Applying Systematic Instruction to Teach ELA Skills Using Fictional Novels via an iPad App

Pamela J. Mims, PhD[1], Carol Stanger, MS[2], Julie A. Sears, MEd[1], and Wendee B. White, MEd[3]

Abstract

Increasingly, researchers have successfully identified strategies to promote comprehension to students who are nonreaders. Further research is needed to replicate these promising results. In the current study, we used a multiple probe across participants design to evaluate the effectiveness of an iPad app, which incorporates evidence-based practices such as constant time delay and system of least prompts, on the acquisition of targeted vocabulary and comprehension of four middle school students with significant intellectual and developmental disability (SIDD). Findings suggest that the intervention resulted in improved performance across all participants and that some generalization and maintenance of skills was seen. Limitations and implications for practice and future research are discussed.

Keywords

Current expectations have challenged teachers to better prepare students with significant intellectual and developmental disability (SIDD) for success in their postschool lives by helping them to excel within the general curriculum, including English/Language Arts (ELA; National Governors Association [NGA], 2010). State standards in ELA require students to access and understand a variety of texts encountered in daily life as well as to develop skills in writing, research, and communication. Unfortunately, the research literature has not caught up to current curricular requirements for students with SIDD. Literature in the field has highlighted several factors such as low academic expectations and poor quality or even the absence of instruction (Erickson, Hanser, Hatch, & Sandars, 2009; Katims, 2000; Kliewer & Biklen, 2001). In addition, much of the literature on literacy instruction for this population has narrowly focused on sight word instruction (Browder, Wakeman, Spooner, Ahlgrim-Delzell, & Algozzine, 2006), yet sight word instruction has little impact on comprehension.

Teaching comprehension requires higher order thinking skills. In the 1950s, Bloom (1956) classified educational goals and the idea of the taxonomy as the complexity of skills moving up the hierarchy for student skill building. Anderson et al. (2001) revised Bloom's taxonomy to modernize educational objectives by re-coining terms from nouns to active verbs and reversing the order of the two highest levels (i.e., remembering, understanding, applying, analyzing, evaluating, and creating). For example, under

evaluating, they focused on verbs that describe outcomes (e.g., appraise, argue, defend, judge, select, support, value, and evaluate). Despite these changes, there has been little intervention research for students with disabilities addressing targets beyond the basic levels of understanding in Bloom's Revised Taxonomy (Anderson et al., 2001).

In 2004, Al Otaiba and Hosp reviewed the literature on effective reading instruction and found that researchers primarily have targeted sight word retention, phonemic decoding, and phonological awareness. While one research team investigated the integration of phonics and basal reading instruction, they found no studies that addressed fluency, vocabulary, or reading comprehension (Al Otaiba & Hosp, 2004; Coyne, Pisha, Dalton, Zeph, & Smith, 2010). A few years later, Browder and her team (2006) completed a framework analysis of 128 studies on teaching reading to a student with moderate to severe intellectual disabilities. The vast majority of the studies examined only one or two areas of literacy instruction and more than two thirds examined

[1]East Tennessee State University, Johnson City, USA
[2]Attainment Company, Lagunitas, CA, USA
[3]University of Dundee, Scotland, UK

Corresponding Author:
Pamela J. Mims, Department of Education Foundations and Special Education, East Tennessee State University, Office 320, Box 70548, 807 University Pkwy., Johnson City, TN 37614, USA.
Email: mimspj@etsu.edu

the teaching of sight words with an emphasis on functional words.

Over the past several years, researchers have increased their focus on the Revised Bloom's Taxonomy (Anderson et al., 2001) level of comprehension and other higher order of thinking skills for ELA and are now beginning to apply comprehensive approaches to literacy for students with SIDD (Browder, Gibbs, Ahlgrim-Delzell, Courtade, & Lee, 2007). In 2012, Mims, Hudson, and Browder used a read aloud approach to teach middle school students with moderate to severe disabilities to respond to WH (e.g., WHAT, HOW) questions after reading adapted grade-aligned biographies. During instruction, the researchers used a modified system of least prompts (SLP) and a graphic organizer to facilitate accurate responding. They used a single case multiple probe across participants design to investigate the effects of the intervention. Results indicated that all the students increased the number of correct responses to WH-questions and maintained their knowledge over time.

While Mims, Hudson, and Browder (2012) focused on teaching WH-questions, Mims, Lee, Browder, Zakas, and Flynn (2012) implemented a more comprehensive approach to teaching grade-aligned ELA with a heavy focus on comprehension across the entire Bloom's Taxonomy. Using a one group, nonrandomized, pre- and post-test design with 15 middle school students with SIDD, they found that scripted lessons featuring systematic and direct instruction (i.e., SLP, model-lead test) led to gains in comprehension (e.g., literal recall, inferential, sequencing, story grammar, and synthesis) across genres of text, as well as gains in vocabulary, student-led research skills, and opinion writing skills.

In an attempt to replicate the above results using a more robust design, researchers examined the effects of a scripted curriculum, which included systematic and direct instruction, on a wide range of grade-aligned ELA skills, including comprehension. Specifically, they replicated the study with 30 students with SIDD using a nonequivalent group research design with a pre–post test (Lee, Mims, Browder, & Ahlgrim-Delzell, 2018). Students were assessed using two pre- and post-tests. One assessment was a curriculum-based measure which featured familiar texts from the curriculum. The second assessment was a generalization measure which featured unfamiliar text but measured the same type of skills taught throughout the curriculum (e.g., comprehension, writing, student-led research). Significant effects were found for both the direct and generalization measures in comprehension as well as other targeted skill areas (e.g., vocabulary, student-led research skills, opinion writing skills).

Special educators of students with SIDD are at a disadvantage as professional development targeting strategies to provide grade-aligned instruction is relatively new (Browder et al., 2012). Rural special educators have even more difficulty as the availability of professional development in general is lacking (Suppo & Mayton, 2014). In addition, many rural special educators report concerns regarding the lack of access to appropriate materials. To mitigate these concerns of appropriately training teachers of students with SIDD and providing meaningful materials, especially those in rural environments, technology-based supports offer teachers a plausible option for providing meaningful instruction and supports (Jimenez, Mims, & Baker, 2016).

Recently, researchers have used technology during the instruction of grade-aligned academics for students with SIDD. For example, Baxter and Mims (2018) used single case multiple probe across participants design to investigate the effects of an iPad app featuring embedded systematic instruction (e.g., SLP) and adapted grade-aligned nonfiction stories on the acquisition of comprehension and targeted vocabulary by three students with SIDD. Results showed a functional relation between the app featuring systematic instruction and listening comprehension (e.g., literal recall, inference, three-step sequence, application, analysis, prediction, main idea, main character, setting, problem, and solution) of the targeted students. Similarly, Spooner, Kemp-Inman, Ahlgirm-Delzell, Wood, and Davis (2015) investigated the effects of using an iPad paired with systematic instruction on listening comprehension skills with the use of shared stories for five students with SIDD. They also reported a functional relation between the use of the iPad and systematic instruction and listening comprehension.

Although several studies have focused on effective strategies to promote listening comprehension of grade-aligned text for students with SIDD, to date, few studies have been conducted to examine the effects of mobile technology (e.g., iPads) on listening comprehension. The purpose of the current study was to investigate the effects of an iPad application with embedded systematic instruction and read aloud approach of grade-aligned adapted fictional novels on ELA skills with middle school students, with SIDD in rural settings. Specifically, the following research questions were targeted:

> **Research Question 1:** What was the effect of the iPad ELA app, *Access: Language Arts* (Attainment Company, 2016), with embedded read aloud of grade level adapted fiction stories and systematic instruction on student's targeted ELA skills?
>
> **Research Question 2:** What was the effect of the iPad ELA app (*Access: Language Arts*) on overall student engagement?

Method

Participants and Setting

Four students, ages 9 to 12 years old, participated in the study. All students were from a self-contained classroom

Table 1. Study Participant Demographics.

Student/ethnicity/gender	Age/grade	Test given/IQ	Verbal ability	Disability	Reading
1/Caucasian/Female	12 years/Grade 7	WISC-IV/IQ < 40	Conversational	CP, Retts, Seizures, SID	Pre-K
2/Caucasian/Male	12 years/Grade 7	WISC-IV/IQ < 40	Conversational	SID	K
3/Caucasian/Female	9 years/Grade 5	WISC-IV/IQ = 50	Conversational	SID	Non-reader
4/Caucasian/Male	11 years/Grade 6	RAIS/IQ < 40	Extremely limited phrases	SID/Autism	Non-reader

Note. WISC = *Wechsler Intelligence Scale for Children*; IQ = intelligence quotient; CP = cerebral palsy; SID = significant intellectual disability.

which served students with significant intellectual disability (SID). The inclusion criteria included the following: (a) use of sight words or symbol reading repertoire, (b) a diagnosis or educational eligibility of moderate to profound intellectual disability or autism, (c) ability to make selections from an array on the iPad, (d) available for the study 3 times a week, (e) in Grades 5 to 8, and (g) participating in their states alternate assessment based on alternate achievement standards. See Table 1 for student demographics.

Student 1 was a 12-year-old Caucasian female in the seventh grade. She was identified as having a SID, cerebral palsy, seizures, and Rett syndrome. She was conversational and recognized some sight words and had little to no exposure to grade-aligned text or ELA instruction. Student 2 was a 12-year-old Caucasian male in the seventh grade. He was identified as having a SID. He was conversational and recognized some sight words and had little to no exposure to grade-aligned text or ELA instruction. Student 3 was 9-year-old Caucasian female in the fifth grade. She was identified as having a SID. She also was conversational and recognized some sight words but had little to no exposure to grade-aligned text or ELA instruction. Student 4 was an 11-year-old Caucasian male in the sixth grade. He was identified as having autism and SID. He had limited conversation skills and little to no exposure to grade-aligned text or ELA instruction.

We conducted the study in two rural public middle schools in southeastern United States. Individual sessions took place in a quiet setting away from the other students in the classroom to provide for control of overexposure to the other students. Sessions occurred, at minimum, 3 times per week and lasted approximately 40 min per session.

Two teachers served as interventionists for the study. At the time of the study, the teacher for Student 4 had a master's degree in special education with a focus on severe disabilities. She had been teaching for 1 year in a classroom for students with moderate to profound, multiple disabilities and/or autism. She typically used direct, systematic instruction in a one to one format to teach targeted ELA skills for about 20 min daily and also delivered small group instruction using Unique Learning Systems curriculum for 30 min daily. Before this study, she did not use middle grade texts for her students. The teacher for the other participating students had also held a master's degree in special education. She had been teaching for 14 years in classrooms for students with challenging behavior, resource classrooms, and her current placement which was a classroom for students with moderate to profound intellectual disability and/or autism. She reported teaching ELA for about 2 hr a day using whatever supports she could find. The teachers were trained to conduct the baseline and intervention procedures by the principal investigator and the grant research associate.

Research Design

A multiple probe across participants single case design (Gast & Ledford, 2010) was used to evaluate the efficacy of the comprehension intervention. Study phases included baseline, intervention, generalization, and maintenance. The teachers conducted at least three baseline sessions for each participant on a chapter pair prior to entering intervention. Once data were stable for the first participant, we introduced intervention and collected data across the remaining story chapters. Once a change was observed for the first participant, we probed remaining participants in baseline to ensure data were still low and stable or descending. The next participant with low and stable or descending data entered the intervention. This same process continued until all participants received intervention. We collected and graphed data on the percentage of unprompted correct responses across baseline, intervention, generalization, and maintenance sessions.

The investigators also assessed whether as a result of intervention, students began new lessons with higher levels of accuracy in answering comprehension questions. To assess this, generalization probes of chapter pairs were conducted prior to students entering the intervention phase with a new chapter pair. These probes indicated the number of correct unprompted responses to vocabulary and comprehension questions for the next chapter pair to be (see Figure 1).
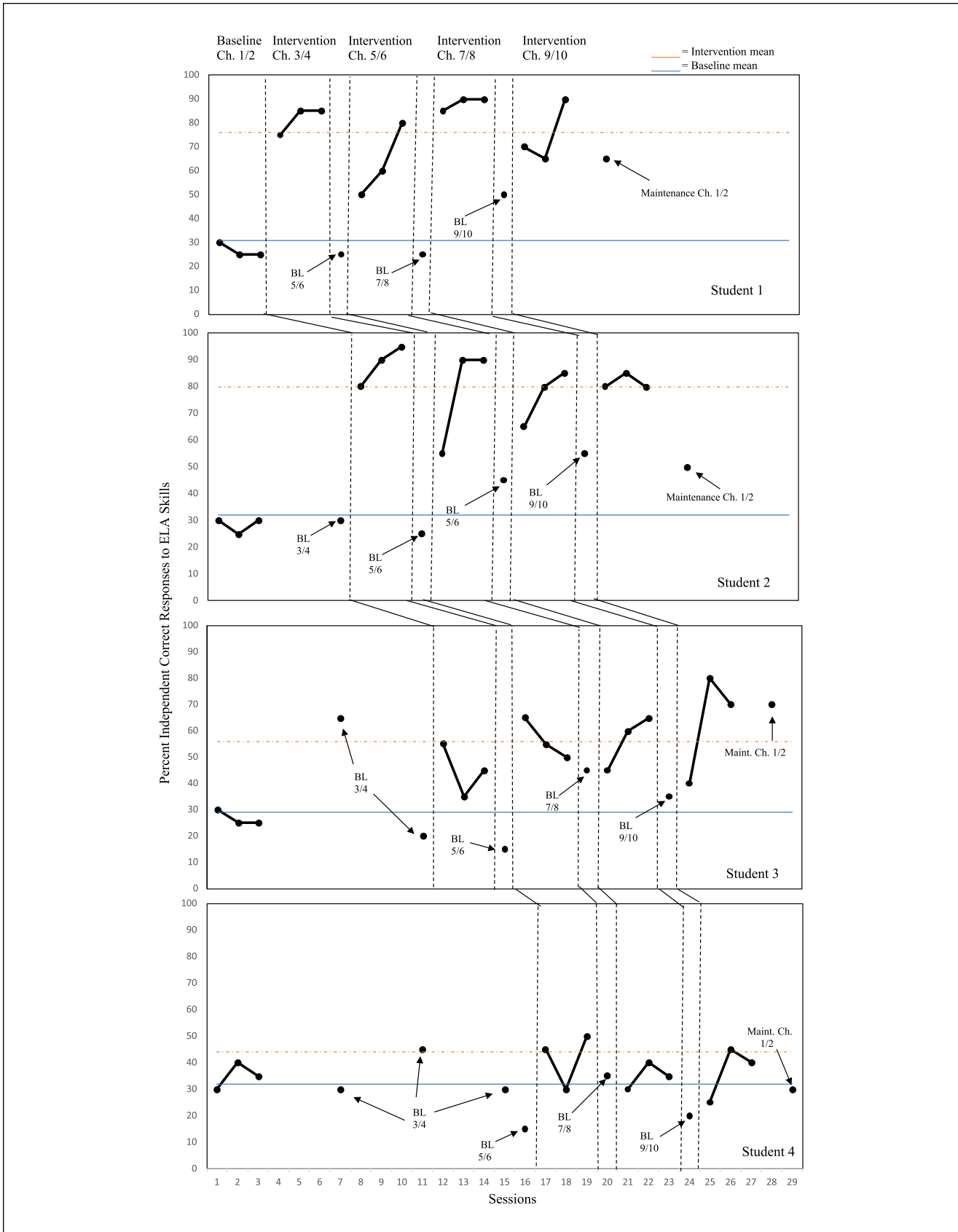
Figure 1. Percentage of unprompted correct responses to vocabulary and comprehension questions.

Materials

Two versions of an iPad app were created for the study by Attainment Company: a baseline version and intervention version (*Access: Language Arts*). Both reflected an adapted version of *Outsiders*, a fictional novel often targeted in Middle School ELA. The selected text also was pulled from the validated *Teaching to Standards: ELA* curriculum (Mims, Lee, Zakas, & Browder, 2013). The text was adapted for nonreaders by summarizing text using controlled vocabulary, reducing the overall Lexile level to a second to third grade reading level, and pairing keywords with picture symbols. The adapted chapter pairs were short enough to be read entirely in one teaching session. Vocabulary and comprehension questions, including prediction questions, were established and validated by a content expert for each chapter pair and included in the application. The text in the intervention version of the app was preprogrammed to be read aloud by a female human voice and presented with highlighted text as it was read aloud. Furthermore, it included underlined vocabulary words that could be touched to present a recorded verbal definition and a repeated storyline that summarized the main idea of the chapter (read aloud by a human male voice). The baseline version of the app was a Text to Speech (TTS) read aloud and did not contain the highlighting as the words were read or the underlined definitions.

Students responded to questions (i.e., word identification, vocabulary definition, comprehension) that were built in to the application by selecting one of three response options. Response options included a combination of picture symbols and words. Each comprehension question included a correct response and two plausible distracters (e.g., if the question asked to identify a person, all response options were people). Both the target and distracter options contained picture symbols and corresponding text (e.g., the text "Pony Boy" along with a picture of Pony Boy). The position of the response options was randomized by the app so that students did not memorize placement of correct answers. The student response features were identical for both baseline and intervention versions of the app, except the baseline version did not include any picture supports.

In the intervention version of the app, systematic instructional strategies were programmed into the application to deliver instruction as needed throughout the sessions. Constant time delay (CTD) was built in to teach vocabulary identification and definitions and included two rounds of 0-s delay trials followed by one round of 5-s delay trials for each word presented. This also occurred for the definitions. The SLP was applied to the app to teach comprehension. For example, when asked the literal recall questions and presented with three response options, the student would indicate a response by selecting one of the response options. If the student could not remember the answer and wanted to

look back at the text, a "hint" button was available which took them back to the page containing or alluding to the answer (if the question was inferential, the app took the student back to the page that discussed the content with which the student could glean the answer). The application read the page aloud and then returned the student to the question page, so they could indicate their response. If the student chose the wrong answer, the app automatically returned to targeted text page, re-read the page, and then returned to the comprehension question page where the initially selected incorrect response option was grayed out and could not be selected again. The question was restated and the remaining response options were presented. The process was repeated until the student selected the correct answer.

In addition to the SLP and CTD, the app also provided error correction and positive feedback. Error correction occurred by graying out a selected incorrect response. Feedback was provided when the student selected the correct answer. This included various specific praise statements (e.g., "Good job. The main character for these chapters was Pony boy."), and the app automatically moved on to the next question. To facilitate students' understanding of story grammar (i.e., main character, setting, problem, solution, main idea), before the question would be read aloud, the definition would be provided. For example, the main character question page would appear and the app would state, "A main character is the most important person in our chapter," followed by the question, "Who is the main character in these chapters?" Finally, data were collected by the application and emailed out to the teacher and researchers upon completion of each intervention session.

Dependent Variable and Data Collection Procedures

The dependent variable was the percentage of unprompted correct responses to ELA tasks (i.e., vocabulary identification, definition matching, comprehension questions). A prompted correct response was defined as the participant touching a corresponding cell within an array displayed on the app within 5 s. For each chapter pair, data were collected on the participants' identification of four target words and their definitions. In addition, we collected data on their responses to comprehension questions in the following areas: (a) literal recall, (b) inferential, (c) three-step sequence (identification for each step of the sequence was assessed separately), (d) application, (e) analysis, (f) main idea, (g) main character, (h) setting, (i) problem, and (j) solution. We also collected data on participants' responses to a request to make a prediction about the story. We scored a prediction response only as occurring or not occurring, as participants could emit a range of correct responses. We graphed data depicting the number of unprompted correct

responses during vocabulary and definition tasks, and to comprehension questions (with the exception of making a prediction). During baseline sessions, the teacher conducted vocabulary and definition identification probes, and asked comprehension questions via the baseline version of the app. The teachers scored student responses on a paper data sheet as they used the app.

During intervention sessions, the application was programmed to collect data during vocabulary, definition, and comprehension probes. It recorded the level of prompting emitted prior to students' selection of the correct answer. Graphed data only reflected the independent unprompted correct responses.

Maintenance. Maintenance data were collected at least 2 weeks after the intervention was completed. During maintenance conditions, we used procedures identical to those during baseline sessions. The students repeated a session for *Outsiders*, Chapter 1 and 2.

Generalization. Generalization of learned skills were measured during the introduction of new chapter pairs. Generalization probes followed the same procedures as baseline sessions.

Social validity. Teacher opinions of *Access: Language Arts II* was obtained by conducting a social validity measure. The classroom teachers (both interventionists) completed a social validity form for each student after the study was complete. Using a 5-point Likert-type scale, they indicated the level of agreement or disagreement with 16 statements by circling one of five responses: (a) 5 = *strongly agree*, (b) 4 = *agree*, (c) 3 = *neutral*, (d) 2 = *disagree*, and (e) 1 = *strongly disagree*. Statements measured perception related to both study procedures (e.g., the SLP via the iPad is appropriate for the student) and outcomes (e.g., the adapted texts helped access the general curriculum for this student). In addition, open-ended questions were asked to both teachers to get a better idea of procedures and outcomes.

Engagement. Data also were collected on the overall level of each student's engagement during the intervention sessions. Students' level of engagement was rated by the teacher immediately following instructional sessions and by the graduate research assistant after observations. They rated the students using the following scale: (a) 1 = does not participate at all (e.g., does not look at/in the direction of the iPad); (b) 2 = passively participates (e.g., looks at the iPad or teacher as they respond, but makes no attempt to respond to teacher directions or iPad application directions without assistance); (c) 3 = occasionally participates (e.g., looks at the iPad or teacher as they respond and makes attempts to respond less than half of the questions asked); (d) 4 = usually participates (e.g., looks at the iPad or teacher as they

respond and makes attempts to respond 50% to 75% of the questions asked); (e) 5 = actively participates most of the time (e.g., looks at the iPad or teacher as they respond and makes attempts to respond to more than 75% of the questions asked); and (f) 6 = actively participates all of the time (e.g., looks at the iPad or teacher as they respond and makes attempts to respond to all questions asked).

Interobserver agreement (IOA) and procedural fidelity (PF). A trained second observer (i.e., graduate research assistant) calculated IOA on the number of correct student response data for 32% of the baseline and intervention sessions. IOA was calculated by taking the number of agreements divided by the number of agreements plus disagreements and multiplying by 100. IOA for baseline and intervention sessions was 99% (range = 87%–100%).

The same graduate research assistant scored 64.5% of baseline sessions and 29.75% of intervention sessions using a PF checklist. We calculated PF by dividing the number of steps delivered correctly by the total number of procedural steps and multiplied by 100. PF for baseline and intervention sessions was 96% (range= 78%–100%).

In addition, IOA of the PF checks were evaluated for 41% of the baseline and intervention sessions. Scoring by the lead research associate was compared with the original scoring by the graduate research assistant using an item-by-item method to obtain the percentage of agreement. IOA of PF was 95.35% (range = 89%–100%).

Procedures

Baseline. The teacher and students sat side-by-side at a table during all sessions. The iPad was installed with a baseline version of the app which provided a TTS read aloud of the adapted chapter book with no prompting, praise, or error corrections. The teacher first introduced the targeted lesson and told the students they were going to read (or continue reading) the book *The Outsiders*. The teacher proceeded by opening up the app with the adapted chapter book, read aloud the title and author, and selected the targeted chapters to be read. Before reading, the teacher provided the student with a short "story walk" where the app presented 5 pages of the text to be read to the student for a duration of 5 s per page. The teacher then read the prediction question (e.g., "What do you think these chapters are going to be about?") and three response options. The teacher waited 5 s for the student to respond. The teacher recorded the data based on the student response and moved on to the read aloud of the targeted chapters. The teacher delivered intermittent attentional prompts (e.g., "Look here." while pointing to the story on the iPad) and praise (e.g., "Good job reading along.") to help the student stay on task while they progressed through the chapter text with TTS read aloud. At the end of the story, the student pushed the test button and

was probed on all vocabulary and comprehension questions. The vocabulary probe consisted of four targeted word cards from the chapter pair being placed in a 2 × 2 array presented via the app. The app asked the student to touch the targeted work and waited 5 s before shuffling the cards (for the cards to be presented in a random order) and asked them to identify the next word. This continued until request to identify all four words had been presented. The app used the same procedures that occurred during the definition of identification probe. The four targeted words appeared in a random 2 × 2 display and the app asked the student to identify the word that matched a given definition. Again, the app waited 5 s before shuffling and moving on to the next definition. The teacher recorded each student response on a data sheet. The teacher continued until all four words had been assessed in both identification and definition task. The app then presented comprehension questions. After a question was asked and the response options were read aloud by the app, the student had the opportunity to select an answer from an array of three response options (i.e., the correct answer, a close distractor, a highly disparate distractor). The teacher looked expectantly at student and waited 5 s for a response. Neither the teacher nor the app prompted or praised student responses, although general verbal praise was given for on-task behaviors (e.g., looking at the story, sitting with hands to themselves).

Intervention. When progressing through the app, the students first selected the targeted story chapters. Professional narration read the title and author of the story aloud to the student. Next, vocabulary instruction was provided for the targeted story using CTD. After vocabulary instruction, the student previewed the story. The preview was a short "story walk" where the first page of every chapter and the last page (5 pages total) were shown to the student for approximately 5 s per page, followed by a prediction question (i.e., "What do you think this story is going to be about?") and three response options. A correct answer was not given; instead, the app continued by saying "You think the story is going to be about [fill in student response]. Let's find out." After prediction, the story was read aloud to the student by professional narration, highlighting word by word as it was read. In addition, key vocabulary words were underlined in the text. If the student touched the vocabulary word, the definition was shown and read aloud. Students moved through each page of the story by selecting the "turn page" button at the bottom, right hand corner of the iPad screen. Once finished with the reading, the app reviewed the prediction question and prompted the student to the correct answer (i.e., most plausible). The app then initiated a vocabulary probe that targeted word and definition identification. After the vocabulary probe, the app progressed through the comprehension and story grammar questions (i.e., literal recall, inferential, three-step sequence, main idea, application,

analysis, main character, setting, problem, solution). Students were presented with the same chapter pair for three consecutive sessions. The teachers then presented a single baseline probe on the next chapter pair before entering intervention with that chapter pair. These probes were conducted to assess whether students had generalized their comprehension skills to untrained chapter content.

Data Analysis

We graphed the number of correct unprompted responses across baseline and interventions sessions. Data were analyzed by visually inspecting graphed data to identify trend, level, and variability within and across conditions and to determine if a functional relation existed between the independent and dependent variables.

Results

Figure 1 provides the percentage of correct responses to vocabulary and comprehension questions during baseline and intervention sessions. Student 1's performance was stable during baseline sessions with a mean of 26.6% correct (range = 25%–30%). During intervention, she immediately increased her performance to 81.6% correct (range = 75%–85%) on Chapters 3 and 4. When probed for generalization on Chapters 5 and 6, Student 1's performance decreased to 25% correct which indicated that she had yet to generalize skills to untrained content. During intervention on Chapters 5 and 6, she again increased her mean percent correct to 63% correct (range = 50%–80%). When probed for generalization on Chapters 7 and 8, she again decreased to 25% correct. During intervention on Chapters 7 and 8, Student 1 increased again to a mean percent correct of 88% (range = 85%–90%). For her final generalization probe on Chapters 9 and 10, she scored 50% correct indicating some generalization. During intervention on Chapters 9 and 10, she scored a mean of 75% correct (65%–90%). For her final maintenance data point, she scored 65% correct indicating she was able to generalize learned skills to Chapters 1 and 2 as well as maintain her scores over time. Overall, Student 1 had an increase from a baseline mean of 26% correct to an intervention mean of 77% correct.

Student 2 data were stable during baseline sessions with a mean of 28.75% correct (three probes in Chapters 1 and 2 and one probe in Chapters 3 and 4; see Figure 1). During intervention in Chapters 3 and 4, he immediately increased to a mean of 88% correct (range = 80%–95%). When probed for generalization on Chapters 5 and 6, Student 2's performance decreased to 25% correct which indicated that he had yet to generalize skills to untrained content. During intervention on Chapters 5 and 6, he again increased his mean percent correct to 78% correct (range = 55%–90%). When probed for generalization on Chapters 7 and 8, he

scored 45% correct, indicating generalization of some skills to untrained content. During intervention on Chapters 7 and 8, Student 2 increased again to a mean percent correct of 77% (range = 65%–85%). For his final generalization probe on Chapters 9 and 10, he scored 55% correct indicating further generalization. During intervention on Chapters 9 and 10, he scored a mean of 82% correct (range = 80%–85%). For his final maintenance datum point, he scored 50% correct indicating he was able to generalize some learned skills to Chapters 1 and 2, but that his maintenance performance was not as strong. Overall, Student 2 had an increase from a baseline mean of 28.75% correct to an intervention mean of 81.25% correct.

Student 3 initially had stable baseline data (*M* = 26.6%; range = 25%–30%), but when probed on Chapters 3 and 4, after Student 1 indicated jump in level and trend, Student 3 scored 65% correct. Researchers decided to delay the introduction of intervention and probe in Chapters 3 and 4, when Student 2 indicated a change in level and trend. After this occurred (when Student 2 entered intervention), Student 3 was probed and decrease performance to 20% correct. Researchers decided to start intervention on Chapters 3 and 4. During intervention in Chapters 3 and 4, she immediately increased performance to a mean of 45% correct (range = 35%–55%). When probed for generalization on Chapters 5 and 6, Student 3 decreased her performance to 15% correct which indicated that she had yet to generalize skills to untrained content. During intervention on Chapters 5 and 6, she again increased her mean percent correct to 57% correct (range = 50%–65%). When probed for generalization on chapter 7 and 8, she scored 45% correct. During intervention on chapter 7 and 8, student 3 increased again to a mean percent correct to 57% (range = 45%–65%). For her final generalization probe on Chapters 9 and 10, she scored 35%. During intervention on Chapters 9 and 10, she scored a mean of 63% correct (40%–80%). For her final maintenance data point, she scored 70% correct indicating she was able to generalize some learned skills to Chapters 1 and 2 and maintain gained skills over time. Overall, Student 3 had an increase from a baseline mean of 33% correct to an intervention mean of 55% correct.

Student 4 was stable during the initial three baseline probes with a mean 35% correct on Chapters 1 and 2 and continued to be stable across baseline probes. In addition, we probed his performance on Chapters 5 and 6 before introducing intervention to determine whether he would maintain low levels of responding as he had been exposed previously to Chapters 3 and 4 during baseline conditions. This baseline probe of Chapters 5 and 6 was low at 15% correct. Overall, his mean baseline performance was 32% correct (range = 15%–45%). During intervention in Chapters 5 and 6, he increased to a mean of 42% correct (range = 30%–50%). When probed for generalization on Chapters 7 and 8, he decreased performance to 35% correct

which indicated that he had yet to generalize skills to untrained content. During intervention on Chapters 7 and 8, his mean percent correct was 35% (range = 30%–40%). When probed for generalization on Chapters 9 and 10, he scored 20% correct. During intervention on Chapters 9 and 10, he increased again to a mean percent correct of 77% (range = 65%–85%). For his final generalization probe on Chapters 9 and 10, he scored 55% correct indicating further generalization. During intervention on Chapters 9 and 10, he scored a mean of 37% correct (25%–45%). For his final maintenance datum point, he scored 30% correct indicating low generalization and maintenance of skills. Overall, Student 4 increased responding from a baseline mean of 32% correct to an intervention mean of 38% correct.

Engagement. Overall student engagement was reported to be a mean of 5 on the 6-point Likert-type scale, indicating the students actively participated most of the time (engaging with the iPad app and teacher for more than 75% of the time). Student 1 was recorded to be engaged at a mean of 6 for every session. Student 2 had a range of engagement from 4 to 6 with an average of 5. Student 3 also averaged at 5, with a range from 3 to 5. Student 4 had the lowest engagement with a mean 3.5 and a range of 1 to 5.

Social validity. After the study was complete, teachers' perceptions of the study were obtained through the completion of brief survey. Using a 5-point Likert-type scale, the classroom teachers indicated the level of agreement or disagreement with statements by circling one of five responses: (a) 5 = *strongly agree*, (b) 4 = *agree*, (c) 3 = *neutral*, (d) 2 = *disagree*, and (e) 1 = *strongly disagree*. Statements targeted teachers' perceptions related to both study procedures (e.g., "The system of least prompts via the iPad is appropriate for the student") and outcomes (e.g., "The adapted texts helped access the general curriculum for this student"). Results indicated that the participating teachers either strongly agreed or agreed with the majority of statements related to usability and feasibility as well as overall social validity of the procedures and outcomes. In addition, the teachers answered several open-ended questions designed to provide detailed feedback for our iterative process. They reported that access to grade-aligned content and materials through the app were helpful and that the students were engaged during the iPad app lessons. They reported that the use of the app in small group instruction was something they were interested in as one to one instruction required a lot of instructional time.

Discussion

There have been few studies on teaching listening comprehension to students with SIDD via mobile technology (e.g., iPad). The current study adds to the emerging body of literature by demonstrating the effectiveness of using an iPad app with embedded systematic instruction to improve the

listening comprehension of students with SIDD. Furthermore, the researchers showed improvement in student responses beyond just literal recall. Specifically, middle grade students with SIDD in rural settings increased their percentage of independent correct vocabulary and definition identification, and responses to comprehension questions after listening to an adapted version of *Outsiders* via the iPad app, *Access: Language Arts*. In addition, three students were maintained performance over time and two students demonstrated some generalization of skills to untrained chapters.

In this study, like Baxter and Mims (2018) and Spooner et al. (2015), the researchers found the use of iPads with embedded systematic instruction to be an effective strategy to promote listening comprehension and overall engagement for students with SIDD. Students were provided access to an adapted version of *Outsiders* read aloud via an iPad app, instruction in targeted vocabulary from the adapted story using CTD, and instruction in comprehension (i.e., prediction, literal recall, three-step sequence, inferential, application, analysis, main character, setting, problem, solution, and main idea). Three of the four students made major gains across all of the skills. Student 4 made small gains, but it was noted that he engaged in frequent challenging behavior across his day. In addition, the teacher reported that the small gains found for Student 4 were very impressive as he made little to no gains in other targeted areas across the school year.

Given the lack of support for teachers of students with SID in rural schools, this study provides a viable option for providing meaningful access to the general curriculum. These teachers are often left with few targeted professional development opportunities, including those on how to meaningfully teach grade-aligned academic skills. Technology such as the iPad and app described in the study can mitigate the lack of targeted supports.

Limitations/Future Research

Despite the overall positive findings, several limitations must be addressed. First, as is common in single case design, due to the small sample size, there is limited generalizability to other participants. Although we were able to demonstrate a functional relation, future research is needed to strengthen external validity through replication.

Second, we initially only conducted three baseline probes for all participants before bringing the first student into intervention. This occurred due to the limited timeline to expose the students to all chapter pairs before the students were out for a long holiday break. We also only conducted baseline on Chapters 1 and 2 for Student 1 before bringing this student into intervention with Chapter 3 and 4. It would have been beneficial to probe this student in Chapters 3 and 4 to ensure the data remained low and stable before bringing this student into intervention. After starting intervention, we conducted a probe with all students in the next chapter pair, before moving into intervention on this chapter pair, to identify if the students might start to generalize the targeted skills to untrained content. In addition, all students were exposed to three repeated readings of the same content which could have led to practice effects and as a result be a potential threat to internal validity. The researchers ensured that all chapter pairs were equivalent in regard to length and complexity (i.e., Lexile) and validated by a content expert in an attempt to address this potential threat. Also, the researchers wanted to provide an authentic grade-aligned text experience by progressing through a chapter book. Future research should investigate this intervention using a method with strong empirical support.

It is also important to consider that Students 3 and 4 did not receive intervention until Chapters 5 and 6 which did not allow them to receive the intervention in earlier chapters. This may have contributed to Student 3's slower acquisition and the overall low data levels for Student 4. Future research should investigate the effects of different questions on each probe of earlier chapters, paying attention to the same types of questions (e.g., literal, inferential), but a different version each time.

Another limitation is that this study was conducted one to one, in a separate room to control for exposure to other participants. Given that the study was conducted in such a controlled setting, it limits the ability to understand the potential effects in a typical classroom setting. Future researchers should investigate the use of this intervention in small or large group instruction as well as in inclusive settings. The impact of research to show the potential effects of this intervention on students with SIDD as well as students without disabilities in a regular, general education classroom would provide a demonstration of the need to more widely consider full inclusion placements for students with SIDD. Finally, future research should investigate the effects of this intervention with high school students as most of the research thus far has been limited to younger students through middle school. The complexity of high school novels adds an intricacy not yet explored with students with SIDD.

Implications for Practice

In this study, we demonstrated the use of an iPad to present adapted grade-aligned text is a plausible option to promote listening comprehension for students with SIDD. Teachers need to consider resources like iPads, paired with strong systematic instructional strategies, to provide engaging and meaningful access to grade-aligned content. In addition, unique features of the intervention, such as embedded systematic instruction, should be utilized by teachers to promote listening comprehension across Bloom's Taxonomy for students with SIDD. Finally, instruction via the iPad should occur as a supplement to typical instruction and not a replacement. This supplemental instruction can promote

independence and self-directed learning for students with SIDD working on grade-aligned ELA skills.

There is mounting evidence that students with SIDD can be successful in comprehending of grade-aligned fictional text. As educators of students with SIDD, it is important to continue to focus on increasing the comprehension abilities of these students. The development of comprehension beyond literal recall is essential for this population as it can lead to improved quality of life outcomes through increased access to literature. Given the importance of providing meaningful instruction in grade-aligned ELA skills, including comprehension, researchers need to continue to investigate plausible methods to promote these skills for students with SIDD.

Declaration of Conflicting Interests

Funding

References

Al Otaiba, S., & Hosp, M. K. (2004). Providing effective literacy instruction to students with Down syndrome. *Teaching Exceptional Children*, *36*(4), 28–35.

Anderson, L. W., Krathwohl, D. R., Airasian, P. W., Cruikshank, K. A., Mayer, R. E., Pintrich, P. R., & Wittrock, M. C. (2001). *A taxonomy for learning, teaching, and assessing: A revision of bloom's taxonomy of educational objectives*. White Plains, NY: Longman.

Attainment Company. (2016). Access: Language arts iPad app (1.2.5) [Mobile application software]. Retrieved from https://itunes.apple.com/us/app/attainments-access-language/id775947109?ls=1&mt=8

Baxter, A., & Mims, P. J. (2018). *Teaching grade aligned skills to high school students with severe intellectual disability using technology*. Manuscript submitted for publication.

Bloom, B. S. (1956). *Taxonomy of educational objectives: The classification of educational goals, by a committee of college and university examiners*. White Plains, NY: Longman.

Browder, D. M., Gibbs, S., Ahlgrim-Delzell, L., Courtade, G., & Lee, A. (2007). *Early literacy skills builder*. Verona, WI: Attainment Company.

Browder, D. M., Jimenez, B., Mims, P. J., Knight, V. F., Spooner, F., Lee, A., & Flowers, C. (2012). The effect of a "tell-show-try-apply" (TSTA) method of professional development on teacher's instructional alignment. *Teacher Education and Special Education*, *35*, 212–227.

Browder, D. M., Wakeman, S. Y., Spooner, F., Algrim-Delzell, L., & Algozzine, B. (2006). Research on reading instruction for Individuals with significant cognitive disabilities. *Exceptional Children*, *72*, 392–408.

Coyne, P., Pisha, B., Dalton, B., Zeph, L. A., & Smith, N. C. (2010). Literacy by design: A universal design for learning approach for students with significant intellectual disabilities. *Remedial and Special Education*, *33*, 162–172.

Erickson, K., Hanser, G., Hatch, P., & Sanders, E. (2009, June). Research-based practices for creating access to the general curriculum in reading and literacy for students with significant intellectual disabilities. *Monograph Prepared for the Council for Chief State School Officers (CCSSO) Assessing Special Education Students (ASES) State Collaborative on Assessment and Student Standards (SCASS)*.

Gast, D. L., & Ledford, J. (2010). Multiple baseline and multiple probe designs. In D. L. Gast (Ed.), *Single subject research methodology in behavioral sciences* (pp. 276–328). New York, NY: Routledge.

Jimenez, B., Mims, P. J., & Baker, J. (2016). Data based decision training for teachers of students with significant disabilities: The power of online modules to effect change. *Rural Special Education Quarterly*, *35*(4), 3–11.

Katims, D. S. (2000). Literacy instruction for people with mental retardation: Historical highlights and contemporary analysis. *Education and Training in Mental Retardation and Developmental Disabilities*, *36*(4), l3–15.

Kliewer, C., & Biklen, D. (2001). School's not really a place for reading: A research synthesis of the literate lives of students with severe disabilities. *Research and Practice for Persons With Severe Disabilities*, *26*, 1–12.

Lee, A., Mims, P. J., Browder, D. M., & Ahlgrim-Delzell, L. (2018). *The effects of a scripted ELA curriculum on aligned ELA standards for middle school students with significant disabilities*. Manuscript in preparation.

Mims, P. J., Hudson, M. E., & Browder, D. M. (2012). Using read-alouds of grade-level biographies and systematic prompting to promote comprehension for students with moderate and severe developmental disabilities. *Focus on Autism and Other Developmental Disabilities*, *27*, 67–80.

Mims, P. J., Lee, A., Browder, D. M., Zakas, T. L., & Flynn, S. (2012). Effects of a treatment package to facilitate English/language arts learning for middle school students with moderate to severe disabilities. *Education and Training in Autism and Developmental Disabilities*, *47*, 414–425.

Mims, P. J., Lee, A., Zakas, T. L., & Browder, D. (2013). *Teaching to standards: English language arts*. Verona, WI: Attainment Company.

National Governors Association. (2010). *Common core state standards*. Available from http://www.corestandards.org/

Spooner, F., Kemp-Inman, A., Ahlgrim-Delzell, L., Wood, L., & Davis, L. L. (2015). Generalization of literacy skills through portable technology for students with severe disabilities. *Research and Practice for Persons With Severe Disabilities*, *40*, 52–57.

Suppo, J. L., & Mayton, M. R. (2014). Expanding training opportunities for parents of children with autism. *Rural Special Education Quarterly*, *33*, 19–28.