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EFFECTS OF USING AN IPAD APP WITH EMBEDDED MODELS TO TEACH SIGHT WORDS TO ELEMENTARY STUDENTS WITH DEVELOPMENTAL DISABILITIES

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EFFECTS OF USING AN IPAD APP WITH EMBEDDED MODELS TO TEACH SIGHT WORDS TO ELEMENTARY STUDENTS WITH DEVELOPMENTAL DISABILITIES

THESIS

A thesis submitted in partial fulfillment of the
requirements for the degree of Master of Science in Education
in the College of Education
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By

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Lexington, Kentucky

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ABSTRACT OF THESIS

EFFECTS OF USING AN IPAD APP WITH EMBEDDED MODELS TO TEACH SIGHT WORDS TO ELEMENTARY STUDENTS WITH DEVELOPMENTAL DISABILITIES

The purpose of the study was to examine the effectiveness of teaching sight words using an iPad app with embedded models to students with developmental disabilities. The experimental design used was multiple probe (conditions) across behaviors replicated across students. All sessions occurred in a one-to-one format. The results showed the iPad app with embedded models were effective in teaching sight words to students with developmental disabilities.

KEYWORDS: Developmental Disability, iPad, model, sight words, technology

Meghan A. Traynor

November 20, 2017

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Section 1: Introduction

Teachers need effective and evidence based strategies to teach students with developmental delays. In recent years, federal legislation has called for educators and clinicians to adopt evidence-based practices. In addition, with an increasing focus on standards-based education being set forth by *No Child Left Behind* (NCLB, 2001), *Every Student Succeeds Act of 2015* (ESSA, 2015), and *Individuals with Disabilities Education Improvement Act* (IDEIA, 2004), there is push for students with disabilities to learn grade-aligned, core content academic standards. Special education teachers need to ensure students make annual yearly progress on their individualized goals in areas such as reading, while also adhering to the objectives set forth by ESSA and IDEA (Coleman, Hurley, & Cihak, 2012). At the same time, the systematic instruction literature, points out the need for students to learn content using effective and efficient strategies that minimize errors (Birkan, 2010; Collins, 2012).

Simultaneous prompting (SP) is a systematic and evidence-based instructional practice that uses models as prompts and can be used by educators to teach students with developmental disabilities. According to a review by Morse and Shuster (2004), SP is considered a near errorless teaching strategy, effective in teaching both discrete and chained skills to persons with and without disabilities. A number of studies have demonstrated and replicated the utility of SP with participants ranging from preschool age through adulthood. Morse and Shuster also reported that "SP was an effective response prompting procedure with 89% of participants achieving criterion, and with high rates of fidelity (>96%), and low participant errors (<5%)" (p. 162).

SP has been effective in teaching sight words to students with developmental disabilities (Dogan & Tekin-Iftar, 2002; Gibson & Schuster, 1992; Swain, Lane, & Gast, 2014). In addition to teaching sight word identification, SP has been effective in teaching identification of sounds and blending sounds to elementary students with moderate intellectual disabilities (Waugh, Fredrick, & Alberto, 2009), state capitals to high school students with learning and behavior disorders (Head, Collins, Schuster, & Ault, 2011), and color identification to students with an intellectual disability in preschool and elementary school (Ciftci & Temel, 2010). Simultaneous prompting also has been used to teach academic tasks such as story writing to an elementary student with autism (Pennington, Stenhoff, Gibson, & Ballou 2012), Pythagorean Theorem to high school students with moderate intellectual disabilities (Creech-Galloway, Collins, Knight, & Bausch, 2013), and telling time to students with intellectual disabilities in elementary through secondary grades (Birkan, 2005). It also has been effective in teaching independent living and leisure skills to adults with severe intellectual disabilities (Dollar, Fredrick, Alberto, & Luke, 2012) and hand washing to elementary students with moderate to severe mental retardation (Parrot, Schuster, Collins, & Gassaway, 2000).

In addition to systematic instruction, teachers have used technology to enhance instruction in the classroom. Technology has become ubiquitous in society and the classroom is not an expectation. With the increase in the use of technology among adults as well as children, technology has begun to replace books, textbooks, television and has become a means of communication for some people. With the push for using and identifying evidence based practice, age appropriate goals and objectives, federal mandates for the consideration (IDEA, 2014) of assistive technology devices, and the

increase in the use of technology throughout the world, there is a need to determine if combining evidence-based practices, technology, and grade level skills would result in increased academic success for students with disabilities.

There have been many studies that have shown the effectiveness of computer-assisted instruction to teach skills to students with disabilities. Computer Aided Instruction is defined as "a program of instructional material presented by means of a computer or computer systems" (Encyclopedia Britannica, 2016). Teachers have effectively used computer-assisted instruction (CAI) to teach sight words to students with developmental delays (Coleman et al. 2012). Mechling, Gast and Krupa (2007) conducted a study on computer-assisted instruction with SMART Board technology to teach sight words to students with moderate intellectual disabilities within a small group setting and all students reached criterion on their target set of words. Students were also able to read the other students sight words through observational learning with an accuracy ranging from 72.2% -100% correct responding. Computer-assisted instruction has also been used to teach students tasks such as story writing to an elementary student with autism (Pennington et al., 2012), receptive understanding of prepositions to students with moderate intellectual disabilities (Mechling & Hunnicutt, 2011), and color identification to students with an intellectual disability in preschool and elementary school (Ciftci & Temel 2010). It also has been used to teach functional skills such as ordering at fast food restaurants to high school students with moderate or severe intellectual disabilities (Mechling & Cronin, 2006) and reading grocery aisle signs to locate items to students with moderate intellectual disabilities (Mechling, Gast, & Langone, 2002). Computers also have been used as a reinforcer to increase task

completion with students with moderate intellectual disabilities and autism (Mechling, Gast, & Cronin. 2006).

With technology advances and the use of mobile devices, there has been an increase in studies on the effects of using apps on mobile devices with persons with disabilities. Some studies implementing apps on iPads for academic tasks have targeted building math fluency in 7th and 8th grade students with autism or multiple disabilities (O'Malley, Jenkins, Wesley, Donehower, Rabuck, & Lewis, 2013), teaching the Pythagorean Theorem to high school students with moderate intellectual disabilities (Creech-Galloway et al., 2013), teaching science content to secondary students with moderate to severe intellectual disabilities (Miller, Krockover, & Doughty, 2013), and teaching spelling to students with developmental disabilities (Ault, Baggerman, & Horn, 2017). There also have been studies conducted using apps to increase work-related behaviors in adults with disabilities (Jones & Bucholz, 2014), and leisure activities with adults with mild mental disabilities (Chan, Lambdin, Graham, Fragale, & Davis, 2014). Fowler (2014) suggested that using an iPad during independent practice increased time on task with 3 students with challenging behaviors compared to typical independent practice. Larabee, Burns, and McComas (2014) also conducted a research study involving decoding grade level words using an iPad and measured time on task behavior throughout. In this study, the students were decoding CVC words by touching and dropping letters on the touchscreen into the appropriate box to create a CVC word. When they touched the letters on the screen the app produced audio of the individual letter sound and student placed the letters in the boxes to create the CVC word. After all the letters were placed in the boxes to create the word, the app said each letter sound

individually then said the word, before advancing immediately to the next word. They found time on task behaviors improved with the iPad use but the student's level of performance did not increase when compared to using standard materials to decode words. There has been an increase in research on the educational effects of apps and mobile devices as discussed above, but there is limited or no research on mobile devices and academic success with sight word identification.

There is limited research on apps on mobile devices that incorporate systematic instruction used to teach students with disabilities. Authors may not clearly identify if systematic instructional procedures are used by apps. Identification of apps that use systematic instruction could lead to academic benefits for students with disabilities. This study uses a procedure similar to the simultaneous prompting procedure in that there is a simultaneous prompt, but in this study unlike SP, a response was not required after the prompt and a no feedback was given during training sessions so therefore it is exposure to a model of the stimulus and prompt. This research study examined the effects of an iPad app exposure of a model, to teach grade level sight words to elementary students with developmental disabilities.

Section 2: Research Question

The researcher asked the following question: Is there a functional relation between an iPad app embedding models and an increase in number of sight words read in elementary students with developmental disabilities?

Section 3: Method

Participants

Four participants, 6 to 9 years of age, were recruited for this study. Of the participants, one was a female an eligibility of a functional mental disability and three were male with an eligibility and diagnosis of autism spectrum disorder. The students attended an integrated public elementary school, received special education services in a resource room for part of their day, and were included in the general education setting for the other part of their day.

Inclusion criteria for this study were as follows: (a) 6-9 years of age, (b) diagnosed with a developmental disability, (c) visual acuity to see the sight words, (b) auditory acuity to hear the sight words from the iPad, (c) ability to verbally state the targeted sight words, (d) ability to imitate a verbal model provided on an iPad, (e) ability to independently use the application on the iPad including activating the touch screen, (f) attending to a task for a minimum of 2 min, and (g) matching like sight words.

The researcher (first author) assessed these skills by using sight words that the student was already able to identify from index cards and put them on the iPad app to make sure the students were able read them on the iPad. Also, using words the student was not familiar with (and were not part of the study), the researcher had the iPad read the words to him/her to see if he they could hear it and verbally imitate the words. To make sure the students could say the words for the study, the researcher read the words to them to see if they could verbally imitate them, but did not show them the words. When assessing these skills, the researcher modeled for the student how to use the app then gave the student the iPad and assessed if they could properly use the app.

Students. Yani was a 6-year-old male with a diagnosis and eligibility of autism. He received instruction in a primary general education first grade classroom for 230 min a day in language arts, math, specials, recess, and lunch, and 180 min in a resource classroom for students with moderate to severe disabilities receiving math, language arts and vocational instruction. Yani also received speech and occupational therapy services weekly in the resource setting. Yani was administered the *Stanford Binet Intelligence Scales, Fifth Edition* in 2014 (SB-V; Roid 2003). The SB-5 indicated a scaled IQ score of 48 (mean = 100, standard deviation = 15), which falls at the <0.1 percentile in the Moderately Delayed range. Yani had a goal on his individualized education program (IEP), to identify grade level sight words. Yani displayed strengths in the areas of rote skills, using a calculator, receptive language, and following two-step directions. He could verbally identify all upper and lowercase letters of the alphabet as well as their sounds, identifying sight words in isolation, read short sentences with sight words previously acquired, and match short phrases or sentences to the corresponding picture. He made requests using one to three word verbalizations for highly preferred items or activities with prompting. Yani enjoyed technology and it was highly reinforcing to him. He enjoyed computers, tablets, and switches with voice output, and was able to independently access computers and tablets. Yani displayed significant deficits in functional communication, staying on task, and completing tasks without multiple prompts.

Jeremy, was a 6-year-old male with a primary disability of autism. Jeremy received special education services for 120 min a day in a resource classroom for students with moderate to severe disabilities. The other part of his day was spent in a first grade

general education classroom setting with his same age peers. Jeremy also received speech and occupational therapy services weekly in the resource setting. He was assessed with the *Kaufman Battery for Children-Second Edition* (KABC-II, Kaufman, 2004) to measure his cognitive and processing abilities. The protocol was not scored as Jeremy was not able to, or did not want to respond to multiple test items. No formal academic assessment was conducted with Jeremy during his evaluation. Jeremy communicated primarily through one word utterances when prompted or highly motivated. He made spontaneous requests using one word verbalizations for highly preferred items or activities. He displayed strengths in the areas of tacting or verbally labeling/identifying familiar items when presented, responds to verbal directions to complete familiar directives, visual perceptual skills to match, and visually identify items. He also was able to identify all upper and lowercase letters verbally, identify letter sounds when presented in a field of 3, and given the sound and could identifying 11 sight words when presented in a field of three. Jeremy displayed significant deficits in the areas of verbally responding and answering academic tasks, producing two syllable words, functional communication, and attending to tasks. According to a preference assessment completed by his mom and teacher, Jeremy preferred technology over other items or activities. He enjoyed computers, tablets as reinforces, and switches with voice output as a way to communicate.

Lexie was a 7-year-old female with a diagnosis of mild mental disability. She received special education services in a resource classroom for students with learning and behavior disorders for 120 min a day. The other part of her day was spent in the second grade general education setting with her same-age peers. Lexie also received

occupational and speech therapy weekly in the resource room. Lexie was assessed using the *KABC-II* (Kaufman & Kaufman 2004). Lexie's performance yielded a Mental Processing Index (MPI) score of 62 and a Nonverbal Index (NVI) score of 55, both which correspond to the 1st percentile and overall cognitive ability within the *Lower Extreme Range*. Lexie was a verbal communicator who used short phrases and full sentences. Her strengths included receptive and expressive language, speech sound production, answering basic recall questions related to verbally presented scenarios, tracing uppercase letters, recognizing her name, and 1:1 correspondence counting items. Lexie's deficits included reading comprehension, identifying alphabet letters out of sequence, identifying sight words, rote counting, and writing her name without a model.

Gabe was a 9-year-old male student with a diagnosis of autism. Gabe spent 110 min in the resource setting for students with moderate to severe disabilities and the other part of his day in a third grade general education class with his same-age peers. Gabe also received occupational, speech, and music therapy weekly in the resource room. Gabe's cognitive functioning was assessed using the *SB-V* (Roid, 2003), and his performance yielded an IQ score of 40, which corresponded with the <0.1 percentile, indicating a classification of *Moderately Delayed*. Gabe primarily communicated using one-word utterances, when prompted. Gabe's strengths included rote skills, identifying upper and lowercase letters, reading sight words in isolation, reading short sentences or phrases with previously acquired sight words, matching short phrases to the corresponding picture, identifying numbers to 25, counting to 100, receptive language following 1-2 step oral directions, and accessing technology independently. Gabe exhibited deficits in the areas of letter sound identification, reading comprehension, answering open-ended questions,

and writing legibly.

Staff. A paraprofessional in the resource room served as the reliability observer. She had 9 years of experience working as a paraprofessional with students with moderate and severe disabilities and implementing systematic instruction. She was previously trained on the use of models for instruction through system of least prompts and most to least prompting procedures as well as the SP procedure and had implemented for 2 years, and had experience taking fidelity data.

Researcher. The researcher, a special education teacher, conducted all training, probe, maintenance, and generalization sessions. She had a bachelor's degree in special education with an emphasis in moderate and severe disabilities and was completing her master's degree in special education leadership with a focus in assistive technology. She was in her sixth year as a special education teacher for students with moderate and severe disabilities. The researcher also had experience with using systematic instruction and served on the assistive technology team in her school district for 2 years.

Instructional Setting and Arrangement

Full and daily probe, maintenance, and generalization sessions were all conducted in a 1:1 setting in the resource room with the researcher sitting at a small table beside the student, as seen in Figure 1. The room was 20.4 m x 10.5 m at its widest points. During training (intervention) sessions, the participants independently sat at a table, one at a time, while the researcher worked at another table with other students about 3.3 m away. The participant using the app was within view of the researcher to ensure the student was accessing the app. The researcher controlled for distractions by waiting until everyone

was quietly working and transitions were over within the room before beginning sessions. During sessions, the paraprofessional taught other students in the classroom who were not involved in the study on the opposite side of the room.

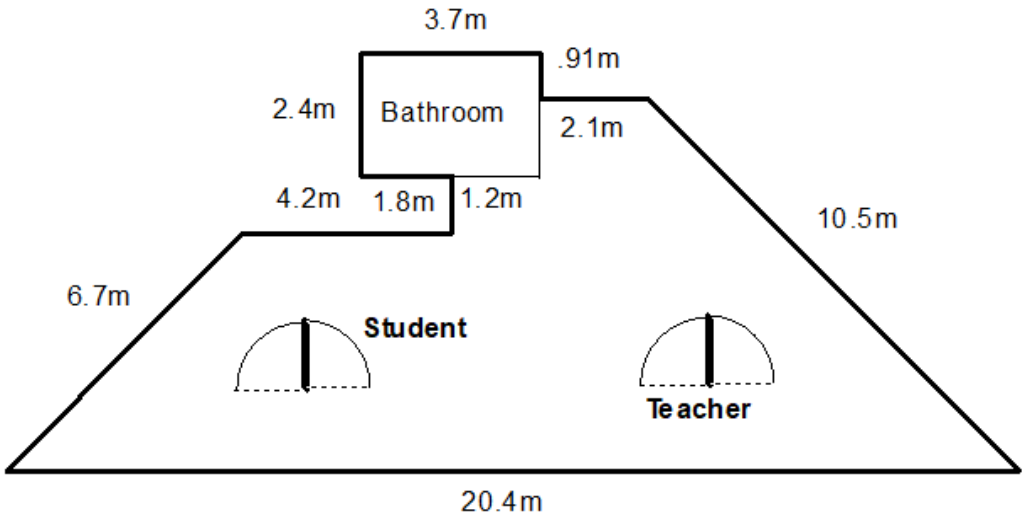

Figure 1. Classroom layout

Materials/Equipment

The materials in this study included (a) data collection sheets, (b) pencil, (c) iPad (d) iPad app: "Sight Words Photo Touch" from Grasshopper Apps (Innovative Investments Limited, 2012), (e) 7.62 cm x 12.7 cm unlined index cards, (f) 21.59 cm x 27.94 cm choice board with pictures of 3 reinforcers, (h) collection of reinforcers (e.g., sensory bean box, therapy ball, edibles), and a (g) digital timer. The sight word app had multiple settings. For each participant, nine words were selected (based on the results from screening) and then divided into sets of 3 words (one for each tier of instruction) (see Table 1). The words were grouped with no words in a group starting with the same

letter. The iPad app randomly presented the words in different colors on a white background in a 10.16 cm x 10.16 cm outlined box in the center of the iPad while voicing the word one time (see Figure 2 for a screenshot).

Table 1

Target Stimuli

Student	Stimuli Set 1	Stimuli Set 2	Stimuli Set 3
Yani	both, fall, upon	always, buy, gave	own, shall, warm
Jeremy	call, fast, many	both, pull, why	made, very, wash
Lexie	call, fast, many	both, pull why	made, very, wash
Grant	far, keep, small	hold, start, try	clean, full, hot

Figure 2. iPad App: Sight words by photo touch

General Procedures

This study was conducted to examine the effectiveness of teaching sight words to elementary students with developmental disabilities using an iPad app with embedded models. The experimental design used was multiple probe (conditions) design across behaviors replicated across students. Probe, maintenance, and generalization sessions occurred in a one-to-one format and training sessions occurred with the student sitting independently. One daily probe and one training session occurred each day for each student. Each student had nine stimuli with stimuli being taught in three sets of three. First, students were tested on all nine stimuli in the first full probe condition, then taught the first set of three stimuli to criterion taking daily probe data on just the first set. Then all nine stimuli were tested again in a second full probe condition, followed by the second set of three stimuli being taught to criterion. The second set received daily probe sessions. A third probe session was conducted with all nine stimuli before teaching the third set of stimuli to criterion, with the third set receiving daily probe sessions. Finally, after the student met criterion on all conditions, a final full probe condition was conducted on all nine stimuli. Maintenance conditions were conducted once a week for 4 weeks after the final full probe condition. Generalization conditions were conducted prior to the start of the study before the first full probe sessions and after the final full probe condition once criterion was met on all word sets. A pre-post experimental design was used for generalization. This sequence was replicated with each student.

Data Collection

Data were collected daily by the researcher on daily probe sessions for the tier receiving training and on full probe sessions for all stimuli before and after criterion was

met on all stimuli. Data were also collected on generalization trials prior to the beginning of the study and at the conclusion of the study, and on maintenance once a week for four weeks after all stimuli had been met. The researcher used a discrete trial recording system for all sessions. Appendix A shows a sample data collection sheet for full probe sessions, and Appendix B shows a sample data collection sheet for daily probe sessions. Data were collected on the correct, incorrect, and no responses on the students' responding to sight words.

Correct response. Correct responses were defined as the student verbally stating the correct word within 5 s after the delivery of the task direction, "What word?" and the stimulus.

Incorrect response. Incorrect responses were defined as the student verbally stating a word other than the correct word within 5 s of delivery of the task direction and the stimulus.

No response. No responses were defined as the student not saying anything after the delivery of the task direction, "What word?" the student did not respond within 5 seconds.

Procedures

Screening. Fifteen words were taken from the grade level sight word list from the iPad app "Sight Words Photo Touch" from Grasshopper Apps (Innovative Investments Limited, 2012), and the researcher had all students verbally imitate the words after the iPad read them. The students did not see the words on the iPad during this part of the screening. The researcher screened the students' ability to intelligibly verbally imitate the words. If students could not imitate the words accurately, but could say an approximation

of the word, the researcher phonetically spelled the student's pronunciation of the word to score the accuracy of responding. The researcher conducted one screening session for intelligibility. From those 15 words, the researcher took the words the student was able to imitate and presented the words on the iPad without sound and asked the student, "What word?' and waited 5 s for a response. The researcher conducted three sessions with one trial on each stimulus. Praise was only given for attention to the task and appropriate behavior during the screening procedures on a variable ratio of three (VR3) schedule. That is, on the average of every third trial the researcher verbally praised students (e.g., "Great! I love how you are looking."). Students had to respond incorrectly to the word two times during the three screening sessions for it to be included in the list of possible words to include in intervention. From the list of unknown words from the screening session, the researcher randomly chose nine sight words to split into three instructional sets, with three words per set. Each student had different words. Then the researcher used stimuli that were not part of the study and assessed if the students could access and move through the app correctly. If the students were unable to use the app independently, the researcher taught the students how to use the app with verbal, model, and physical prompting using the least intrusive prompt the student needed to be successful. After three sessions of teaching the students how to use the app, to ensure the prompting procedures were successful, the researcher conducted a session without prompting to assess if the student could move through the app correctly and independently.

Full probe conditions. Full probe conditions occurred prior to training each word set and after all word sets reached criterion. These sessions occurred in a one-to-one format in the resource room. The researcher sat at a small table directly beside the

student. Prior to each probe session, students were given a choice board to select a reinforcer by pointing to one of three pictures that they could obtain following the instructional session. After they chose their reinforcer, the researcher secured student attention by using the attentional cue, “Are you ready?” and waiting for the student to make eye contact or verbally answering “yes”. Next, the researcher held the iPad with the sound turned off, directed the student’s attention to the iPad where the words were presented, said, “What word,” and waited 5 s for the student to respond. The teacher recorded the student response then advanced the iPad to show the next stimulus. All nine stimuli were presented randomly to each student for three trials each, for a total of 27 trials per session. Since the app randomly selected the order of the words to present, if a word appeared more than three trials, the researcher skipped the word and did not show the word to the student, so there were only 27 trials on the first 3 occurrences of each stimulus for each student. If the student responded correctly (i.e., stated the correct word within 5 seconds), a “+” was placed on the data sheet. If the student responded incorrectly (i.e., stated an incorrect word within 5 seconds), the teacher recorded a “-” on the data sheet. If the student did not respond (i.e., student did not say anything within 5 seconds) an “O” was recorded on the data sheet. No praise or prompting was delivered for correct, incorrect, or no responses during probe sessions. Praise did not occur in order to attempt to keep sessions at a fast pace since 27 words were being assessed during full probe conditions. The teacher provided general praise for appropriate behavior and attention to the task on a VR3 schedule (e.g., “Great looking!’, “I love how you are sitting and looking!”). At the end of the full probe session, the student received the reinforcer for participation regardless of accuracy of responding.

Daily probe condition. Daily probe sessions were conducted in the same manner as full probe sessions except only the set of three stimuli that were currently being taught was assessed. These sessions occurred immediately prior to app training sessions of the three stimuli to assess the student's acquisition of currently trained words. Once the student's attention was secured, the stimuli and task direction were presented to the student. Each stimulus was presented randomly to the student for three trials and a total of nine trials per daily probe sessions. Data were collected for correct, incorrect, and no responses as in full probe sessions. Correct responses resulted in descriptive verbal praise (e.g., "Right, the word is boy!"). Incorrect responses and no responses were ignored (i.e., the teacher said nothing, waited 3-5 s, and delivered the next trial). Verbal praise was given for attending during probe sessions on a VR3 schedule of reinforcement. When the daily probe sessions were complete, students received the reinforcer they chose from the choice board regardless of accuracy of responding.

App intervention. The iPad app: "Sight Words Photo Touch" from Grasshopper Apps (Innovative Investments Limited, 2012), with embedded models, was used for this study. The training sessions occurred immediately after the daily probe sessions. Training sessions occurred in the resource room a minimum of three times a week, with one session conducted per day. Students sat at a small table by themselves during the training sessions with their back to the rest of the classroom. During the training session, the researcher sat at a kidney-shaped table working with other students, but was able to see the iPad to ensure the student was accessing the app correctly.

The researcher handed the student the iPad with the app open and ready to go, with the task direction, "Work on your words." and set a timer for 2 min. The app was set

to only present the three words in the stimuli set the student was currently working on, but since the app randomly presents the words, the 2 min time period was set to ensure the student had at least one trial of each word. The researcher ensured the student was looking at the iPad when the timer was started. The iPad app presented trials using a model by presenting one word at a time and immediately stating the word at 0 s delay. Then the student touched the word, a red circle appeared around the word, and the app gave verbal praise (e.g. “awesome”, “great”). The next word then appeared on the screen. When the new word appeared, the app immediately stated the word with 0 s delay. Students were not required to imitate or verbally state the words during the training sessions, but the researcher sat in visual proximity with a view of the student and iPad, about 3.3 m from the student, to ensure the student was on task, advancing through the words, and not exiting out of the app. If the student exited out of the app or was not attending to the app, the researcher stopped the timer, opened the app and redirected the student to the task and reminded them of the reinforcer for which they were working. Once the app was open and student attention was secured, the researcher started the timer where it was stopped, to finish the 2 min. Data on student responding were not collected during the training sessions. When the 2 min was complete and the timer beeped, students received the reinforcer they chose from the choice board.

Maintenance procedures. Maintenance procedures were built into the experimental design in that full probe sessions were conducted on all stimuli before any instruction occurred and after criterion was met on each tier of stimuli. Therefore, during full probe sessions, the researcher obtained maintenance data on previously learned stimuli. In addition, after the final full probe session, once all words were taught to

criterion, maintenance trials were conducted once a week for 4 weeks on all nine stimuli in the same manner as full probe sessions. If a student's responding fell below 100% accuracy during maintenance sessions, one training session using the app was conducted only on the stimuli for which the student fell below criterion. These words were assessed again during the next maintenance session. If the student did not reach 100% correct responding again on the next maintenance session, another training session was conducted on the stimuli for which the student fell below criterion.

Generalization procedures. Generalization tests across materials occurred prior to instruction and at the completion of the study. Prior to instruction, a generalization pretest was given in which the researcher assessed the students' ability to read the words when handwritten with black marker on individual 7.6 cm *x* 12.7 cm white index cards. After the final probe was conducted, a generalization posttest with the words on index cards was given. The generalization sessions were conducted using the same procedures as full probe sessions.

Experimental Design

The experimental design was a multiple probe (conditions) across behaviors replicated across students (Gast & Ledford, 2014). The intervention was applied to one tier at a time in a time-lagged fashion. Experimental control was demonstrated when the baseline data remained stable and did not change until the intervention (iPad app) was implemented across the tiers (sets of sight words). Mastery criterion was 100% accuracy for 3 consecutive sessions before introducing the next tier.

Reliability

A paraprofessional in the resource room collected both inter-observer agreement data (IOA) and procedural fidelity data. The paraprofessional was familiar with systematic instruction and the simultaneous prompting procedure. Before the study, the paraprofessional was trained on the behavioral definitions of the teacher behaviors to be implemented, the data collection system, and the behavioral definitions of the dependent variable. The paraprofessional took data simultaneously on both the inter-observer and procedural reliability a minimum of once during each of the probe conditions, at least once in every condition, and for at least 20% of the sessions in each condition for each participant. Appendix C shows full probe reliability data, Appendix D shows daily probe reliability data, and Appendix E shows training reliability data. If the agreement fell below 80%, the paraprofessional was retrained and data were reviewed to determine where the disagreements were and to review the definitions of the behaviors.

Dependent variable reliability. IOA was calculated using the point-by-point method by calculating the number of agreements divided by the number of agreements plus disagreements and multiplying by 100 (Gast & Ledford, 2014).

Procedural reliability. Procedural reliability was calculated by counting the number of observed behaviors, dividing by the number of planned behaviors, and multiplying by 100 (Gast & Ledford, 2014). Behaviors observed during full and daily probe sessions included (a) having materials ready (iPad sound off for probe sessions and all 9 words for full probe session and correct set of 3 words for daily probe session), (b) presenting the choice board, (c) giving an attentional cue/gaining students attention, (d) giving task direction, (e) waiting the appropriate response interval, (f) delivering the

correct consequence, and (g) giving reinforcement chosen from the choice board. During training sessions behaviors observed included (a) having materials ready (correct set of 3 words), (b) presenting the choice board, (c) giving an attentional cue/gaining students attention, , (d) giving task direction, (e) setting the timer for 2-min, (f) redirecting the student to the app when needed (during training sessions), and (g) giving reinforcement chosen from the choice board.

IOA and procedural fidelity data were collected during 20% of full probe sessions for all four students. IOA and procedural fidelity across all sessions and students was calculated at 100%. IOA and procedural fidelity were collected during 27% of the daily probe sessions for Yani, Jeremy, and Grant and 21% of sessions for Lexie. IOA and procedural fidelity across all sessions and students in daily probe was calculated at 100%. Procedural fidelity during daily training sessions was collected during 27% of the sessions for Yani, Jeremy, and Grant and 21% of the sessions for Lexie. Procedural fidelity across all training sessions and students were calculated at 100%.

Section 4: Results

The results indicated that the use of app exposure with embedded models was effective in teaching sight words to the 4 students with developmental disabilities. All probe sessions remained stable with 0% responding across all participants and conditions until the independent variable was introduced. Data was analyzed by looking at the trend, stability and immediacy of effect at the end of a week or after 4 data points in a condition.

Student responding data for Yani is shown in Figure 3. Yani reached criterion on all three sets of sight words in 15 training sessions with 9 words mastered in 30 min of app instruction. He learned each tier in a mean of 3 sessions (range, 4-6). On the first day of training, Yani had an immediate and abrupt increasing trend in a therapeutic direction with each word set. During daily probe sessions, Yani had a mean of 31% errors (range, 25-35%). Because data were not collected during the app and students were not required to respond, no data on accuracy of responding during the app sessions were collected. In the generalization pre-test, Yani was unable to read any of the words, but responded with 100% correct responding during the generalization posttest. In maintenance sessions, Yani maintained 100% correct responding on words previously taught. He also had 100% correct responding on weekly maintenance probes held following the final probe condition.

Student responding data for Jeremy is shown in Figure 4. Jeremy reached criterion on all three sets of sight words in 26 training sessions with 9 words mastered in 52 min of app instruction. He learned each tier in a mean of 8.7 sessions (range, 7-10).

On the third day of training, Jeremy had an increasing trend in each word set. During daily probe sessions, Jeremy had a mean of 34% errors (range, 22-33%). Because data were not collected during the app and students were not required to respond, no data on accuracy of responding during the app sessions were collected. In the generalization pre-test, Jeremy was unable to read any of the words, but responded with 100% correct responding during the generalization posttest. In maintenance sessions, Jeremy maintained 100% correct responding on words previously taught. He also had 100% correct responding on weekly maintenance probes held following the final probe condition.

Student responding for Lexie is shown in Figure 5. She reached criterion on two sets of sight words in 43 training sessions with 6 words mastered in 86 min of app instruction. She learned a tier in a mean of 21.5 sessions (range, 19-24). Modifications were needed for Lexie to reach criterion in Tiers 1 and 2. In Tier 1 after 4 sessions, visual analysis showed zero-celerating, so the researcher added one session on the iPad identical to training sessions, on all 3 words in set one before session 5. Following this modification, Lexie's responding increased to 33% on the next daily probe session, then to 67% after 4 sessions and 100% after 7 sessions. However, her responding decreased to 67% for 5 sessions before responding increased again to 100% for three consecutive sessions to meet criteria. During Tier 2, after visual analysis showed a flat trend, with 0-33% responding, the researcher added massed training trials on the iPad identical to training sessions, between sessions 44 and 45 on the two words Lexie was consistently missing. After the massed trials, responding increased to 67% after 2 sessions and after 5 sessions 100% responding for three sessions to reach criterion. Lexie was unable to reach

criterion on word set three. During daily probe sessions, Lexie had a mean of 30% errors (range, 24%-37%). Because data were not collected during the app and students were not required to respond, no data on accuracy of responding during the app sessions were collected. In the maintenance session after word sets one and two, Lexie maintained 100% responding on both word sets. In the generalization pre-test, Lexie was unable to read any of the words. She was unable to be tested on the generalization posttest and maintenance after the final probe session, since she did not reach criterion on set 3 and was unable to be assessed due to the end of the school year.

Student responding for Gabe is shown in Figure 6. He reached criterion on all three sets of sight words in 45 training sessions with 9 words mastered in 90 min of app instruction. He learned each tier in a mean of 15 sessions (range, 5-24). In the final probe sessions, Gabe dropped to 89% responding, missing one word consistently from tier 1. Modifications were needed for Gabe to reach criterion in tiers 1 and 2. In Tier 1, following low responding levels, the researcher added two session on the iPad, identical to training session, on all 3 words in set one before session 15. Following this modification, Gabe's responding immediately increased to 67% on the next daily probe session, then to 100% after 2 sessions and 100% responding for three consecutive sessions to meet criteria. During Tier 2, after responding was continuous at 67%, the researcher added massed trials on the iPad between sessions 44 and 45, identical to training sessions, on the one word Gabe was consistently missing. After the massed trials, responding increased to 67% after 1 session and after 2 sessions responding increase to 100% three sessions to reach criterion. During daily probe sessions, Gabe had a mean of 33% errors (range, 20%-45%). Because data were not collected during the app and

students were not required to respond, no data on accuracy of responding during the app sessions were collected. In the generalization pre-test, Gabe was unable to read any of the words, but responded with 100% correct responding during the generalization posttest. In maintenance sessions, Gabe responded with 89% accuracy on words previously taught on one weekly maintenance probe held following the final probe condition. Due to the end of the school year, Gabe was unable to be assessed on other weekly maintenance sessions. The mean number of trials to criterion by word sets is shown in Table 2.

Table 2

Mean Number of trials to criterion by word sets

Word sets **Student**	**1**	**2**	**3**	**Mean Number of Sessions**
Yani	6	4	5	3
Jeremy	10	7	9	8.7
Gabe	16	24	5	15
Lexie	24	19	-	21.5
Mean Across Students	14	13.5	6.3	

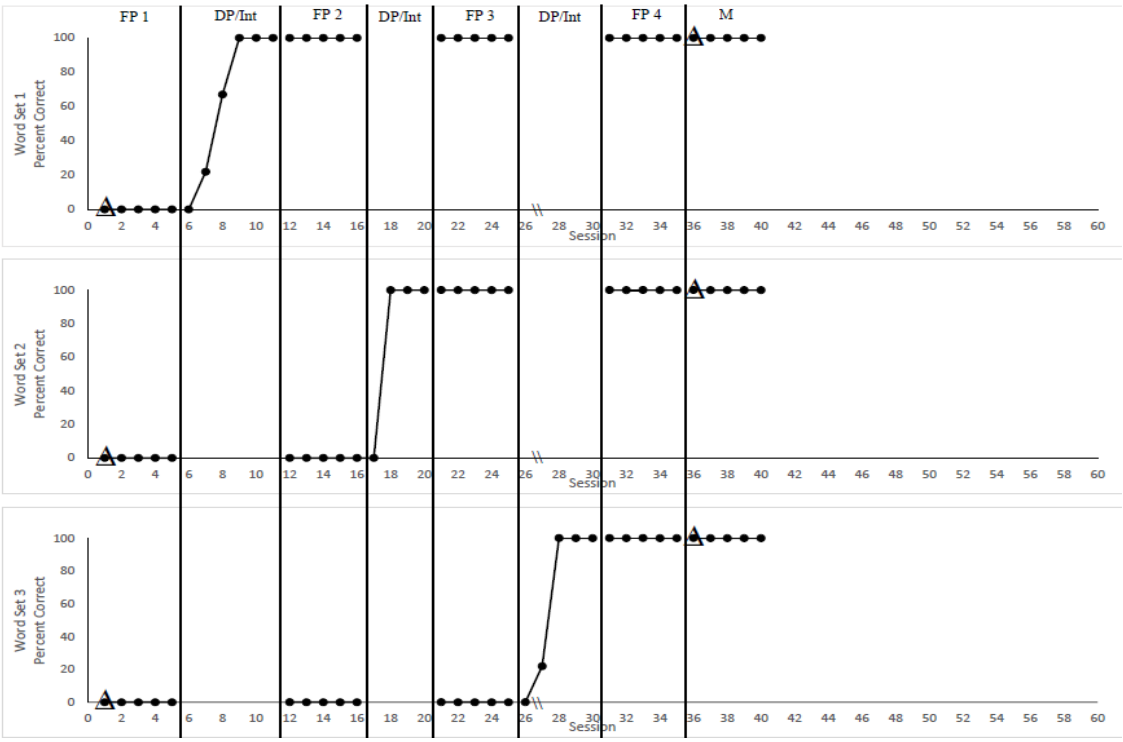

Figure 3. Results Graph- Yani. Percentage of sight words correct during probe sessions. Δ represents generalization.

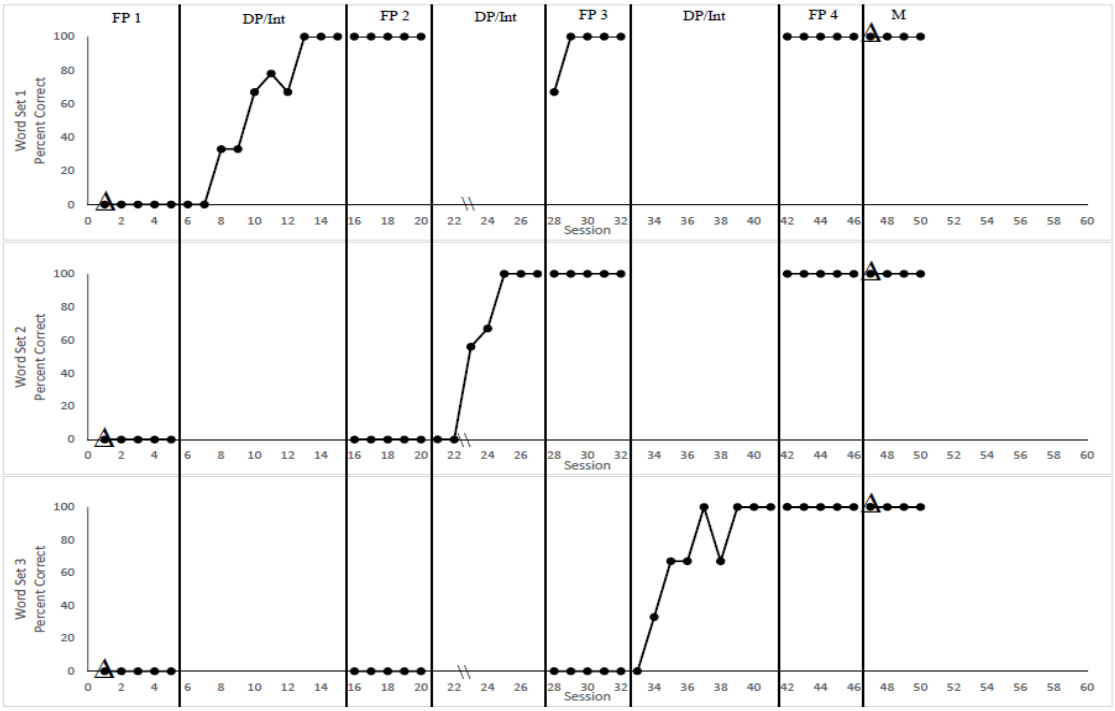

Figure 4. Results Graph- Jeremy. Percentage of sight words correct during probe sessions. Δ represents generalization.

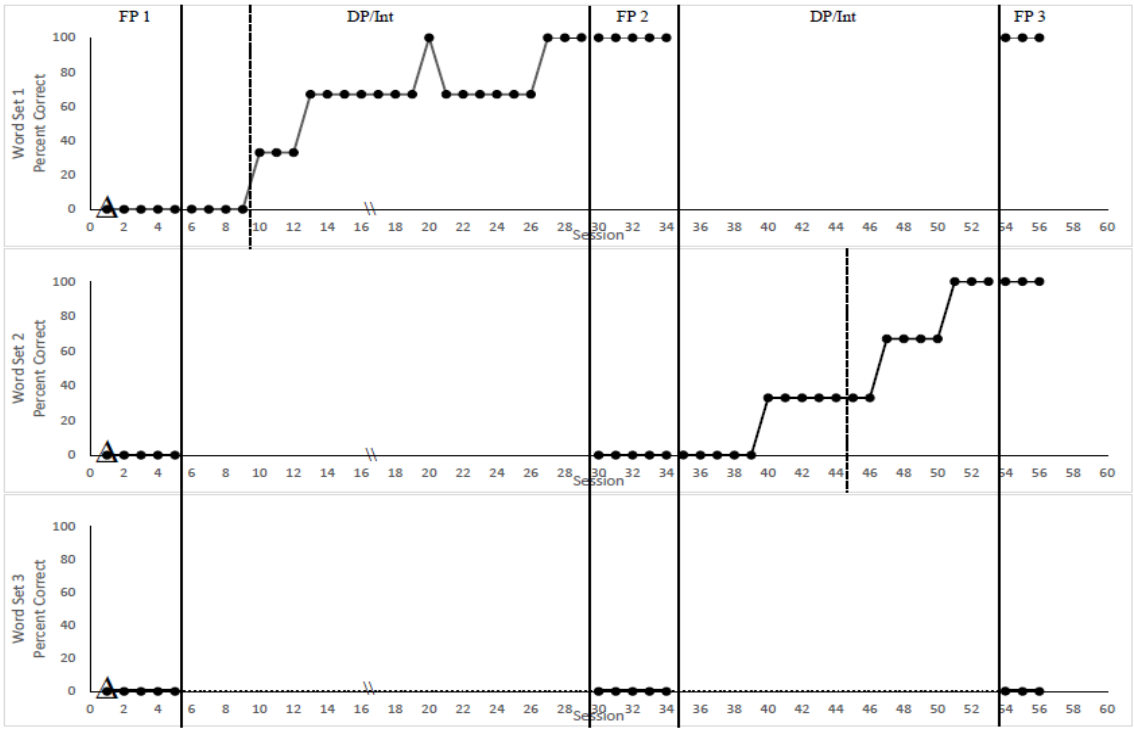

Figure 5. Results Graph- Lexie. Percentage of sight words correct during probe sessions. Δ represents generalization.

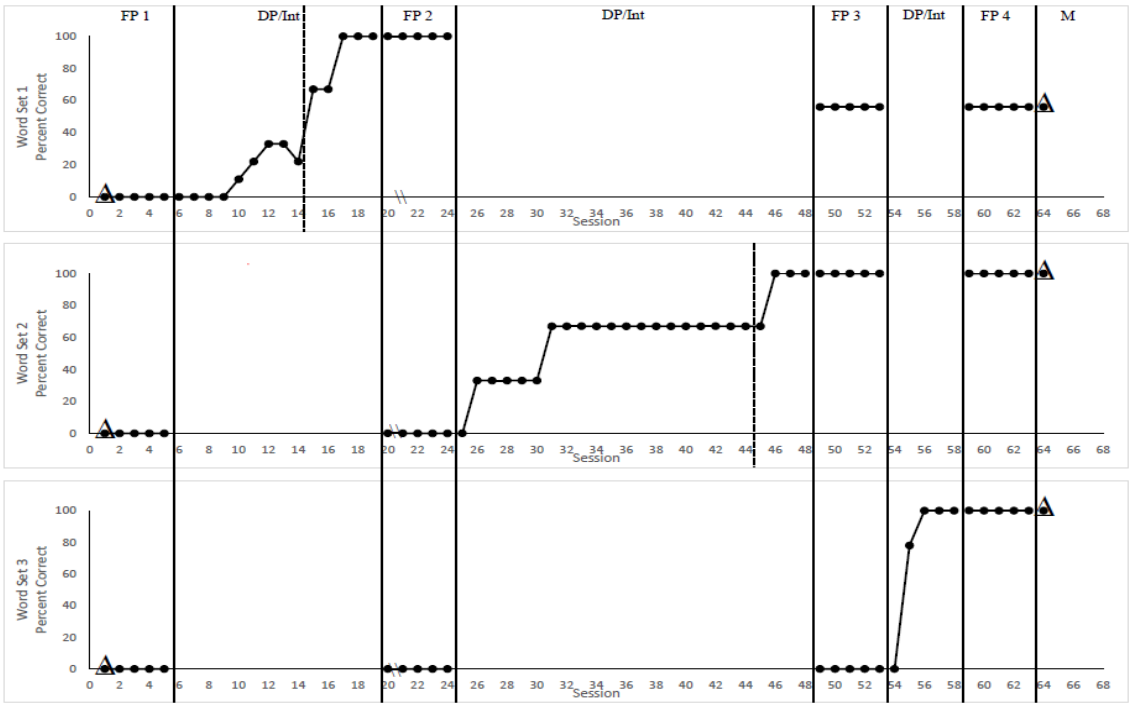

Figure 6. Results Graph- Gabe. Percentage of sight words correct during probe sessions. Δ represents generalization.

Section 5: Discussion

The purpose of this study was to determine if an iPad app using the simultaneous prompting procedures could teach sight words to four students with developmental disabilities. Results from this study showed as the procedures were written the iPad app was effective as planned for 2 students and with modifications was effective for 2 students. A functional relation was shown with Yani and Jerome because their responding was at 0% until the intervention was implemented then there was an increase in responding which occurred across all 3 tiers. Prior to the study, the students had no prior experience using an iPad to work on sight words, but did have experience with the simultaneous prompting from direct instruction from a teacher. This study also produced high rates of IOA and reliability with 100% agreement and accuracy for at least 20% of all sessions across all students and condition.

This study provided additional evidence that students may learn new skills with computer aided instruction without direct instruction from the teacher. Since this study was set up with a verbal and model prompt provided by an app on a mobile device, it was effective from exposure to the app plus reinforcement for correct responses from the researcher in daily probe sessions. This is important since most students have time in the school day where they have to work independently and many students struggle to stay on task during these independent work periods (Flower, 2014) so it is important to know if these students are staying on task and learning during independent work time. This study is also unique because the iPad app was providing the verbal and model prompt. Typically, when simultaneous prompting is delivered by a teacher, students are required to repeat or imitate the response in training sessions. However, in this study, students

were not required to repeat the response in order to advance on to the next trial and data were not collected on their responding during training sessions. Also, during simultaneous prompting there is a simultaneous prompt then feedback during training sessions, but in this study there was a simultaneous prompt but no feedback, therefore it was exposure to a model of the stimulus and prompt. Anecdotal notes from the study show that students did not typically if at all repeat or imitate the words during training sessions but still learned sight words.

Data showed variability in the number of sessions students required to reach criterion on word sets. Overall, three students were able to reach criterion on all three word sets, and one student was able to reach criterion on two word sets. Due to the school year ending, there were no other sessions conducted to see if the student would have reached criterion on the last word set and if she would have maintained the other words she previously mastered. Historical data, prior to using the iPad app, showed that these procedures were about two times more effective in teaching sight words to two of the students, than handwritten words with teacher directed simultaneous prompting. For example, Jeremy had learned 10 sight words in 48 sessions when teacher-directed procedures were used, but with the app he learned 9 words in 26 sessions. Yasin had learned 10 words in 28 sessions when teacher directed procedures were used, but with the app he learned 9 words in 15 sessions.

Another consideration of the data is the errors that students made during the course of the study. Because probe trials occurred daily, this provided the opportunity to make errors, even though the probe trials are not technically considered instruction. Across all tiers, students had a range of 30%-34% errors during daily probe sessions.

Typically, with systematic instruction is preferred to have error rates less than 20%. So an error rate this high is concerning. If another instructional strategy had been used in which daily probes were not required, the percentage of errors may have been lower. However, despite the error rate, the iPad app with a systematic instructional teaching procedure built in, was effective in teaching sight words to four students with developmental disabilities working independently in a resource setting.

Practical Implications

This study provided evidence that students can learn independently using CAI and this could be helpful to classroom teachers who have multiple students and large caseloads. It allows classroom teachers to work with other students while other students are working and learning independently on the app. It also allows students to gain independent work skills on academic tasks while making progress. If students get upset or display challenging behaviors when they make errors, this procedure might not be appropriate since with this procedure there was high levels of student error.

This study was conducted by the researcher who was also the classroom teacher, so this study can be translated to real-life settings for teachers and students in the classroom. Also, there are a lot of apps and teachers can evaluate the quality of the apps by determining if it incorporates systematic instructional principles/methods then using these apps to teach other**.** It would be beneficial for teachers to review their data after a school week, then make modifications if necessary. Also, it may be beneficial to lessen the number of probes provided over the course of the study, such as probe every other day or session instead of every day or session.

Limitations

A limitation of this study it that since the daily probe sessions were teacher directed, the instruction is really a combination of the app and reinforcement for correct responses during probes. So the data does not show how the students would have responded to the app alone without the daily probes. There was no fidelity taken on responding during training sessions or for off task behavior. The observer recorded the number of researcher redirects per student and data shows that the two students that required redirects, were also the students who one was unable to meet criterion on all three sets of words and the other student was unable to reach maintenance and did not maintained all words previously learned. The experimental design could be strengthened by intermittently probing untreated behaviors in between the probe conditions.

Future Research

Future research could involve additional use of apps to teach students with disabilities academics as well as more research identifying apps that use systematic instruction. Also, future research would be providing antecedent and consequence for the responding during full probe and training sessions. Researchers should analyze and evaluate apps for systematic instruction embedded in the app.

Appendix A: Full Probe Data Sheet

Student: _____ Instructor: _____

+ correct - incorrect O no response

Dates										
Session #										
# Correct										
# Possible										
% Correct										

Appendix B: Daily Probe Data Sheet

Student: _____ Instructor: _____

+ correct - incorrect O no response

Date										
Session #										
Begin and End Time										
#correct										
#possible										

Appendix C: Full Probe Reliability Data Sheet

Baseline/Full Probe Session
Reliability Data Sheet
Procedural Fidelity and Interobserver Reliability

Student: _____ Instructor: _____
Date: _____ Session #:_____

Instructional Materials Prepared: Yes No

Attentional Cue Prior to Session: Yes No

Choice board presented before: Yes No

Provides reinforcer at end: Yes No

Stimulus	Task Direction	Wait Time	Student Response

Stimulus	Task Direction	Wait Time	Student Response
Summary Data			
Procedural Fidelity # observed/total planned x 100			
IOA # agree/ # agree + disagree x 100			

Appendix D: Daily Probe Reliability Data Sheet

Daily Probe Session Reliability Data Sheet
Procedural Fidelity and Interobserver Reliability

Student: _____ Instructor: _____ Date: _____ Session #:_____

Instructional Materials Prepared: Yes No Attentional Cue Prior to Session: Yes No

Choice board presented before: Yes No Provides reinforcer at end of session: Yes No

Trial	Stimulus	Task Direction	Wait Time	Student Response	Consequence	
					Praise	Ignore
1						
2						
3						
4						
5						
6						
7						
8						
9						
Summary Data						
Procedural Fidelity # observed/ total planned x 100						
IOA # agreements / # agree + disagree x 100						

Appendix E: Training Session Reliability Data Sheet

Training Session Reliability Data Sheet
Procedural Fidelity and Interobserver Reliability

Student name: _____ Instructor: _____

Date: _____ Session #: _____

Instructional Materials Prepared: Yes No Attentional Cue Prior to Session: Yes No

Stimulus set	Choice Board	Ensures Attention	Task Direction	Set timer- 1 min	Reinforcer at end	Redirected student if off task (+ redirected - No redirection)
1 2 3						
Summary Data						
Procedural Fidelity # observed/ total planned x 100						

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