximately 50 words. The majority of the words in a young child's vocabulary can be classified as nouns, verbs, modifiers, personal-social, and function words. One-word expressive vocabulary also emerges around the age of 1 year. At approximately 18 months, children begin to produce 2-word utterances, follow simple commands, and answer simple questions. Children understand approximately 300 words at the age of 2, and the number triples by age 3. By age 4, children answer basic "wh-" questions (who, what, where) and describe experiences. Children also begin to understand associations (e.g., toothbrush is related to toothpaste). At the age of 5, children are able to understand nearly 13,000 words, and approximately 90% of morphology skills are attained (Owens, 2008).

Acquisition of basic concepts, a specific area of vocabulary, occurs throughout the early childhood years, from ages 2 ½ to 5 years (Boehm, 1986; Bracken & Panter, 2011). The *Bracken Basic Concept Scale-Revised* (*BBCS-3:R*) assesses comprehension of 11 categories of concepts. Colors, letters, numbers/counting, shapes, and self-/social awareness appear first in the developmental sequence, often as children begin preschool. The concepts of quantity and size are typically understood by kindergarten or first grade. The acquisition of more complex concepts, including comparisons, direction/position, texture/material, and time/sequence, occurs between kindergarten and third grade (Bracken, 2011). Basic concepts are functional vocabulary

terms frequently found in elementary curricula, especially in pre-kindergarten through first grade (Balat, 2009). Basic concepts are often used in instructional statements (e.g., "Line up **behind** Abby."). Therefore, an understanding of these terms is necessary in order to complete tasks assigned. Children lacking an understanding of basic concepts appear to be disadvantaged academically (Boehm, 1986). Bracken and Panter (2011) identified an existing "strong correlation between concept development and intelligence, achievement, school readiness, and overall language development" (p. 474). Knowledge of basic concepts provides the foundation for more advanced thinking, which is crucial to academic success.

Vocabulary Learning

Knowledge, experience, and exposure. Learning new words requires one to make connections with existing knowledge and prior experiences. This makes teaching vocabulary challenging, as each child has differences in knowledge and experience. Biemiller (2005) stated that parents and other caregivers are responsible for the majority of vocabulary acquisition throughout the primary years. It was stressed that "one cannot acquire words that are not encountered" (Biemiller, 2005, p.6). As children spend much time at home, the type and number of words spoken by parents determine the exposure to vocabulary (Biemiller, 2005). Socioeconomic status affects the quality and quantity of language exposure provided in the home. "Few doubt that children in low-income families are in developmental jeopardy because of the conditions that often accompany or foster poverty, such as low parent education levels, family disorganization, limited opportunities, rundown housing, bad schools and hazardous neighborhood conditions" (Zill, 1993, p. 38). In a 27-month study, Hart and Risley (1992) examined the relationship between socioeconomic status, parent/child interactions, and the IQ of the children. Differences in cognitive ability could be attributed to "the extensive amount of

time, attention, and talking that higher SES parents invest in their children" (Hart & Risley, 1992, p. 1104). In another study, Hart & Risley (1995) identified "meaningful differences" in children's exposure to and knowledge of language. Forty-two families participated in the study. Parents' occupations were used to divide the families into three socioeconomic groups: professional families, working families, and families receiving welfare. The children all began speaking at approximately the same age. Therefore, the differences in children's language ability were attributed to home experiences. Children in professional families were exposed to more words per hour than children in other socioeconomic groups, resulting in larger vocabularies. Hart and Risley (1995) found that in 1 year, on average, children in professional families heard 11 million words, compared to 6 million words for children in working class families and 3 million words for children in families receiving welfare. This study supported the theory that the connections utilized in acquiring new words are determined by previous knowledge and experiences which are influenced by socioeconomic status.

Classroom influences. As children begin school, the classroom becomes an additional source of exposure to vocabulary. Considering that children have varying levels of language exposure when entering preschool, early language intervention is imperative. By first grade, there is a significant gap between word knowledge of children from higher and lower socioeconomic backgrounds (Graves, Brunetti, & Slater, 1982). Children from economically disadvantaged backgrounds are more likely to have delays in language development (Balat, 2009; Hart & Risley, 1992; Hart & Risley, 1995; Siefert & Schwarz, 1991). Stanovich (1986) described the "Matthew effect," acknowledging the reciprocal relationship between vocabulary acquisition and reading comprehension. Reading increases exposure to vocabulary, and knowledge of word meanings enables reading comprehension. Children with more sophisticated

word knowledge typically have more frequent exposure to written language, which enables them to acquire new word meanings more efficiently. However, children with little exposure to language typically have less exposure to written language and have more difficulty learning word meanings (Stanovich, 1986; Stahl & Nagy, 2006; Siefert & Schwarz, 1991). As children enter school, their reading abilities are assessed and used to determine the type of reading materials to which they are exposed. More advanced readers work with challenging materials, while students with lower reading skills receive diluted texts. Consistently grouping students in this manner contributes to widening the knowledge gap (Chall, 2002). Considering that children enter school with varying levels of language exposure, it is imperative to identify the need for language intervention and strive to close the gap between children of high and low socioeconomic backgrounds (Biemiller, 2004).

Receptive and expressive vocabulary. Expressive and receptive language use different retrieval routes; thus, children typically have disproportionate skills in the two areas. Gershkoff-Stowe and Hahn (2007) described a model of lexical access for comprehension. They proposed that incoming auditory information stimulates the phonological depiction stored in memory and proceeds to the semantic level, wherein meaning is attached to the word. Word production, on the other hand, involves reversing the stages of comprehension. It begins with semantic knowledge stored in memory and extends to the phonological representation of the word. Activation of semantic and phonological information stored in memory is necessary in both comprehension and production. The ability to access stored information depends on two factors: "the strength of connections that link units to one another and the strength associated with each unit at a given moment in time" (Gershkoff-Stowe & Hahn, 2007, p. 683). Young children

develop early concepts before sound forms; therefore, when learning language, production is more difficult than comprehension.

Fast-Mapping in Language Acquisition. Carey and Bartlett (1978) proposed that two phases, fast-mapping and slow-mapping, are involved in the process of language acquisition. Fast-mapping, the initial phase, occurs as children use knowledge of a familiar word to determine the meaning of an unfamiliar word. A rudimentary representation of the term is promptly stored in the child's memory; however, it is often imprecise. Slow-mapping occurs as the child enhances the initial representation by adding information with each succeeding exposure to the word. Carey and Bartlett (1978) indicated that when given a familiar and an unfamiliar word, preschoolers were able to infer the meaning of the novel word. For example, when instructed to choose "the chromium tray, not the blue one," children were able to make the correct selection based on their knowledge of the word "blue."

Expanding on the work of Carey and Bartlett (1978), Dollaghan (1985) evaluated fast-mapping by utilizing five fast-mapping tasks to determine the type of information stored in memory after exposure to a novel word. Fast-mapping enables a spurt in vocabulary by allowing the initial representation of many words to be stored in memory and later refined. Therefore, a large number of words can be learned simultaneously. Thirty-five typically-developing preschool students participated in the study. Children were given a single exposure to a nonsense syllable ("koob") and its referent, an asymmetrical plastic ring. Five fast-mapping tasks were administered: exposure, comprehension, production, recognition, and location. Participants first encountered the novel word, "koob," during the exposure task. After one exposure, comprehension was assessed by requiring participants to select the item when given oral instructions. Children were instructed to choose the "koob," given four choices: the novel

object, one familiar object, and two unfamiliar objects. For the production task, children were asked to label objects, including the "koob," with emphasis placed upon the amount of phonetic information retained following the exposure and comprehension tasks. Children who could not complete the production task were asked to identify the term when given 3 choices. The location task determined whether children stored information regarding nonlinguistic features of the word, such as where it was hidden. Dollaghan (1985) found that 91% of participants responded correctly to the exposure task, and 81% were able to select the item after hearing the label. While 74% of the children attempted to say the word, 26% refused. Forty-five percent of those who attempted correctly produced 2 of the 3 phonemes. Of those who did not attempt to produce the word, 62% were able to identify the label. Sixty-one percent recalled the location in which the object was hidden. The fast-mapping skills observed in this study indicated that children were able to adapt their knowledge of language in order to "participate in many communicative exchanges that exceed his/her strictly linguistic capabilities" (Dollaghan, 1985, p. 453). Children established a connection between the object and its label, as well as some contextual information. Overall, the production task received the lowest scores, indicating that "phonetic information is the most vulnerable aspect of the fast-mapping process" (Dollaghan, 1985, p. 453).

Theories of vocabulary learning. Several theories exist to explain the process of language acquisition. Knowledge of learning theories is useful when developing teaching techniques. The behaviorist theory (Skinner, 1938) suggests that when learning language, reinforcement determines the acquisition of new skills. Traditional therapy techniques (e.g., drill-and-practice) are influenced by behaviorism, as a stimulus is provided in order to trigger a response. Reinforcement is used to increase the frequency of positive behaviors, while punishment is used to reduce the frequency of negative behaviors. Alternatively, the social

interaction theory states that children's language acquisition is greatly affected by their interactions (Vygotsky, 1978). As children observe the language skills of others, they develop a desire to communicate. They begin by expressing needs and imitating others, but as language skills progress, children internalize communicative skills and form their own ideas.

Teaching Vocabulary

Instruction for Typical Development. "Chances of successfully addressing vocabulary differences in school are greatest in the preschool and early primary years" (Biemiller, 2004, p. 30). Vocabulary knowledge strongly correlates with reading comprehension and is crucial to academic success (Beck, Perfetti, & Kucan, 1982; Hiebert & Kamil, 2005; Jenkins et al. 1978; Stahl & Fairbanks, 1986). Vocabulary can be learned indirectly or taught directly. Children learn word meanings indirectly in a number of ways. Everyday experiences with oral language expose children to unfamiliar words. Shared storybook reading with adults introduces children to new terms and helps to form connections with words already stored in memory. As children are able to read independently, they have another opportunity to learn new vocabulary words.

Direct vocabulary instruction. Although indirect word learning occurs frequently, direct instruction is necessary when learning more difficult terms that may not be encountered in daily conversation. Specific word instruction introduces children to terms found in school curricula, enhancing reading comprehension. Along with specific word instruction, students are taught word learning strategies. Educators cannot possibly provide direct instruction for every word a child will need; therefore, strategies for learning are imperative (Armbruster, Lehr, & Osborn, 2010). "The ultimate goal of any effective instruction is to put the learners in a position to take on responsibility for their own learning" (McKeown & Beck, 2004, p. 25). This includes teaching students how to use context clues, as well as reference tools, such as dictionaries and

encyclopedias (Armbruster et al. 2010). Research has also indicated that students learned more vocabulary words when the instructional techniques were interactive, as repeated exposure to a word in a variety of contexts most resembled natural vocabulary learning (Armbruster et al. 2010; Beck et al. 2005; Brett et al. 1996). Jitendra, Edwards, Sacks, and Jacobson (2004) noted that, like typically developing peers, children with language impairment learned more through direct vocabulary instruction.

In order to identify useful vocabulary to teach, Beck, McKeown, & Kucan (2002) developed a three-tier vocabulary model. Tier 1 words (e.g., boy, school, orange, grass) are concrete terms that are widely known and can be illustrated. Tier 2 words (e.g., intervene, leisure, sullen, scornful) are more abstract, typically the main focus when teaching vocabulary. They are considered high-frequency words, meaning that knowledge of tier 2 words leads to higher productivity in reading comprehension. Tier 3 words (e.g., chromosome, photosynthesis, heterozygous, mitosis) are specialized to certain fields; therefore, they are not practical to teach to everyone (Beck, McKeown, & Kucan, 2002).

A recent study by Gershkoff-Stowe & Hahn (2007) indicated the importance of the number of practice opportunities, as experience affects the ability of children to fast-map novel words. The authors enlisted 16 typically-developing children between the ages of 16 and 18 months in a longitudinal study which examined the emerging comprehension ability of children just before the characteristic vocabulary explosion. Twenty-four pictures of common objects were divided into two "high-practice" sets, one "medium-practice" set, and one "low-practice" set. Throughout the 12 sessions, participants were exposed to "high-practice" sets 20 times, "medium-practice" sets 3 times, and "low-practice" sets only once. Each session for the experimental group consisted of a training and testing phase. For training, the parent and

experimenter labeled each object in a natural context at least 6 times per session. Children were shown pictures of half of the objects and asked to point to the picture that corresponded to the label given by the experimenter. The procedure was repeated for the remaining objects, as well. Children in the experimental group were exposed to two "high-practice" sets for the majority of sessions, one "high-practice" and one "medium-practice" set every third session, and one "high-practice" and one "low-practice" set during the final session. In contrast, the control group was exposed to two "high-practice" sets in the initial session, and one "high-practice" and one "low-practice" set during the final session. However, only familiar words were practiced during the remaining sessions, limiting exposure to novel words to just two sessions. The ability to fast-map each set of words was measured after the initial exposure of each set. Children in the experimental group showed more progress between the initial and final sessions than those in the control group. Also, children in the experimental group accurately identified 71% of "low-practice" words, compared to 38% with the control group. Data validated the hypothesis that recurrent exposure to novel words facilitates the fast-mapping of a multitude of words simultaneously. Repeated practice strengthens the ability to retrieve lexical information; therefore, "knowing some words appears to prime the system to knowing more words" in typically-developing children (Gershkoff-Stowe & Hahn, 2007, p. 690).

Jenkins, Pany, & Schreck (1978) also conducted a study which evaluated teaching strategies commonly used in vocabulary instruction. Twelve fourth-grade students participated in the study which employed four treatment conditions: "meanings from context," "meanings given," "meanings practiced," and "no meanings." Twenty-four target words were divided into three groups of eight. Each student was given eight words, two for each of the four treatment conditions. For the "meanings from context" group, students read a sentence containing the

target word followed by a sentence containing a synonym of the target. Direct instruction was not provided. "Meanings given" meant that after students read a sentence containing the target word, an experimenter defined the word and used it in another sentence. For "meanings practiced," students read the target word in isolation. An experimenter then provided a synonym and used the target word in a sentence. Students repeated both the target word and its synonym. The "no meanings" condition served as the control, as students only read the target word in isolation. Pretests and posttests were given to assess knowledge of vocabulary and comprehension, using an isolated word vocabulary test, a multiple choice vocabulary test, a sentence paraphrase test, and a sentence anomaly test. In each of the four treatment conditions, students collectively scored highest using "meanings practiced," followed by "meanings given," "meanings from context," and "no meanings," respectively. These results correlated with the amount of direct instruction provided, as practicing required the most teaching and no meanings involved none. It was also noted that words practiced resulted in the greatest retention. The authors then replicated the study with 6 students in grades 4 through 6 who were receiving special education services for reading instruction. The treatment conditions received the same ranking as the first experiment, which offered support for the effectiveness of direct vocabulary instruction for both typically-developing children and those with learning disabilities.

Direct instruction for basic concepts. Integrating basic concepts into elementary curriculum has resulted in gains in basic concept knowledge (Boehm, 1986; Siefert & Schwarz, 1991). Siefert and Schwarz (1991) evaluated the effectiveness of large group language intervention for at-risk students by targeting basic concepts in Head Start programs. Fifty-seven children, 13 of which had language delays, were given the *Boehm Test of Basic Concepts-Revised* (*BTBC-R*) (Boehm, 1986) as a pretest. Intervention was provided for seven consecutive

weeks. Fourteen basic concepts missed most frequently on the pretest were targeted (2 concepts per week). A speech-language pathologist provided 30 minutes of intervention twice weekly. A combination of direct instruction, interactive instruction, and incidental teaching was used. Direct instruction began by using objects to illustrate the concepts. For example, three objects (small, medium, and large) were presented for the concept "medium-sized," and children compared the sizes of the objects to determine which was "medium-sized". The students were then asked if an object was "medium-sized." Their verbal responses provided feedback to the interventionist, who gave additional examples when necessary. Interactive instruction integrated the concept into activities, such as art, drama, or games. The interventionist indirectly targeted the concept by making remarks when students used it correctly and modeling when the concept was misused. The Head Start teachers incorporated the concepts targeted into daily lessons, which provided incidental teaching.

Following intervention, group pre- and post-test scores on the *BTBC-R* were compared. The control group had an average gain of 5.10 standardized points on *BTBC-R* performance, while the average gain of the experimental group was 9.00 points. The difference in pre- and post-test raw scores for the 14 target concepts was also evaluated. The control group gained approximately 4.93 points, compared to the 9.29 point gain of the experimental group. In addition, pre- and post-test raw scores were compared for the 36 concepts that were not targeted. No group differences were noted. Finally, the experimenters compared the change in raw scores of the 14 targeted concepts with the change in raw scores of 14 randomly selected non-targeted concepts. No significant difference was noted for the control group, as the scores of the control group increased by 4.93 points on target concepts and by 3.86 points on nontargeted concepts. However, the experimental group gained approximately 9.29 points on the targeted concepts and

3.57 on nontargeted concepts, revealing a significant difference in the intervention condition. The experimental group showed greater increases in each comparison, demonstrating the effectiveness of classroom-based intervention in the Head Start population.

Ellis, Schlaudecker, & Regimbal (1995) conducted a study which examined the effectiveness of direct instruction on basic concepts. The participant group consisted of forty kindergarten students. Collaboration between a speech-language pathologist, two kindergarten teachers, and a physical education teacher occurred for this study. Basic concepts were "embedded in directions for learning locomotor skills" (p. 70), making this exercise applicable in a physical education class. Following a pretest using the *Boehm Test of Basic Concepts-Revised (BTBC-R),* each teacher selected five of the most frequently missed concepts to target. Concepts of time were omitted, as they were presumed to be too difficult for kindergarten students to understand. Both teachers consulted with the speech-language pathologist and provided direct instruction. Children in the experimental group received 30 minutes of direct instruction from their classroom teacher weekly. The target word was introduced for 10 minutes, followed by 20 minutes of supplemental activities, such as a concept story. The concept was also incorporated into a 30-minute physical education class once per week. Children in the control group received regular kindergarten instruction from the classroom teacher, who was unaware of the details of the study. Children in the experimental group scored significantly lower on the *BTBC-R* pretest than children in the control group with the basic concepts being targeted. In order to determine the effectiveness without allowing varying levels of preexisting knowledge to affect the results, an analysis of covariance (ANCOVA) was performed. The adjusted mean scores were 6.74 for the experimental group and 4.52 for the control group. Data indicated that the collaborative intervention approach accounted for the difference between the two groups, as preexisting

knowledge did not affect scores. The findings were consistent with previous research support for basic concept instruction (Boehm, 1986; Siefert & Schwarz, 1991). The implementation of basic concept instruction in a large group setting promoted the learning of concepts in a more natural context (Ellis, Schlaudecker, & Regimbal, 1995).

Vocabulary intervention in language impairment. Methods of vocabulary instruction for children with language impairment must also be considered. Bearing in mind the language gap suggested by Biemiller (2004), it is important to identify at-risk children and provide intervention before the children lacking vocabulary knowledge irreversibly fall behind their peers. Jitendra, et. al (2004) noted that children with language impairment, like typically developing peers, learned more through direct vocabulary instruction.

> "Students with special language-learning needs often require more explicit, intensive, individualized scaffolding and repeated opportunities to encode words in their mental lexicons on multiple levels…in order to develop deep associations and automacity; whereas students with typical development may be able to acquire such concepts and forms more quickly and incidentally in the context of whole-group instruction" (Ukrainetz, 2006, p. 101).

Steele and Mills (2011) reviewed existing evidence on vocabulary intervention for children with language impairment. Intervention targeting curriculum-aligned, meaningful vocabulary words should be individualized and offer support through scaffolding. Intervention is often conducted in individual or small-group sessions. One suggestion to promote deep processing of new words included providing a student-friendly definition of the word rather than a dictionary definition. For example, the dictionary definition of *introduce* is "to present (a person, product, etc.) to a particular group of individuals or to the general public for or as if for

the first time by a formal act, announcement, series of recommendations or event, etc." (dictionary.com, as cited Steele & Mills, 2011). The simpler, student-friendly definition is "to tell about something or someone for the very first time" (Steele & Mills, 2011, p. 362). It was also noted that providing multiple contexts for a word, providing scaffolding, and using keyword strategies and visual organizers enabled students to create a deeper understanding of targeted vocabulary.

Rice, Buhr, & Nemeth (1990) compared the fast-mapping abilities of children with language impairments to two groups of typically developing peers, one of equivalent chronological age, and one of younger children with equivalent language skills, determined by mean length of utterance. Twenty children with language impairment, ages 3 to 6, who were enrolled in preschools for language-impaired children participated in this study. The control group consisted of 20 typically-developing children, ages 2 to 5, attending preschool or day care that were matched, based on MLU, to children in the experimental group. The 34 typically-developing children, age 5, who participated in the Rice and Woodsmall (1988) study served as a chronological age-matched group. Two 6-minute animated television programs with no narration that portrayed a sequence of actions were used. Voice-over narration was added, incorporating 20 target words determined to be unknown to the participants during the *Peabody Picture Vocabulary Test-Revised* pretest (*PPVT-R)* and 20 control words with which the preschool children were familiar. Four categories of words, including objects, actions, attributes, and affective state, were represented by 5 target words and 5 control words. The words were used within a story context and always occurred in complete sentences. The study consisted of four 15-minute sessions for each participant. The *PPVT-R* was administered in the first session, followed by other standardized testing. A language sample was collected during the second

session. The third session began with a comprehension pretest, followed by a viewing of the video stimuli. The final session consisted of a second viewing of the video immediately followed by a comprehension posttest. The comprehension pre- and posttests were based on the *PPVT-R*. The chronological-age match group scored significantly higher than the MLU-matched group on the comprehension posttest. The MLU-matched group scored significantly higher than children in the language-impaired group. The most significant difference between children with language impairment and peers was the rate of fast-mapping. It was noted that although the rate was slower, children with language impairment followed the same progressive pattern for types of words that they were able to fast-map as their typically developing peers. The reduced rate of fast-mapping was determined to be a contributing cause of the limited vocabularies associated with language impairment (Rice, Buhr, & Nemeth, 1990).

A study conducted by Nash and Donaldson (2005) compared the lexical representations of words of children with SLI to typically developing peers and examined the effectiveness of different types of learning contexts. Forty-eight children, ages 4 to 9, participated in the study: 16 children with language impairment, 16 typically developing peers matched by chronological age, and 16 typically developing children matched by vocabulary age. The children with SLI were selected from the SLP's caseload, and the typically developing children were selected from a mainstream classroom. The *British Picture Vocabulary Scale* and the *Wechsler Preschool and Primary Scale of Intelligence* were administered to quantify vocabulary deficits and to measure intelligence. A pretest was also administered to determine unfamiliar words that could be targeted. Children were instructed to point to the picture that illustrated the word or point to the empty box if the word was unknown (to prevent guessing). Eight nouns were chosen as target words, four for each context. Two contexts of vocabulary learning, story context and explicit

teaching, were compared. For explicit teaching, the experimenter presented a picture of the object and provided a verbal description, which consisted of using the noun 6 times and naming the category of the object and one of its attributes twice. For the story context, students looked at illustrations while listening to a recording of the experimenter reading a story. Each unfamiliar word, including *aster, polka, molasses,* and *phial* occurred 6 times in the story and was accompanied by 2 illustrations. Although words were not explicitly defined, the meaning of each could be inferred from the context of the story or the illustrations. The category and an attribute of each word were provided (e.g., *dance* and *fast* described *polka*). Five assessments of word learning, including Naming, Word Recognition, Word Definition, Meaning Recognition, and Picture Selection, were administered after each session. During the Naming task, children were required to label pictures that were randomly drawn from a bag. In order to assess word recognition, the experimenter provided a picture of an object and pronounced the word in four different ways. The children were required to select the correct pronunciation. For Word Definition, students were asked to provide a definition of the word, including the category and attribute taught in the activity. Students were asked 2 yes/no questions regarding the meaning of each word for the Meaning Recognition task. The Picture Selection task required children to select the image that depicted the word. Students were assessed after each of the four sessions, two using explicit teaching and two with a story context. A total word learning (TWL) score was also calculated, using composite scores from each of the tasks. Comparing the TWL scores of students with SLI and typically developing students indicated that students with SLI learned less about the target words in all trials (2 in each context). Children with SLI scored significantly lower than the chronological-age controls in both contexts. The scores of children with SLI were similar to vocabulary-age controls on all tasks but naming, for which they received a

significantly lower score. Results suggested that vocabulary deficits associated with SLI are related to both the phonological and semantic characteristics of words and also that children with SLI performed in a manner similar to vocabulary-age peers.

Ellis Weismer & Hesketh (1993) evaluated the effects of linguistic input manipulations on word-learning abilities of children with SLI. Participants included 16 kindergarten children, 8 with specific language impairment and 8 with typical language skills. Participants with SLI attended a self-contained classroom for children with severe language disorders. All children scored within the average range on the Columbia Mental Maturity Scale, indicating age-appropriate intelligence. Children with SLI scored significantly lower than peers on language assessments, including the *Peabody Picture Vocabulary Test-Revised* (*PPVT-R*), the *Test of Language Development-2*(*TOLD-2*), and analyses of conversational speech using *Systemic Analysis of Language Transcriptions* (*SALT*). Children participated in 3 experimental conditions: rate condition, stress condition, and visual condition. Intervention occurred individually for four 40-minute sessions. The 3 conditions were administered in a similar manner. Children were given a toy figure (Sam) and were instructed to listen to the words and move Sam accordingly. Target words for the rate and stress conditions were object labels (i.e., Sam's toys), positional words noting Sam's location were used for the visual condition. All target words were one-syllable, consonant-vowel-consonant forms. Recorded natural speech utterances served as stimuli for the rate and stress conditions. For the rate condition, utterances were produced at a slow (2.8 syllables/second), a normal (4.4 syllables/second), and a fast (5.9 syllables/second) rate. Three novel words were paired with rates at which they were presented, and this varied among participants due to counterbalancing. Each experimental condition consisted of 15 exposure probes, 15 production probes, and 15 comprehension probes. For

production probes, participants were prompted to label the objects. Children were instructed to place Sam *by the* _____, in order to assess comprehension probes. The stress condition involved two types of utterances, one with neutral stress and one with emphasis on the target word. The visual condition paired gestures with verbal input to illustrate the meanings of "away from," "on top of," and "beside." MANOVA analyses were used to compare group performance in each condition. Although children in both groups had significant gains in production and comprehension of novel words when presented at a slower rate, children with SLI had a greater increase in accuracy with a decrease in rate. The majority of the SLI group scored higher on words with more emphatic stress on speech than neutral stress. Both groups of children had higher comprehension scores on words presented with gestures in the visual context. Children with SLI received lower mean scores than typically-developing peers on all tasks except comprehension in the visual context, in which they scored identically. These results indicated that children with SLI were not as adept at word learning as their peers, regardless of the type of input, but that they benefitted from a slower rate of presentation and use of stress to emphasize a word.

Scaffolding. According to Ukrainetz (2006), scaffolding pairs adult support with the student's active participation, with the goal of helping the student progress from dependence on adult support for a particular skill to the ability to complete the task independently.

Bellon-Harn, Credeur-Pampolina, & LeBoeuf (2013) evaluated the effectiveness of using a scaffolded language intervention program on speech sound production in children speaking African American English. Participants included two preschool children with moderate speech-language impairments who were enrolled in a Head Start program. A single-subject, multiple baseline design was used to measure results across participants. Along with the treatment,

baseline and posttreatment measures were taken. Treatment occurred during ten 20-minute sessions. Presentation of a book began the session; 15-page books were used for three sessions. If the child did not initiate a response following the story, the clinician asked a wh- question. The child's interactions and responses determined the amount and type of scaffolding that was provided. Scaffolding techniques included using cloze procedures, focused contrast, expansion, and direct models. Baseline, treatment, and posttreatment sessions were recorded, and 50 to 60 utterances from each session were transcribed. For each sample, percent consonant correct-revised (PCC-R) and a proportion of errors (POE) were calculated. An ANOVA analysis was conducted on the means and standard deviations of PCC-R for each child. Large effect sizes were noted between baseline and treatment sessions, and small effect sizes were noted following the posttest sessions. Both children decreased errors and maintained gains in posttreatment sessions, indicating generalization. Positive changes were noted in PCC-R and POE. Incorporating scaffolding improved the accuracy of speech production for both participants.

Integrating Technology into Education

Many forms of technology are currently being utilized in educational settings, making it necessary to examine the effects of technology on vocabulary instruction. Technology has sparked transformation in areas such as socialization, business, health, and research. Barron, Cayton-Hodges, Bofferding, Copple, Darling-Hammond, & Levine (2011) noted that exposure to technology in education is also on the rise. It is estimated that students in preschool and primary grades typically interact with media between 4 and 7.5 hours daily (Barron et al., 2011). Collaboration is occurring among professionals who study learning and those who design educational technologies.

As technology is integrated into classrooms, a shift in the teaching model occurs. Barr and Tagg (1995) suggested two paradigms, instructional and learning. Traditional teaching employs the instructional paradigm, in which the teachers play the primary role in education. Integrating technology into education involves using the learning paradigm, which actively involves students in the learning process as they manipulate the devices. A learning environment fostering student collaboration allows for the use of resources and utilizes broad assessment, showing significant gains in student learning. Bell & Kozlowski (2008) indicated that as students are given control of the learning process, they develop skills that promote future self-learning abilities. The interactive approach facilitates the generalization of learned skills to other contexts.

In order to successfully integrate technology into educational settings, an effort to restructure the classroom is imperative. This demands that teachers alter their approaches and beliefs about teaching. Teachers are required to learn new instructional methods which incorporate technology (Means, 1994; Inan & Lowther, 2010). "The key to the partnership [between technology and school reform] lies in educators developing reformed sets of curricular and instructional goals and then using technology as a tool to support these goals" (Means, 1994, p. 5).

Means (1994) identified four purposes that technology can serve in schools: to tutor, to explore, to be a learning tool, and to communicate. Currently in education, the emphasis is placed upon the latter two. Devices used as tools for learning or communication are compatible with active learning, as they are designed to support students in learning. "Instructional value lies in the educational activity that uses the tools and communication devices" (Means, 1994, p. 13).

Technology as a Learning Tool

A number of technological devices are currently used in classrooms. Inan & Lowther (2010) reported that the average classroom has Internet access and approximately one computer for every four students. The use of computers in educational contexts is diverse. Students can use computers to conduct research, create multimedia presentations, type documents, and play games that provide additional practice opportunities. Interactive whiteboards are another innovative learning tool that can be used for a variety of purposes. Teachers can present multimedia lessons using interactive whiteboards, and students can engage by drawing, writing, or selecting answers on the board. Technology provides opportunity for monitoring progress in the classroom by giving teachers immediate feedback on students' learning (Education Solutions, 2012). Like computers and interactive whiteboards, the iPad is a tool that can be utilized in many facets of education. More than 20,000 educational apps exist in a number of different topics, providing opportunities to tailor learning activities to meet individual student needs. The iPad is also useful for instructors, as it allows them to create lessons and track progress (Apple in Education, 2012).

Technology and Vocabulary

Technology continues to be integrated into daily activities, increasing its potential to play a role in vocabulary instruction. However, the cognitive resources of the learner must also be considered. When two types of stimuli present the same information simultaneously, more processing may be required in order to outweigh cognitive load (Acha, 2009). In order to increase the effectiveness of multimedia programs, presentation modes must be considered. Acha (2009) examined which technology-driven presentation mode (i.e., a single stimulus or two stimuli) was most beneficial for elementary students. Participants included 135 third- and

fourth-grade Spanish children who were learning the English language. An English vocabulary pretest was given using paper and pencil, and an interactive short story was used for the study. Children were divided into 3 groups: "word-only," in which children were exposed to text alone, "picture-only," in which children were provided an image, and "word and picture," which featured both an image and a text translation of the word. Each child used a separate computer. After receiving instructions on the program, the children were given 20 minutes to read the story and immediately complete a vocabulary posttest evaluating which terms the children remembered. A delayed posttest was given 2 weeks later. Children in the "picture-only" group and the "word and picture" group received similar scores, while children in the "word-only" group scored significantly higher. Children in the "word-only" group recalled a higher percentage of words in both the immediate and delayed posttest. The results indicated that when a word and a picture are presented simultaneously, more processing was necessary, due to the higher cognitive load. Acha (2009) suggested that, although combining a picture and word was not beneficial to the learning of a second language, it may be more effective in other learning environments. With the increasing use of interactive technology in education, this study implied that multimedia programs must be tested in the context in which they will be used in order to achieve desired results.

Flores, Musgrove, Renner, Hinton, Strozier, Franklin, & Hil (2012) conducted a study which compared the iPad with a picture-based system, a non-electronic form of AAC. Although previous studies had been conducted comparing speech-generating devices with a picture-based system, none considered tablet devices, such as the iPad. Five male students between the ages of 8 and 11 participated in this study. All participants had been diagnosed with autism spectrum disorders or intellectual disability and were participating in a university-sponsored extended

school year program. Each of the students regularly used a picture-based system to communicate. Although none had been exposed to the iPad prior to the study, all were given adequate training. The study was performed during snack time in hopes of generating requests in a natural interaction. Data was collected by measuring the frequency of communication behaviors. Pictures displayed the options for snack (pretzels, goldfish crackers, cookies, and drink), as well as signs for "I want" and "more." With the picture-based system, students were required to choose the picture cards and place them on a Velcro strip. Alternatively, the iPad required users to touch the picture on the screen. All students alternated between the picture-based system and the iPad. Three of the students demonstrated more communicative behaviors with the iPad than the picture-based system, and the other two participants had similar results with both. Although results showed no obvious pattern, the iPad was not detrimental to the number of communicative behaviors. On a questionnaire, program staff indicated that the iPad was a faster form of communication, was easier for students to manipulate, and appeared to be preferred among the students. It was also noted that the iPad was more efficient for staff members, in that once programmed, minimal alteration was needed. However, no existing research examines the utility of iPads engaged in direct vocabulary instruction.

Summary and Purpose

Typical children learn many words simultaneously through fast-mapping. Children with language impairment have a slower rate of fast-mapping than peers; therefore, intervention is necessary to facilitate vocabulary learning. Direct instruction that engages learners as active participants seems to be the most effective style of teaching vocabulary, including basic concepts. Speech-language pathologists, as well as other professionals, can provide scaffolding to guide children in learning. Educational technologies can be tools which engage students in the

learning process. As the iPad is a relatively new form of technology, it is necessary to consider its value as a teaching tool.

The purpose of this study was to compare two approaches to using the iPad as an intervention tool: using the iPad alone and pairing the iPad with scaffolding. The iPad was used to teach basic concepts (receptive and expressive) to kindergarten, first, and second students who had a language delay.

CHAPTER III

Methods

Research Design

A single-subject modified alternating treatment design with a baseline phase and treatment phase was used to compare the effects of using an iPad alone versus using an iPad with scaffolding to teach basic concepts to four elementary students. Alternating treatments enabled researchers to simultaneously compare the effectiveness of two treatment approaches. Using both types of treatment with each participant reduces intersubject variability, and counterbalancing eliminates sequencing effects (Barlow & Hersen, 1984; McReynolds & Kearns, 1983).

Participants

This study involved one kindergarten student, one first grade student, and two second grade students who were receiving speech/language therapy services through two school districts in central Illinois. Internal Review Board (IRB) approval was obtained, as well as informed consent from parents (see Appendices A and B). Child assent was also obtained prior to assessment (see Appendix C).

The following inclusionary criteria were used to select subjects: (a) currently receiving services for expressive/receptive language delay, (b) deficits in basic concept knowledge, (c) normal hearing, and (d) English as the primary language. Descriptive data for each participant was obtained from the school speech-language pathologist.

Subject 1 was a 6 year, 5 month old male enrolled in first grade at School A. He had a medical diagnosis of ADHD and asthma. He began receiving special education services in 2010, with an eligibility label of Speech/Language Delay. At the time of the study, he was receiving 60 minutes of language therapy per week for semantic and narrative language goals.

Subject 2 was a 5 year, 6 month old male enrolled in kindergarten at School B. No significant medical history was noted. He began receiving services for speech-language impairment in preschool in 2011, with an eligibility label of Developmental Delay. He was receiving 60 minutes per week of language services targeting semantics at the time of the study.

Subject 3 was a 7 year, 7 month old male enrolled in second grade at School A. He was exposed to methamphetamine in utero. He attended the Early Childhood Special Education preschool program for two years, and began receiving speech/language services in the public school system in 2008. He had a medical diagnosis of ADHD, and his individualized education plan (IEP) label was developmentally delayed. At the time of the study, he was receiving 150 minutes of resource services, 60 minutes of speech/language therapy, and 30 minutes of occupational therapy weekly. Language goals were in the areas of semantics and narrative language.

Subject 4 was a 7 year, 7 month old male enrolled in second grade at School A. He was exposed to methamphetamine in utero. He attended the Early Childhood Special Education preschool program for two years, and began receiving speech/language services in the public school system in 2008. He had a medical diagnosis of ADHD, and his individualized education plan (IEP) label was intellectual disability. At the time of the study, he was receiving 150 minutes of resource services, 60 minutes of speech/language therapy, and 30 minutes of occupational therapy weekly. Language goals were in the areas of semantics and narrative language.

Procedures

Assessment. The *Bracken Basic Concept Scale*: *Third Edition, Receptive (BBCS-3:R)* (Bracken, 2007a) and the *Bracken Basic Concept Scale: Expressive (BBCS:E)* (Bracken, 2007b)

served as a pretest, allowing the researcher to identify unknown vocabulary to target during intervention. The *BBCS-3:R* assesses the receptive knowledge of basic concepts in children between the ages of 3 and 7 years. It correlates with cognitive development and academic achievement. For receptive tasks, the child was required to point to the picture that corresponded with the description (e.g., "Look at all of the pictures. Show me which child is **on** the swing"). Alternatively, the *BBCS:E* assesses expressive knowledge in children ages 3 to 7. For expressive tasks, the child completed the statement with a label for the picture (e.g., "This tree is **behind** the house, and this tree is [in front]"). The basic concepts targeted in this study were chosen from those that were unknown to the subjects on the pretest.

Baseline, intervention, and maintenance probes were similar to tasks found on the *Receptive (ROWPVT-4)* (Martin & Brownell, 2010) and *Expressive One-Word Picture Vocabulary Tests, Fourth Edition (EOWPVT-4)* (Martin & Brownell, 2010). The *EOWPVT-4* requires the child to provide an oral label to describe the illustration for the concept, while the *ROWPVT-4* requires the child to match a label with an illustration. Receptive probes included four pictures, one representing the targeted concept and three semantically similar foils. Students were asked to point to the image illustrating the concept. In order to assess expressive knowledge, students were shown an illustration and asked to label the concept. Following the second weekly session, the SLP probed each subject to quantify the level of understanding of all targeted concepts. Following every other session, the SLP probed each subject to quantify the level of understanding of targeted concepts. Expressive probes were administered before receptive, so that students were not influenced by exposure to the target word during the receptive measure (Lugo-Neris, 2007). In order to assess expressive knowledge, students were shown an illustration and asked to label the concept, (e.g. "Tell me where the ball is"). All target

words were expressively probed. Cueing was provided when subjects could not independently label targeted concepts. Cueing techniques were similar to those used by Dollaghan (1985), in which the assessor verbally provided 3 choices: the correct term (e.g., "over"), a phonetically similar foil (e.g., "ever,"), and a phonetically unrelated foil (e.g., "tidy"). For the present study, semantically similar (e.g. "under") foils were used. The pictures included the targeted concept and three foils. The SLP then provided 4 pictures and asked the student to point to the one illustrating the concept, (e.g. "Show me **over**)," in order to assess receptive knowledge.

During the baseline phase, probes were administered to establish stability of the targeted basic concepts. No intervention for basic concepts was provided during the baseline phase. For the first set of baselines, knowledge of 15 words that were missed on the *Bracken* pretest and that were featured on the *Magical Concepts* app was assessed. Three baseline sessions were conducted for each participant. The desired number of targets was 12. Since three subjects missed fewer than 12 words on the first set of baselines, an additional baseline set of targets was necessary. For the second set of baselines, several of the concepts from the *Bracken* were not available on the app. Therefore, target words available on the app were selected from categories in which pretest scores were delayed. During the second set of baselines, two sessions were conducted for each of the participants that missed less than 12 words during initial baselines. A complete list of target words for each student is provided in Appendix D.

During the intervention phase, probes were implemented following every other session. After the completion of intervention, two sessions of maintenance probes were administered for each subject in order to measure generalization. No intervention for basic concepts was provided during the intervention phase.

The *BBCS-3:R* and the *BBCS:E* were again administered as a posttest upon completion of the intervention to examine the overall improvement in basic concepts that resulted for each subject following five weeks of intervention.

Intervention. Intervention began after the completion of baseline sessions. The intervention was provided by a school-based speech-language pathologist (SLP) for two 30-minute sessions per week, over the course of five weeks. Due to time constraints, some subjects received four 30-minute intervention sessions in one week. Siefert and Schwarz (1991) documented change while using two 30-minute intervention sessions per week in a seven-week study examining the combination of direct instruction, interactive instruction, and incidental teaching to teach basic concepts to young children. Therefore, it was deemed appropriate to use a similar framework. Originally, it was planned to use the same intensity, frequency, and duration of treatment. However, due to time constraints, the equivalent of only five weeks of treatment was completed.

Two teaching approaches, pairing the iPad with scaffolding and using the iPad alone, were used to target 10 basic concepts. Both methods were used within each session. Students received intervention for half of the basic concepts with the iPad alone, while the remaining concepts were taught using the iPad with scaffolding. For all concepts, the SLP provided a brief introduction of the concept by saying the word, modeling, and providing positive and negative examples (e.g., "The ball is **above** the box. Now the ball is not **above** the box, it is **below** it").

For tasks solely using the iPad, subjects were given the device following the introduction of the basic concept by the SLP and general instructions on how to use the app *Magical Concepts*. The app featured 67 basic concepts and was set to only target the concepts specifically chosen for each participant. Following a verbal instruction (e.g., "Show me the

balloon in the **center** of the circle."), students were required to select from a pool of pictures the image that best illustrated the concept. Students received a star for each correct response; after receiving 5 stars, students were rewarded with a magic show. Incorrect responses resulted in a chiming sound. The app tracked each student's progress from each session, including an overall accuracy and accuracy for each targeted concept. For the iPad alone condition, subjects navigated through the app independently, completing the tasks without assistance from the SLP. The iPad alone approach was representative of the behaviorism theory, in which a stimulus elicits a response that is then either reinforced or punished. In this approach, no scaffolding or feedback was provided by the SLP. The only feedback the child received was the automated response (i.e., correct or incorrect) provided by the iPad app.

The second approach incorporated scaffolding into therapy, which added the social interaction component and simplified task complexity. The amount of scaffolding was individualized for each subject. Interactive scaffolding requires intentional, dynamic facilitation of the intervention, based upon student abilities. For intervention with scaffolding, the SLP initially provided support by guiding the subjects through the tasks and reinforcing their responses. As students began to internalize the skill, the support was gradually withdrawn.

Linguistic, regulatory, and response facilitations, three types of interactive scaffolding, were used in this study. Response facilitations utilize cuing strategies in order to elicit an answer, while linguistic facilitations required the SLP to build upon the student response by extending, expanding, or recasting. Regulatory facilitations occurred as the SLP related the knowledge to previous experiences and maintained student awareness of the concepts. Scaffolding requires a balance of support consistent with each child's zone of proximal development in order to be productive. Too much support does not challenge the student, while too little support results in

frustration. Both scenarios result in minimal learning. Therefore, it was the goal of the SLP to make the task challenging but attainable, providing support as needed (Ukrainetz, 2006). Guidelines based upon Ukrainetz's (2006) description of scaffolding were provided to the SLP in order to promote consistency in intervention using scaffolding (see Appendix E).

Reliability of Measurement and Treatment Fidelity

Assessments were scored by both the student researcher and another student clinician in order to ensure reliability. Each therapy session was video recorded, and a treatment fidelity checklist was completed 3 times throughout the duration of the study to ensure that intervention was provided in a consistent manner. Specifically, it was designed to ensure that no scaffolding was provided during the iPad only condition, and to examine the number and type of scaffolds used during the iPad with scaffolding condition.

Data Analysis

The effectiveness of each intervention strategy was determined by examining changes within subjects across baseline, treatment, and maintenance phases. Visual plots of data for each individual subject were used for analysis of probe data points. Within-subject comparisons of pre- and post-test scores on the *BBCS-3:R* and *BBCS:E* were made to examine changes in overall basic concept knowledge.

Chapter IV

Results

The purpose of this study was to examine receptive and expressive learning of basic concepts in two conditions: (1) using the iPad alone and (2) pairing the iPad with scaffolding by a speech-language pathologist (SLP). Detailed results for each subject are discussed below.

Treatment Fidelity

For treatment using the iPad alone, students wore headphones connected to the iPad while completing the activities in order to ensure that no scaffolding was provided. A treatment fidelity checklist was completed for three of the sessions in order to determine the type and frequency of scaffolding provided during the iPad with scaffolding condition. A variety of response facilitations were utilized, including waiting for and modeling the response, repeating and emphasizing the concept, providing cuing through physical signals, pausing before providing the answer, providing part of the answer, and asking the student to repeat the answer. Linguistic facilitations included modeling in advance; expanding, extending, and recasting; vertical structuring; and providing focused contrast. Several regulatory facilitations were used, primarily relating the concept to past knowledge, commenting on student performance, and aiding selective and sustained attention. Appendix F contains a complete list of response, linguistic, and regulatory facilitations.

Subject 1

Pretest. On the *Bracken* receptive pretest, Subject 1 received a scaled score of 5 (5^{th} percentile) on the school readiness composite. A scaled score of 4 (2^{nd} percentile) was obtained on three subtests: direction/position, texture/material, and quantity. On the self-/social awareness subtest, a scaled score of 6 (9^{th} percentile) was obtained. Subject 1 received a scaled score of 7 (16^{th} percentile) on the time/sequence subtest. On the *Bracken* expressive pretest, a scaled score

of 8 (25th percentile) was achieved on the school readiness composite. Subject 1 received a scaled score of 4 (2nd percentile) on the direction/position subtest and a scaled score of 5 (5th percentile) on the self-/social awareness subtest. For the texture/material, quantity, and time/sequence subtests, a scaled score of 3 (1st percentile) was achieved. Based upon pretest results, Subject 1 was delayed or very delayed in all subtests, with the exception of the expressive school readiness composite, which was within the average range.

Baselines. In the iPad alone condition, Subject 1 identified 1 target word during session one and 3 words during session two. No targets from the iPad alone condition were produced in the first session, but 1 word was produced in the second session. Subject 1 identified 3 of the words that were taught using the iPad with scaffolding during both sessions. No target words were produced in either baseline session by Subject 1.

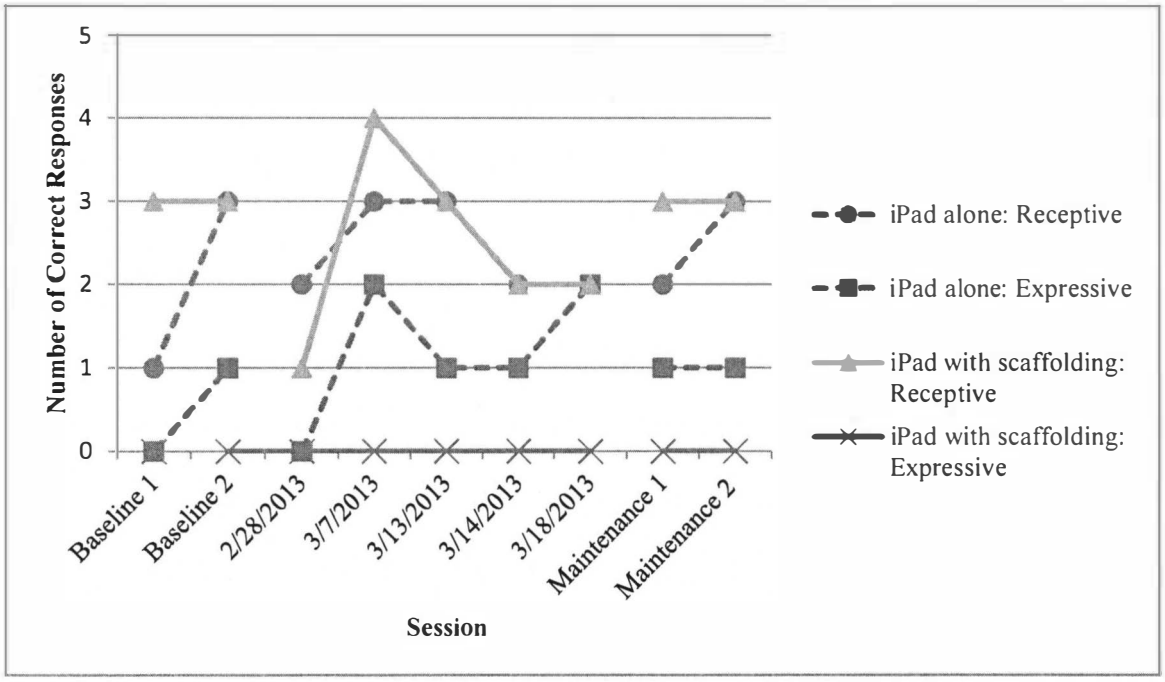
Probes. During the course of the study, Subject 1 had two grand mal seizures, as well as several petit mal seizures. Of the 5 words taught using the iPad alone, Subject 1 correctly identified 2 words during probe session one. Three words were identified during probe sessions two and three, and 2 words were identified during probe sessions four and five. No expressive targets were produced during the first two sessions. One word was produced in both sessions three and four. For the final probe session, Subject 1 produced 2 words. Although identification of concepts was inconsistent, production of concepts targeted using the iPad alone consistently increased.

During probe session one with scaffolding, Subject 1 identified 1 word. Four words were identified in probe session two and 3 words in session three. Subject 1 correctly selected 2 words in both sessions four and five. No expressive targets were produced in any of the sessions.

Overall identification of targets was inconsistent, and there was no change in Subject 1's ability to produce targets.

Maintenance probes. Of the words that were taught using the iPad alone, Subject 1 identified 2 target words during session one and 3 words during session two. One target word was produced in both sessions. For the scaffolding condition, 3 words were identified in each session. No target words were produced in either maintenance session.

Figure 1. Subject 1's Session Data



Posttest. On the receptive posttest, Subject 1 received a scaled score 7 (16th percentile) on the school readiness composite. A scaled score of 5 (5th percentile) was obtained on two subtests: direction/position and quantity. On the self-/social awareness subtest, a scaled score of 2 (0.4th percentile) was received. A scaled score of 6 (9th percentile) was achieved on both the texture/material and time/sequence subtests. Expressively, Subject 1 received a scaled score of 10 (50th percentile) on the school readiness composite. A scaled score of 7 (16th percentile) was

obtained on both the direction/position and time/sequence subtests. On the self-/social awareness and quantity subtests, a scaled score of 6 (9th percentile) was achieved. For the texture/material subtest, Subject 1's scaled score was 1 (0.1th percentile).

Table 1. Pretest and Posttest Scores for Subject 1

	Pretest				Posttest			
Subtest	Expressive		Receptive		Expressive		Receptive	
	Scaled Score	Percentile Rank	Scaled Score	Percentile Rank	Scaled Score	Percentile Rank	Scaled Score	Percentile Rank
School Readiness	8	25	5	5	10	50	7	16
Direction/ Position	4	2	4	2	7	16	5	5
Self-/Social Awareness	5	5	6	9	6	9	2	0.4
Texture/ Material	3	1	4	2	1	0.1	6	9
Quantity	3	1	4	2	6	9	5	5
Time/ Sequence	3	1	7	16	7	16	6	9

Comparison of pretest and posttest scores. Scaled scores for Subject 1 increased both receptively and expressively on the school readiness composite, the direction/position subtest, and the quantity subtest. For the texture/material subtest, the receptive score increased while the expressive score decreased. Conversely, the receptive scores decreased while the expressive scores increased on the self-/social awareness and the time/sequence subtests.

Subject 2

Pretest. On the *Bracken* receptive pretest, Subject 2 achieved a scaled score of 8 (25th percentile) on both the school readiness composite and the direction/position subtest. On the self-/social awareness subtest, the scaled score was 3 (1st percentile). A scaled score of 5 (5th

percentile) was obtained on the texture/material subtest. Subject 2 received a scaled score of 4 (2^{nd} percentile) on two subtests: quantity and time/sequence. On the *Bracken* expressive pretest, a scaled score of 8 (25^{th} percentile) was achieved on the school readiness composite. Subject 2 received a scaled score of 6 (9^{th} percentile) on the direction/position subtest and a scaled score of 2 (0.4^{th} percentile) on the self-/social awareness subtest. For the texture/material subtest, a scaled score of 4 (2^{nd} percentile) was obtained. Subject 2 received a scaled score of 5 (5^{th} percentile) on the quantity subtest and a scaled score of 3 (2^{nd} percentile) on the time/sequence subtest.

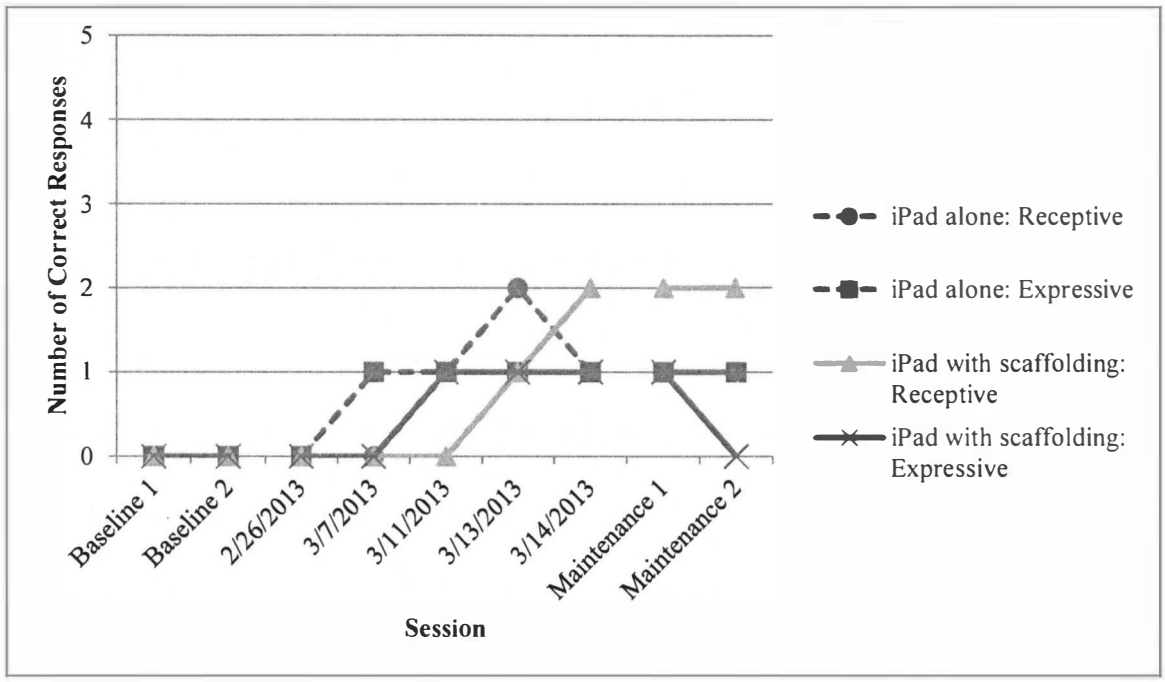
Baselines. Two baseline measures were collected for Subject 2. None of the words that were targeted in either condition were expressively answered or receptively identified during either of the two baseline measures.

Probes. Of the 5 words taught using the iPad alone, Subject 2 did not correctly identify any words during probe sessions one and two. One word was identified during probe session three, and 2 words were identified during probe session four. During the final probe session, 1 word was identified. No expressive targets were produced during the first probe session. In the remaining four probe sessions, 1 word was produced. Although identification of concepts was inconsistent, production of concepts targeted using the iPad alone did not change after the second session.

During the first three probe sessions, Subject 2 did not identify any target words that were taught using scaffolding with the iPad. One word was identified in probe session four and 2 words in session five. No expressive targets were produced in probe sessions one and two, but 1 target was produced in sessions three, four, and five. There was an increase in both the identification and production of target words.

Maintenance probes. Of the words taught using the iPad alone, Subject 2 identified 1 target word and produced 1 target word during both maintenance sessions. Of the words in the scaffolding condition, 2 words were identified in each maintenance session. One target word was produced in the first session, but no targets were produced in the final maintenance session.

Figure 2. Subject 2's Session Data



Posttest. On the receptive posttest, Subject 2 received a scaled score of 8 (25th percentile) on the school readiness composite. A scaled score of 6 (9th percentile) was obtained on two subtests: direction/position and time/sequence. Subject 2 scored a scaled score of 8 (25th percentile) on the texture/material subtest. On the self-/social awareness and quantity subtests, a scaled score of 7 (16th percentile) was received. Expressively, a scaled score of 10 (50th percentile) was achieved on the school readiness composite. A scaled score of 6 (9th percentile) was obtained on the direction/position subtest, while a scaled score of 3 (1st percentile) was

obtained on the self-/social awareness subtest. For the texture/material, quantity, and time/sequence subtests, Subject 2 received a scaled score of 5 (5th percentile).

Table 2. Pretest and Posttest Scores for Subject 2

	Pretest				Posttest			
Subtest	Expressive		Receptive		Expressive		Receptive	
	Scaled Score	Percentile Rank	Scaled Score	Percentile Rank	Scaled Score	Percentile Rank	Scaled Score	Percentile Rank
School Readiness	8	25	8	25	10	50	8	25
Direction/ Position	6	9	8	25	6	9	6	9
Self-/ Social Awareness	2	0.4	3	1	3	1	7	16
Texture/ Material	4	2	5	5	5	5	8	25
Quantity	5	5	4	2	5	5	7	16
Time/ Sequence	3	2	4	2	5	5	6	9

Comparison of pretest and posttest scores. On the school readiness composite, the receptive scaled score remained the same, while the expressive score increased. Subject 2 received higher receptive and expressive scaled scores on the following subtests: self-/social awareness, texture/material, and time/sequence. For the direction/position subtest, the receptive score decreased, while the expressive score remained the same. Conversely, the receptive score on the quantity subtest increased, whereas the expressive score remained the same.

Subject 3

Pretest. Because the *Bracken Basic Concept Scale* was normed on children up to age 6:11 and Subject 3 was 7:7 at the time of the pretest, the raw scores could not be converted into scaled scores. Therefore, raw scores and age equivalencies were used to measure knowledge in each area of concepts. On the receptive pretest, Subject 3 received a raw score of 77 (age equivalency 6:1) on the school readiness composite. A raw score of 28 (age equivalency 4:5)

was achieved on the direction/position subtest and a raw score of 18 (age equivalency 4:5) was obtained on the quantity subtest. On the self-/social awareness subtest, a raw score of 27 (age equivalency 5:1) was obtained. For the texture/material subtest, Subject 3 received a raw score of 24 (age equivalency 6:1). A raw score of 10 (age equivalency 4:3) was achieved on the time/sequence subtest. Expressively, Subject 3 received a raw score of 60 (age equivalency 6:4) on the school readiness composite. For the direction/position subtest, a raw score of 12 (age equivalency 3:7) was obtained. On the self-/social awareness subtest, he received a raw score of 12 (age equivalency 4:6). Subject 3 received a raw score of 7 (age equivalency 4:6) on the texture/material subtest and a raw score of 7 (age equivalency 5:9) on the quantity subtest. For the time/sequence subtest, a raw score of 6 (age equivalency 4:3) was achieved. Scores on all subtests, both receptive and expressive, were below Subject 3's chronological age of 7:7.

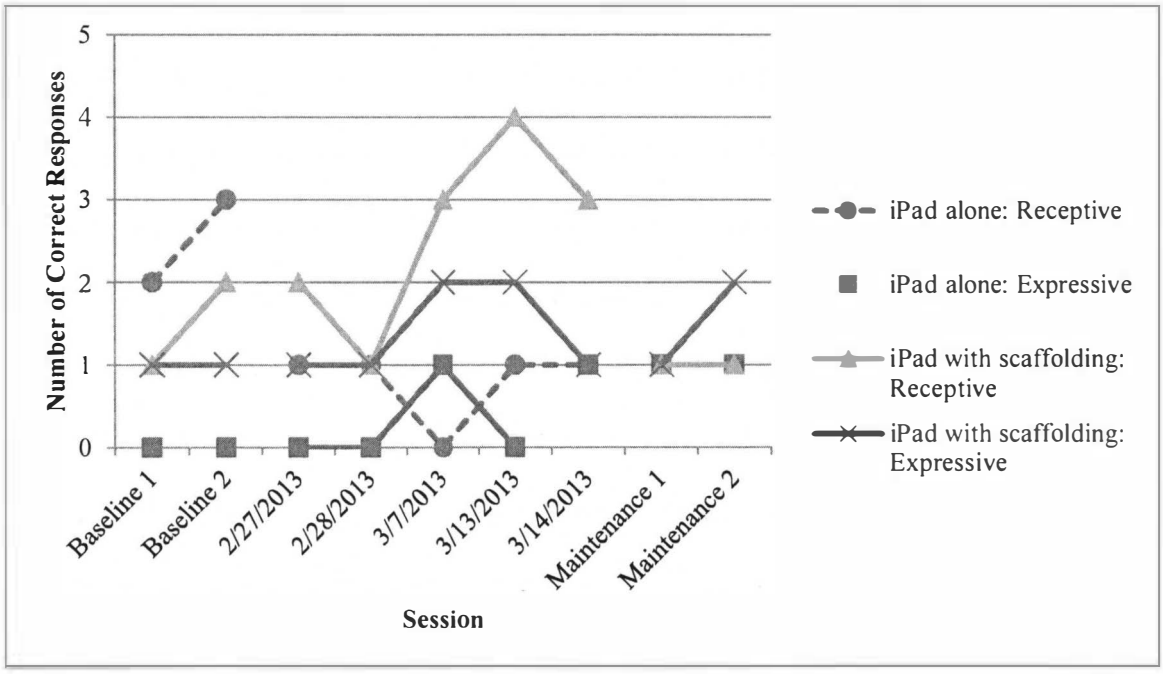
Baselines. In the iPad alone condition, Subject 3 identified 2 target words during session one and 3 target words during session two. No expressive targets were produced in either session. Of the words in the scaffolding condition, 1 was identified during the first session and 2 were identified during the second session. One target word was produced in each baseline session.

Probes. Of the 5 words taught using the iPad alone, 1 target word was receptively identified during the first two probe sessions. No target words were identified during probe session three, but 1 word was identified during the final two probe sessions. No expressive targets were produced during the first two probe sessions. One word was produced in probe session three, but no words were produced in probe session four. During the final probe session, 1 word was produced. Both the identification and production of concepts was inconsistent.

During the first probe session using scaffolding, Subject 3 identified 2 target words. One word was identified in probe session two and 3 words in session three. During probe session four, he selected 4 of the correct targets. In the final session, Subject 3 identified 3 target words. Subject 3's ability to identify target words was inconsistent. He produced 1 expressive target in probe sessions one and two, and produced 2 targets in sessions three and four. In the final session, he correctly produced 1 target word. There was an increase in the production of targets after session two, but it decreased in the final session.

Maintenance probes. For the iPad alone condition, 1 target word was identified and 1 target word was produced during each maintenance session. Of words in the scaffolding condition, 1 word was identified in each maintenance session. One target word was produced in the first maintenance session and 2 target words were produced in the final session.

Figure 3. Subject 3's Session Data



Posttest. On the *Bracken* receptive posttest, Subject 3 received a raw score of 77 (age equivalency 6:1) on the school readiness composite. A raw score of 27 (age equivalency 4:4) was obtained on the direction/position subtest. On the quantity subtest, a raw score of 30 (age equivalency 6:2) was obtained. A raw score of 30 (age equivalency 5:7) was obtained on the self-/social awareness subtest and a raw score of 17 (age equivalency 4:10) was achieved on the texture/material subtest. On the time/sequence subtest, a raw score of 21 (age equivalency 6:1) was obtained. Expressively, Subject 3 received a raw score of 62 (age equivalency >6:11) on the school readiness composite. For the direction/position subtest, a raw score of 18 (age equivalency 4:7) was obtained. On the self-/social awareness subtest, a raw score of 13 (age equivalency 4:10) was achieved. Subject 3 received a raw score of 9 (age equivalency 5:0) on the texture/material subtest and a raw score of 7 (age equivalency 5:9) on the quantity subtest. For the time/sequence subtest, a raw score of 8 (age equivalency 4:9) was received.

Table 3. Pretest and Posttest Scores for Subject 3

	Pretest				Posttest			
Subtest	Expressive		Receptive		Expressive		Receptive	
	Raw Score	Age Equivalency	Raw Score	Age Equivalency	Raw Score	Age Equivalency	Raw Score	Age Equivalency
School Readiness	60	6:4	77	6:1	62	>6:11	77	6:1
Direction/ Position	12	3:7	28	4:5	18	4:7	27	4:4
Self-/ Social Awareness	12	4:6	27	5:1	13	4:10	30	5:7
Texture/ Material	7	4:6	24	6:1	9	5:0	17	4:10
Quantity	7	5:9	18	4:5	7	5:9	30	6:2
Time/ Sequence	6	4:3	10	4:3	8	4:9	21	6:1

Comparison of pretest and posttest scores. The school readiness composite score remained the same on the receptive test, but increased on the expressive test for Subject 3. On the direction/position subtest, Subject 3 received a slightly lower receptive score but an increased expressive score. Receptive and expressive scores increased on the self-/social awareness and time/sequence subtests. Although the expressive score for the quantity subtest remained the same, the receptive score was higher. On the texture/material subtest, Subject 3 received a higher expressive score and a lower receptive score.

Subject 4

Pretest. On the receptive pretest, a raw score of 76 (age equivalency 6:0) was obtained on the school readiness composite. Subject 4 received a raw score of 50 (age equivalency 6:0) on the direction/position subtest and a raw score of 30 (age equivalency 6:2) on the quantity subtest. A raw score of 31 (age equivalency 6:1) was obtained on the self-/social awareness subtest. For the texture/material subtest, a raw score of 20 (age equivalency 5:4) was obtained. Subject 4 received a raw score of 10 (age equivalency 4:3) on the time/sequence subtest. Expressively, a raw score of 60 (age equivalency 6:4) was obtained on the school readiness composite. For the direction/position subtest, a raw score of 20 (age equivalency 5:0) was received. On the self-/social awareness subtest, a raw score of 13 (age equivalency 4:10) was achieved. Subject 4 received a raw score of 10 (age equivalency 5:4) on the texture/material subtest and a raw score of 3 (age equivalency 3:9) on the quantity subtest. For the time/sequence subtest, a raw score of 9 (age equivalency 5:1) was obtained. Scores on all subtests, both receptive and expressive, were below Subject 4's chronological age of 7:7.

Baselines. In the iPad alone condition, Subject 4 identified 3 target words during session one and 4 target words during session two. Two targets were produced in the first session and 1

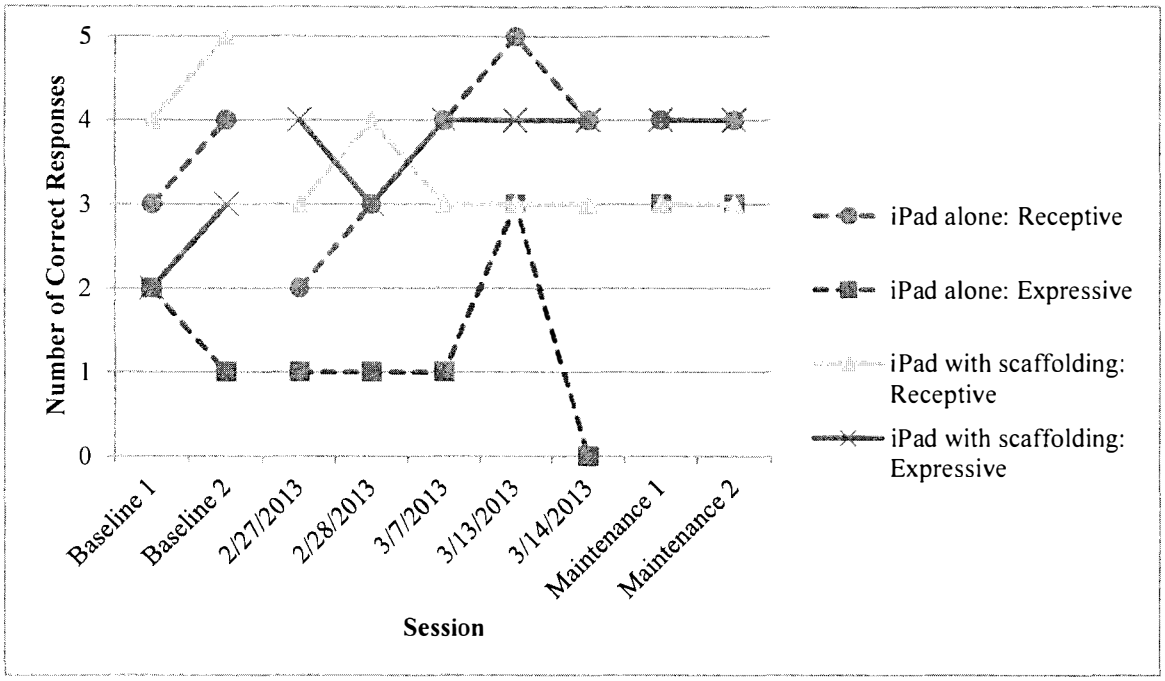
target was produced in the second session. In the scaffolding condition, Subject 4 identified 4 words during the first session and 5 during the second session. Two target words were produced in session one and 3 in session two.

Probes. Of the 5 words taught using the iPad alone, Subject 4 correctly identified 2 target words during probe session one. Three words were identified during session two, and 4 words were identified in session three. Subject 4 identified all 5 targets during session four. During the final session, 4 words were identified. One expressive target was produced during the first three probe sessions. In the final two probe sessions, 3 words were produced. Both the identification and production of targets consistently increased, with the exception of the final receptive probe session.

During the first probe session using scaffolding, Subject 4 identified 3 target words that were taught using scaffolding with the iPad. Four words were identified in probe session two. During the final three sessions, 3 target words were identified. Four expressive targets were produced in probe session one and 3 targets in session two. In the final three sessions, 4 targets were produced. The ability to identify and produce target words was inconsistent.

Maintenance probes. Of the words that were taught using the iPad alone, Subject 4 identified 4 target words during both maintenance sessions. Three targets were produced in both maintenance sessions. During both sessions, Subject 4 identified 3 words and produced 4 words that were taught using the iPad with scaffolding.

Figure 4. Subject 4's Session Data



Posttest. On the *Bracken* receptive posttest, a raw score of 78 (age equivalency 6:4) was obtained on the school readiness composite. Subject 4 received a raw score of 46 (age equivalency 5:8) on the direction/position subtest and a raw score of 24 (age equivalency 5:4) on the quantity subtest. A raw score was received on the self-/social awareness subtest was 27 (age equivalency 5:1). For the texture/material subtest, Subject 4 received a raw score of 18 (age equivalency 5:1). A raw score of 7 (age equivalency 3:10) was achieved on the time/sequence subtest. Expressively, Subject 4 received a raw score of 63 (age equivalency >6:11) on the school readiness composite. For the direction/position subtest, a raw score of 18 (age equivalency 4:7) was obtained. On the self-/social awareness subtest, a raw score of 14 (age equivalency 5:3) was achieved. Subject 4 received a raw score of 10 (age equivalency 5:4) on the texture/material subtest and a raw score of 6 (age equivalency 5:3) on the quantity subtest. For the time/sequence subtest, Subject 4 received a raw score of 10 (age equivalency 5:6).

Table 4. Pretest and Posttest Scores for Subject 4

	Pretest				Posttest			
Subtest	Expressive		Receptive		Expressive		Receptive	
	Raw Score	Age Equivalency	Raw Score	Age Equivalency	Raw Score	Age Equivalency	Raw Score	Age Equivalency
School Readiness	60	6:4	76	6:0	63	> 6:11	78	6:4
Direction/ Position	20	5:0	50	6:0	18	4:7	46	5:8
Self-/ Social Awareness	13	4:10	31	6:1	14	5:3	27	5:1
Texture/ Material	10	5:4	20	5:4	10	5:4	18	5:1
Quantity	3	3:9	30	6:2	6	5:3	24	5:4
Time/ Sequence	9	5:1	10	4:3	10	5:6	7	3:10

Comparison of pretest and posttest scores. Raw scores on the school readiness composite increased both receptively and expressively. Receptive and expressive scores decreased on the direction/position subtest. For the texture/material subtest, the receptive score decreased while the expressive score remained the same. Subject 4 received lower receptive scores but higher expressive scores on the self-/social awareness, quantity, and time/sequence subtests.

Chapter V

Discussion

The purpose of this study was to determine which approach to intervention was more effective for receptive and expressive basic concept learning: using the iPad alone or use of scaffolding techniques to supplement the iPad. Alternating treatments enabled researchers to simultaneously compare the effectiveness of two treatment approaches.

Intervention with the iPad alone.

Receptively, there were no clear patterns for Subjects 1 and 4. Subject 2 showed a pattern of increasing scores in the identification of receptive concepts. Following the baseline measures, Subject 3's ability to receptively identify concepts decreased. Considering expressive targets, Subject 1's scores were inconsistent during the intervention sessions. However, there was no change from the baseline to maintenance sessions. For Subject 2, expressive scores improved over baseline and were maintained in subsequent probes. Inconsistent scores were noted for Subjects 3 and 4 during the intervention sessions. However, Subject 4's scores increased from baseline sessions to the maintenance sessions.

Intervention using Scaffolding with the iPad.

For receptive targets, Subjects 1 and 3 showed no clear pattern. Scores increased for Subject 2, while Subject 4 had a decrease in scores following the baseline sessions. Expressively, no change was evident during the probes for Subject 1. Subjects 2 and 3 showed inconsistent scores. Following the baseline measures, expressive scores for Subject 4 increased.

Comparison of Interventions

Data was inconclusive, as there were no clear patterns across subjects. The iPad alone condition showed varying trends, with increases for Subjects 2 (receptive and expressive) and 4

(expressive). For the scaffolding condition, scores increased for Subject 2 (receptive) and Subject 4 (expressive).

Pretest and Posttest Comparisons

For the receptive tests, Subjects 1, 2, and 4 achieved an increase in scores on the school readiness composite, and Subject 3 demonstrated no change. Subject 1 obtained an increased score on the direction/position subtest, while all other subjects' scores decreased. Subjects 1, 2, and 3 achieved increased scores on the quantity subtests, while Subject 4's score decreased. For the self-/social awareness and time/sequence subtests, scores increased for Subjects 2 and 3 and decreased for Subject 1 and 4.

For the expressive tests, all subjects achieved increased scores on the school readiness composite, self-/social awareness subtest, and time/sequence subtest. Scores increased on the direction/position subtest for Subjects 1, 2, and 3, while scores decreased for Subject 4. Subject 1 and 4 showed an increase on the quantity subtest, while Subjects 2 and 3 demonstrated no change. For the texture/material subtest, scores increased for Subjects 2 and 3, decreased for Subject 1, and remained the same for Subject 4.

Posttest receptive scores increased on the school readiness composite (i.e., Subject 1 and 4), quantity subtest (i.e., Subjects 1, 2, and 3), self-/social awareness subtest (i.e., Subjects 2 and 3), time/sequence subtest (i.e., Subjects 2 and 3), and texture/material subtest (i.e., Subjects 1 and 2). All subjects' scores for expressive areas increased on the school readiness composite, self-/social awareness subtest, and time/sequence subtest. Expressive scores also increased on the following subtests: quantity (i.e., Subjects 1 and 4), direction/position (i.e., Subjects 1 and 3), and texture/material (i.e., Subjects 2 and 3).

Relationship to Literature

Minimal evidence exists that compares approaches for using the iPad as an intervention tool. Specifically, there is no evidence for using the iPad to teach basic concepts. Results were inconclusive in a study comparing the iPad as a form of alternative and augmentative communication (AAC) to a non-electronic picture-based system (Flores, Musgrove, Renner, Hinton, Strozier, Franklin, & Hil, 2012). Acha (2009) found that cognitive load must also be considered, since including a simultaneous presentation of word and picture representations may require more processing effort.

Research indicated that direct, naturalistic intervention using incidental learning facilitated the learning of basic concepts (Siefert & Schwarz, 1991; Ellis, Schlaudecker, & Regimbal, 1995; Bellon-Harn, Credeur-Pampolina, & LeBoeuf, 2013). Likewise, Steele & Mills (2011) stated that using scaffolding resulted in a deeper learning of targeted words for children with language impairment.

Due to the inconsistent patterns demonstrated by the subjects included in the current study, data did not support or refute previous research.

Limitations

A principal limitation to this study was the time frame. Initially designed to take place over a period of seven weeks, as in the study Siefert & Schwarz (1991), the current study was reduced to five weeks due to time constraints. Extending the length of time of the study would have allowed more concepts to be targeted. Early in the study, one participant moved to another school district, making it necessary to recruit an additional participant. In addition, school holidays, snow days, and illnesses limited the amount of data that could be collected within the time allotted for the study.

Subjects 3 and 4 were older than the population on which the *Bracken Basic Concept Scales* was normed. Therefore, raw scores could not be converted into scaled scores. However, the raw score could be used to determine a concept age equivalent, which allowed for comparisons to be made. Because Subject 4 received higher baseline scores, the amount of growth that could be measured was limited.

Another limitation was the selection of words available on the iPad app. Not all words that were missed on the pretest were featured on the iPad app; therefore, words in similar categories had to be chosen as targets. For sessions using the iPad alone in this study, only one concept was targeted for 15 minutes. When targeting just one word on the *Magical Concepts* app, images had to be repeated for the activity to last for 15 minutes. In daily intervention settings, it would likely be more effective to use a combination of targets rather than repeating a single target.

Future Research

Replication of this study over a longer period of time with opportunities for more data points during baseline, intervention, and maintenance phases is needed. Additional factors that could be improved include using age-matched participants and using an iPad app that featured more words targeted in the assessment.

The use of a group research design would be beneficial in order to better understand the use of the iPad in intervention, allowing for more comparisons, as well as generalizations to other populations. Future studies could compare therapy using the iPad with scaffolding and traditional therapy with scaffolding. It would also be beneficial to expand research to iPad apps targeting other language areas besides basic concepts.

Conclusion

Due to a limited number of subjects and a limited amount of time for the study, the results were not sufficient to determine the efficacy of different intervention approaches using the iPad. From the results of the current study, it is possible that the effectiveness of each condition depended upon the learning styles of the subjects. Therefore, this study does not provide clear evidence that one condition would be more successful for all students.

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Appendix A

IRB Approval

October 11, 2012

Meredith Healy
Communication Disorders and Sciences

Thank you for submitting the research protocol titled, "A Comparison of Intervention Techniques Using the iPad" for review by the Eastern Illinois University Institutional Review Board (IRB). The IRB has approved this research protocol following an expedited review procedure. IRB review has determined that the protocol involves no more than minimal risk to subjects and satisfies all of the criteria for approval of research.

This protocol has been given the IRB number 12-132. You may proceed with this study from 10/10/2012 to 10/9/2013. You must submit Form E, Continuation Request, to the IRB by 9/9/2013 if you wish to continue the project beyond the approval expiration date.

Prior to commencing the study, please obtain a letter of permission to conduct the study from the elementary school in Sullivan, IL, and forward the letter to the EIU Office of Research and Sponsored Programs.

This approval is valid only for the research activities, timeline, and subjects described in the above named protocol. IRB policy requires that any changes to this protocol be reported to, and approved by, the IRB before being implemented. You are also required to inform the IRB immediately of any problems encountered that could adversely affect the health or welfare of the subjects in this study. Please contact me, or the Compliance Coordinator at 581-8576, in the event of an emergency. All correspondence should be sent to:

Institutional Review Board
c/o Office of Research and Sponsored Programs
Telephone: 581-8576
Fax: 217-581-7181
Email: eiuirb@www.eiu.edu

Upon completion of your research project, please submit Form G, Completion of Research Activities, to the IRB, c/o the Office of Research and Sponsored Programs.

Thank you for your assistance, and the best of success with your research.

Richard Cavanaugh, Chairperson
Institutional Review Board
Telephone: 581-6205
Email: recavanaugh@eiu.edu

Appendix B

Informed Consent

CONSENT TO PARTICIPATE IN RESEARCH

You are invited to participate in a research study conducted by Meredith Healy, Mrs. Lynn Calvert, and Dr. Angela Anthony, from the Department of Communication Disorders & Sciences at Eastern Illinois University. Your participation in this study is entirely voluntary. Please ask questions about anything you do not understand, before deciding whether or not to allow your child to participate.

PURPOSE OF THE STUDY

The purpose of this study is to compare the effects of two language intervention approaches using the iPad: using the iPad alone versus pairing the iPad with scaffolding.

PROCEDURES

If you volunteer to allow your child to participate in this study, he or she will:
-Be tested with the *Bracken Basic Concept Scale, Third Edition: Receptive* and the *Bracken Basic Concept Scale: Expressive* as pre- and post-test measures which will take approximately one hour to complete at the beginning of the study, and one hour at the end of the study.
-Receive instruction with the school speech-language pathologist using the iPad to target basic concepts for 2 30-minute sessions per week for 5 weeks. Basic concepts are functional vocabulary terms that are crucial to academic success, such as *above, behind,* and *inside.* The sessions will be video recorded using a Flip camera and saved to a password protected file only accessible in the EIU Speech-Language-Hearing Clinic so that the researchers will have access to the sessions.
-Be asked name illustrations and to match a label with the corresponding illustration in order to assess expressive and receptive knowledge after each session.

POTENTIAL RISKS AND DISCOMFORTS

There is minimal risk associated with participation in this study. However, possible short-term risks include participating in intervention strategies which may result in limited or no improvement in the target areas. No physical risks are associated with this research. Psychological risks include an increase in frustration and/or anxiety for your child if he/she has difficulty completing the tasks within the research design.

POTENTIAL BENEFITS TO SUBJECTS AND/OR TO SOCIETY

Subjects will receive intervention services throughout the duration of this study. They will also be exposed to the iPad, a relatively new form of technology. If this study is successful, the findings could serve as a guide when determining intervention strategies using the iPad. Since little evidence exists in this area, it could also provide implications for future research.

CONFIDENTIALITY

Any information that is obtained in connection with this study and that can be identified with you or your child will remain confidential and will be disclosed only with your permission or as required by law. A Flip camera will be used to record the sessions, and videos will be saved to a secure drive which will be password protected. Only the researcher, faculty mentors, and the SLP providing intervention will have access to the data. Any paper files will be stored in a file with no identifying information and kept in a locked drawer. Access to these files will be limited to the researcher and faculty supervisors in order to verify data collection procedures and analysis. Confidentiality will be maintained at all times through the use of unidentifiable participant labels. All records relating to this research study, including those from subjects who formally withdraw from the study, will be maintained for a period of at least three years. Upon the completion of this time period, all paper files will be shredded, and all electronic files will be permanently deleted from the drives.

PARTICIPATION AND WITHDRAWAL

Participation in this research study is completely voluntary. If you volunteer your child to be in this study, you may withdraw your child at any time without consequences of any kind.

IDENTIFICATION OF INVESTIGATORS

If you have any questions or concerns about this research, please contact:

Meredith Healy	Mrs. Lynn Calvert	Dr. Angela Anthony
(217) 259-5823	(217)581-2712	(217)581-2712
mrhealy@eiu.edu	lcalvert@eiu.edu	abanthony@eiu.edu

RIGHTS OF RESEARCH SUBJECTS

If you have any questions or concerns about the treatment of human participants in this study, you may call or write:

Institutional Review Board
Eastern Illinois University
600 Lincoln Ave.
Charleston, IL 61920
Telephone: (217) 581-8576
E-mail: eiuirb@www.eiu.edu

You will be given the opportunity to discuss any questions about your rights as a research subject with a member of the IRB. The IRB is an independent committee composed of members of the University community, as well as lay members of the community not connected with EIU. The IRB has reviewed and approved this study.

I hereby consent to the participation of _____, a minor/subject in the investigation herein described. I understand that I am free to withdraw my consent and discontinue my child's participation at any time.

_____ _____
Signature of Minor's Parent or Guardian Date

I, the undersigned, have defined and fully explained the investigation to the above subject.

_____ _____
Signature of Investigator Date

Appendix C

Child Assent Form

Child Name:_____

ASSENT TO PARTICIPATE IN RESEARCH

My name is Meredith Healy. I am a student at Eastern Illinois University.

I am asking you to help me with a project, because we want to learn about using the iPad to teach you some new words. If you agree to be in this study, I will show you some pictures and ask you to tell me what they are or point to the right pictures I name. _____(SLP) will use the iPad during your time with her.

You will miss a little bit of class time. It is okay if you are a little nervous.

Your parents said it's okay if you work on this project with me, but if you do not want to be in this study, you do not have to do it. It is up to you and no one will be upset if you do not want to participate or if you change your mind later and want to stop.

You can ask any questions that you have about the study. If you have a question later, you can call me or ask me next time.

Would you like to come with me and be part of the study?

YES NO

Appendix D

Target Words for Each Subject

Subject 1										
	Session 1	Session 2	Session 3	Session 4	Session 5	Session 6	Session 7	Session 8	Session 9	Session 10
iPad alone	short	short	medium	medium	few	few	old	old	apart	apart
iPad with scaffolding	missing	missing	upside down	upside down	pair	pair	narrow	narrow	center	center

Subject 2										
	Session 1	Session 2	Session 3	Session 4	Session 5	Session 6	Session 7	Session 8	Session 9	Session 10
iPad alone	pair	pair	same	same	center	center	missing	missing	light	light
iPad with scaffolding	near	near	above	above	surprised	surprised	old	old	few	few

Subject 3										
	Session 1	Session 2	Session 3	Session 4	Session 5	Session 6	Session 7	Session 8	Session 9	Session 10
iPad alone	few	few	half	half	narrow	narrow	pair	pair	light	light
iPad with scaffolding	missing	missing	upside down	upside down	medium	medium	right	right	near	near

Subject 4										
	Session 1	Session 2	Session 3	Session 4	Session 5	Session 6	Session 7	Session 8	Session 9	Session 10
iPad alone	right	right	apart	apart	near	near	above	above	pair	pair
iPad with scaffolding	few	few	upside down	upside down	half	half	surprised	surprised	old	old

Appendix E

Guidelines for Interactive Scaffolding

Response Facilitations	Linguistic Facilitations	Regulatory Facilitations
· Wait for a response · Model the response · Repeat and emphasize · Cue through physical signals · Pause before providing the answer · Provide part of the answer · Provide the answer and have the student repeat it	· Model (provide in advance) · Expand · Extend · Recast · Use vertical structuring · Use build-up/breakdown · Use focused contrast · Redirect	· Maintain awareness and acceptance of the goal · Highlight importance of content · Relate content to past knowledge · Comment on student performance · Inhibit impulsive responses · Aid selective and sustained attention · Help student manage challenge · Review cumulative performance · Comment on task similarities

(Ukrainetz, 2006)

Appendix F

Treatment Fidelity Checklist

Response Facilitations			
	2/28/13 (Subject 1:upside down)	3/13/13 (Subject 1: narrow)	3/14/13 (Subject 3: near)
Wait for a response	2	2	2
Model the response	1	0	1
Repeat and emphasize	1	5	2
Cue through physical signals	1	1	0
Pause before providing the answer	5	5	0
Provide part of the answer	1	2	0
Provide the answer and have the student repeat it	0	0	0
Linguistic Facilitations			
	2/28/13 (Subject 1:upside down)	3/13/13 (Subject 1: narrow)	3/14/13 (Subject 3: near)
Model (in advance)	1	1	1
Expand/extend	3	6	2
Recast	1	1	1
Vertical structuring	1	0	1
Build-up/breakdown	0	0	0
Focused contrast	3	6	3
Redirect	0	0	0
Regulatory Facilitations			
	2/28/13 (Subject 1:upside down)	3/13/13 (Subject 1: narrow)	3/14/13 (Subject 3: near)
Maintain awareness/ acceptance of goal	1	1	1
Highlight importance of content	0	1	0
Relate content to past knowledge	4	4	3
Comment on student performance	0	7	1
Inhibit impulsive responses	0	0	0

Aid selective and sustained attention	3	2	1
Help student manage challenge	0	3	0
Review cumulative performance	0	1	0
Comment on task similarities	1	1	0