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The Effects of Low-Tech and High-Tech Active Student Responding Strategies during History Instruction for Students with SLD

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Instruction in history is important for all students. However, students with specific learning disabilities (SLD) often struggle to learn information in this content area. Instructional strategies proven effective for students with SLD are those that include active student responding (ASR), which are observable, measurable responses to instructional antecedents. Using an alternating treatments design, we compared a low-tech ASR condition (interactive notebook strategy) to a high-tech ASR condition (Quizlet Application on an iPad) used as end-of-session reviews of history content. Participants were seven Hispanic middle school students with SLD. Results showed that all participants made improvements using either ASR method over a series of pretest control probes and that differences between the two conditions were negligible. These results, and implications for practice and future research, are discussed.

Keywords: **Specific Learning Disability, Active Student Responding, Opportunity to Respond, Technology, Social Studies, Mobile Devices**

Introduction

History is the foundation of effective citizenship and effective citizens possess an understanding of how history affects their lives in the present and how it may affect their lives in the future (Bradley Commission, 1988). Unfortunately, students with specific learning disabilities (SLD) typically struggle learning historical content. On standardized tests assessing knowledge of U.S. history, these students consistently score lower than students without learning disabilities (NAEP, 2010). They may struggle with learning history because they: (a) lack conceptual/critical thinking skills (Okolo, 2005), (b) read below their grade level (Gersten, Baker, Smith-Johnson, Dimino, & Peterson, 2006; Mastropieri, Scruggs, & Graetz, 2003), (c) do not have adequate background knowledge (Okolo, 2005), (d) cannot keep up with the pace of instruction, and/or (e) have learning styles that are not compatible with classroom instructional methods (Ferretti, MacArthur, & Okolo, 2001; Mastropieri & Scruggs, 2010).

There is considerable evidence to demonstrate that increasing active student responding (ASR) has a positive impact on learning (Barbetta, Heron, & Heward,

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1993; Barbetta & Heward, 1993; Jerome & Barbetta, 2005; Twyman & Heward, 2016). Heward (1994) defines ASR as "observable [student] responses made to an instructional antecedent" (p. 286). Contingent feedback follows the student's response, which can be provided by teachers, peers, or technology (Vargas, 2014), and this feedback is most effective when it is (a) provided immediately, (b) given contingently, and (c) specific to guide the student to the accurate response (Barbetta et al., 1993; Jerome & Barbetta, 2005; Vargas, 2014) For students identified as SLD and other disabilities, ASR is associated with many positive outcomes including increased content area achievement, increased on-task behavior, and timely performance feedback for the teacher and the student (Barbetta & Heward, 1993; Haydon et al., 2010; Jerome & Barbetta, 2005). Unfortunately, even though research consistently demonstrates that increased levels of ASR improves learning outcomes, teachers often provide low levels of student response opportunities during instruction across all grade levels and instructional content areas (Whitney, Cooper, & Lingo, 2015).

Technology and Active Student Responding

Technology in education refers to the use of low-tech and high-tech instructional practices and materials to facilitate the learning process among students (Twyman & Heward, 2016). Indeed, Baer, Wolf, and Risley (1968) referred to one of the dimensions of applied behavior analysis as technological. In this sense, skill acquisition and behavior reduction methods represent a technology since procedures can be precisely described to allow others the opportunity to replicate. Twyman and Heward (2016) appropriately refer to ASR as an instructional technology that is low-tech; others can easily implement the strategy with little to no cost with minimal obstacles (e.g., loss of power). Moreover, ASR, like other instructional tactics, can be implemented using no-tech, low-tech, or high-tech materials (Twyman & Heward, 2016). Low-tech is defined as the use of materials that do not involve electronics and are relatively inexpensive, simple tools. Examples of low-tech materials for student's responses during ASR activities include items such paper, pencils, and flashcards, to name a few. High-tech is defined as the use of devices based on computer technology and requires additional training for individuals to use. Moreover, these devices often involve the use of a power source. Examples of such materials for student responses can include the use of clickers, computers, and software, among others (Dell, Newton, & Petroff, 2017; Twyman & Heward, 2016). Thus, student responses, as part of an ASR component to instruction, can be no-tech (e.g., oral responding), low-tech (e.g., written responding), or high-tech (e.g., use of clickers, tablets, and computers; Twyman & Heward, 2016).

Low-tech ASR and the Interactive Notebook. With respect to students' response type during the use of an ASR strategy, there are several no- and low-tech instructional strategies including response cards (Randolph, 2007), guided notes (Haydon, Mancil, Kroger, McLeskey, & Lin, 2011; Heward, 1994), and choral responding (Haydon, Marsicano, & Scott, 2013). Another low-tech ASR approach that was investigated in the current study is a form of structured student note-taking referred to as an interactive notebook. The interactive notebook is a note-taking style that consists of a spiral notebook or composition notebook organized in a structured manner (Bower & Lobdell, 1999; Mallozzi & Heilbronner, 2013; Young, 2003). In an interac-

tive notebook, the right page is used for input such as teacher-driven discussion notes and graphic organizers. The left page of the interactive notebook is used for output such as student drawings, cartoons, reflections, and questions. Headings, key ideas, terms, and new vocabulary are underlined or highlighted. A title page is created for every new unit and every page is dated (Brower & Lobdell, 1999; Young, 2003). However, despite descriptions of this note-taking strategy in the literature, it has limited empirical support. In one of the few studies on this method, Mallozzi and Heilbronner (2013) examined the effects of the interactive notebook among students during science instruction. They reported that instruction embedded with the interactive notebook helped students achieve learning gains compared to students who did not use the interactive notebook. Although these results are promising, additional research is needed to evaluate the effectiveness of this ASR note-taking strategy.

High-Tech ASR. When students are responding during the implementation of the ASR method, their responses can also involve the use of high-tech materials. Researchers have examined the use of high-tech ASR among college students and reported favorable results (e.g., Poirier & Feldman, 2007; Zayac, Ratkos, Frieder, & Paulk, 2016). Positive, but limited, results have also been reported in the K-12 education literature on the use of high-tech ASR (e.g., Jerome & Barbetta, 2005; Scott, Fahsl, Fark, & Peterson, 2014). The lack of research of high-tech ASR use in K-12 settings is more pronounced when the content of instruction is social studies and/or U.S. History. In one of the few examples of using high-tech ASR during social studies instruction, Jerome and Barbetta (2005) examined the effects of two ASR conditions during computer-assisted instruction (CAI) on desktop computers. Fifth grade students with SLD were presented with social studies facts using computer-based software. The ASR conditions required students to click on responses to complete fill-in-the-blank statements or to click on a symbol to hear and orally repeat facts. In the no-response condition, students simply listened to the computer reading the social studies facts. The data indicated that students were able to learn and maintain social studies facts under both ASR conditions during CAI. The results of that study provide limited support for the premise that the use of technology paired with ASR would enhance learning in social studies among K-12 students with SLD. Although this study showed positive results for the students, additional research is needed in this area for at least two important reasons: first, there is a lack of research in this area related to social studies instruction; second, the use of mobile technology–multiple versions of high-tech devices–are ubiquitous in our society, including schools.

Mobile Technology

In recent years, mobile devices, such as tablets, have become increasingly popular in K-12 settings (Twyman & Heward, 2016). School districts have placed a high priority on wireless technology and invested in tablets for students (Software Information Industry Association [SIIA], 2013). Notwithstanding this surge of mobile technology in today's classrooms, research on its effectiveness, specifically tablets such as the iPad, as learning tools to increase student engagement and learning gains has only recently emerged (e.g., Chou, Block, & Jesness, 2012; Neely, Rispoli, Camargo, Davis, & Boles, 2013). The literature in the field of social studies using iPad integration is extremely limited (Berson, Berson, & Manfra, 2012), as most of the

research on the effectiveness of using iPads or tablet devices has been in the content areas of math and reading (Harmon, 2011; Haydon et al., 2012; Neely et al., 2013). Therefore, research on the effectiveness of using an iPad, or other tablet device, is needed in subjects outside of math and reading.

Significance of the Study

Given that students tend to learn more when there is increased ASR in the classroom, continued research in this area is merited. The use of interactive notebooks as a low-cost and low-tech ASR note-taking system may be a promising practice, but additional data are needed to examine its utility, especially among students with SLD. Therefore, this study was designed to investigate its effects during history instruction. Also, the use of mobile technology is emerging in today's classrooms. Much of the recent literature has indicated that evidenced-based strategies combined with such technology are effective in facilitating instruction in math and reading (Harmon, 2010; Haydon et al., 2012; Neely et al., 2013). However, little attention has been given to integrating mobile technology in social studies classrooms (Berson et al., 2012). Considering the effectiveness of ASR and the increased use of technologies such as mobile devices in the classroom, it is prudent to examine the effects of an ASR system delivered via mobile technology, especially in the area of history instruction. Therefore, the purpose of this study was to compare the effects of two different ASR systems used at two different times during history instruction. As such, the following research questions were investigated:

> Research Question 1. Are there differences in the acquisition of U.S. history content when an independent end-of-study review uses a low-tech interactive notebook or a high-tech ASR system using mobile technology?
>
> Research Question 2. Are there differences between the independent use of the low-tech interactive notebook or the high-tech ASR system using mobile technology when answering questions in a matching format versus a fill-the-blank-format?
>
> Research Question 3. What are the participants' opinions and preferences regarding the use of the low-tech interactive notebook and the high-tech ASR system for review of U.S. History content?

Method

Participants

This study was approved by the university's and local school district's Institutional Review Boards. Seven Hispanic middle school students with SLD (ages 13-15 years) participated in this study, and six of the seven (all but participant six) were educated in classes for student who are English Speakers of Other Languages (ESOL) and had exited those programs from kindergarten through 8th grades. Participants were selected based on the following criteria: (a) identified as having a SLD, (b) demonstrated weaknesses in reading, (c) demonstrated difficulties with social studies content, and (d) had comprehension of content area material listed as a problem area on his or her individualized education plan (IEP). These difficulties were demon-

strated on participants' most recent scores on the statewide reading assessment and civics end-of-course (EOC) exams. A description of each participant, with relevant test scores, is presented in Table 1.

Table 1. ***Participant Demographic Information***

Participant	Gender	Age	Grade	Primary Exceptionality	Intelligence Score	2013-2014 FCAT Reading Level	Florida Civics End of Course Exam *t*-score***
1	F	14	8	SLD	94*	2	44
2	M	15	8	SLD	78**	1	30
3	M	14	8	SLD	88	1	36
4	M	14	8	SLD	80*	1	20
5	M	13	8	SLD	91**	2	46
6	M	13	8	SLD	70**	1	25
7	M	15	8	SLD	77**	1	20

Note. *Intelligence score obtained using the DAS-II.
** Intelligence score obtained using the WISC-IV.
****t*-scores based on a scale of 20-80 with a Florida state mean score of 50 and a standard deviation of 10.

Setting

This study was conducted in a varying exceptionalities self-contained middle school history classroom located in the southeast region of the United States. The school was a low-income Title I school where 84% of students received free or reduced-lunch and the racial/ethnic breakdown was as follows: 93% Hispanic, 3% Black, 3% White, and 1% Asian. Thirteen percent of students were identified as students with disabilities and 20% of students were identified as English Language Learners (ELLs). The first author of this study served as their special education teacher and primary researcher.

Materials

Materials included in this study were the state and school district approved curriculum for middle school social studies, U.S. history textbooks, an interactive whiteboard, a computer with Microsoft PowerPoint software (Microsoft Office Professional Plus 2010, Version 14.0.7128.5000) for lesson presentation, pens and pencils, highlighters, notebooks, and four iPads with the Quizlet application (App; Version 1.5.2). The Quizlet App (2013) on the iPad is an interactive application that integrates text, sound, and graphics that allows learners to study material using three different modes: cards, learn, and match. In the cards mode, students study terms by shuffling/randomizing terms and listening to audio recordings of the term and its definition. In the learn mode, students are presented with a definition or a graphic

and prompted to type in the correct response (the ASR component). If they do not know an answer, they can tap the "Don't Know" button and the correct answer will appear. Their correct and incorrect responses are tracked, and if they chose, they can redo the learn mode with only the terms they did not answer correctly. Lastly, in the match mode, students are timed and must match terms with their correct definitions (a second ASR component). The first author created the Quizlet learning sets corresponding to each lesson. The reading level used on Quizlet was consistent with participants' eighth grade U.S. history textbook. This was determined using the Flesch-Kincaid level feature (Kincaid, Fishburne, Rogers, & Chissom, 1975) in Microsoft Word.

A technology skills assessment created by the first author was used to determine participants' ability to operate an iPad. Given an iPad that was already powered on, each participant had to be able to: (a) attach headphones, (b) adjust the stand, (c) use the wake mode, (d) change orientation from landscape to portrait, (e) use one finger to scroll, (f) adjust volume settings, (g) single tap to access applications, and (h) power off the iPad screen.

Paper and pencil tests, corresponding to the curriculum, were used throughout the study and these were developed by the first author. Pretests consisted of 30 factual history questions (15 vocabulary-matching items and 15 fill-in-the-blank items). Pretests were used to determine participants' content knowledge, and they were also used to develop post-lesson tests. To develop the post-lesson tests, the first author selected 20 questions that the participant answered incorrectly on the pretest and used those questions to create two post-lesson tests for each unit. Each post-lesson test consisted of five vocabulary-matching items and five fill-in-the-blank items. There were a total of 13 tests.

Dependent Variable and Data Collection

The dependent variables measured during this study were overall percent of correct responses on post-lesson U.S. history tests, as well as percent correct responding on matching vs. fill-in-the-blank test questions. Participants' tests were graded using an answer key. A plus (+) sign was scored for correct responses and a minus (-) sign was scored for incorrect responses. Unanswered items were also scored with a minus (-) sign. Participants' scores were then converted to percent correct by dividing the number correct by the total number of questions and multiplying by 100.

Experimental Design

An alternating treatments design (ATD) was used in this study. An ATD requires the rapid alternation of two or more distinct conditions and observing their effects on the target behaviors. An ATD was used because it is a practical design for: (a) comparing the effectiveness of two or more instructional interventions, and (b) intervention conditions can be implemented immediately (Wolery, Gast, & Hammond, 2010). There were two conditions in this study that included: (a) history instruction using an ASR notetaking strategy with an end-of-lesson review with those notes, and (b) history instruction with an end-of-lesson review using Quizlet on the iPad. There was also a pretest probe administered before each unit to determine participants' pre-intervention skills, as well as to examine potential confounding variables (e.g., maturation and multiple treatment interference).

Pre-Study Procedures

Interactive notebook. The first author taught participants to use the interactive notebook during the previous school year (7th grade). The first author reviewed the strategy with each participant at the start of current school year and they successfully used the strategy up to the point where the study began.

Technology assessment. The first author individually administered the technology skills assessment to ensure participants had adequate skills to operate the iPad. If a participant was not proficient in using an iPad, the first author provided training on the basic operations of the device. Participants had to demonstrate 100% accuracy of skills prior to the start of the study.

Quizlet training. The first author trained each participant on the use of the Quizlet App during a 1:1 session. Training consisted of: (a) how to identify the volume symbol in Quizlet in order to enable/disable or start/stop the voice feature, (b) how to swipe through screens to advance terms in the cards mode, (c) how to type in responses in the learn mode, and (d) how to tap responses in the match mode. Each participant then practiced using the app during a practice session. Participants demonstrated 100% accuracy using the app prior to the start of the study.

Study Procedures for Both Conditions

For both intervention conditions (Condition A [instruction and review using the interactive notebook] and Condition B [review using Quizlet on the iPad]), content instruction consisted of 30 minutes of direct and explicit instruction (Archer & Hughes, 2011; Taylor et al., 2009). Prior to the start of each lesson, the teacher activated prior knowledge by posing content-related questions to the participants. The teacher then explained the goal/objective of that day's lesson. Next, the teacher presented the new content for that day's lesson using PowerPoint slides. Lessons consisted of approximately 10 slides that contained text, visuals, maps, and diagrams appropriate to the goals of the lesson. Throughout the lessons, the teacher checked participants' understanding by asking questions and requiring participants to respond. Verbal praise was given for correct responses and corrective feedback was given for incorrect responses. In all conditions, participants took notes using their interactive notebooks.

There were seven units of instruction throughout this study. Each unit consisted of three class periods (a pretest probe and two lessons). During the first class period for each unit, participants took a 30-question pretest. Each pretest covered information from the two lessons for that unit. Participants were given 45 minutes to complete each pretest. Test questions were read to participants upon request.

During the second class period for each unit, participants engaged in Lesson One and then were randomly assigned to Condition A (note taking and review with interactive notebook) or Condition B (note taking with interactive notebook and review using Quizlet on the iPad). After the content review session, participants took a post-lesson test consisting of 10 questions that were comprised of incorrectly answered questions from the pretest. During the third class period for each unit, participants engaged in Lesson Two and were again randomly assigned to either Condition A or B. Then, participants took a post-lesson test consisting of 10 different questions but derived from the same unit pretest. Each post-lesson test was specifically related

to the content from that day's lesson (i.e., the test for Lesson One had questions specific to Lesson One and the test for Lesson Two had questions specific to Lesson Two). This process was repeated for each content unit of instruction. If a participant was randomly assigned to the same condition for two consecutive sessions, that participant would default to the other condition for the next lesson. Finally, students in this class typically received quizzes once or twice a week.

Condition A: ASR using the interactive notebook. During this condition, participants took notes using their interactive notebooks throughout the teacher-led lesson. Then the students used those notes to study during the 15-minute end-of-session review. Next, the participants were given a 10-question post-lesson test based on the content from that day's lesson. The participants were given 15-minutes to complete the test. Test questions were read to any participant upon request.

Condition B: ASR using Quizlet. After instruction where students took notes with their interactive notebooks, the participants reviewed the content of the lesson by using Quizlet on the iPad for 15 minutes. The participants spent 5 minutes in the cards mode reviewing the terms, 5 minutes in the learn mode typing in responses (the ASR component), and 5 minutes in the match mode matching terms and definitions (the ASR component). Once the time for a mode expired, participants were prompted to move to the next mode. The participants used the modes in order of cards, learn, and match on a consistent basis. As with Condition A, after using Quizlet on the iPad, the participants took a 10 question post-lesson test based on content from that day's session. The participants had 15 minutes to complete the test. Test questions were read to the participants upon request.

Social Validity Measure

Social validity refers to the social importance of the outcomes for key stakeholders, and it enhances a study by demonstrating that interventions are meaningful to the accomplishment of a goal in the participant's life (Wolf, 1978). To measure social validity, participants were given a written questionnaire at the end of the study. The questionnaire consisted of five open-ended questions about participants' experiences during the study.

Interobserver Agreement (IOA) and Treatment Fidelity (TF)

The first and second authors independently scored participants' tests. Agreement data were collected for 43.75% of the pretest probes and 34.89% of the post-lesson tests for Conditions A and B. Point-by-point agreement was used where both observers had to score the same code on corresponding questions. Using the formula, total number of agreements divided by the total number of agreements and disagreements multiplied by 100, IOA for the pretest probes equaled 99.05% (range 96.67-100%) and IOA for the post-lesson tests equaled 99.78% (range 96.67-100%; Gast, 2010).

An independent observer (another social studies teacher) collected TF data for 50% of the sessions. Treatment fidelity was calculated by dividing the number of observed researcher behaviors by the number of planned researcher behaviors and multiplying by 100 (Gast, 2010). Treatment fidelity equaled 100%.

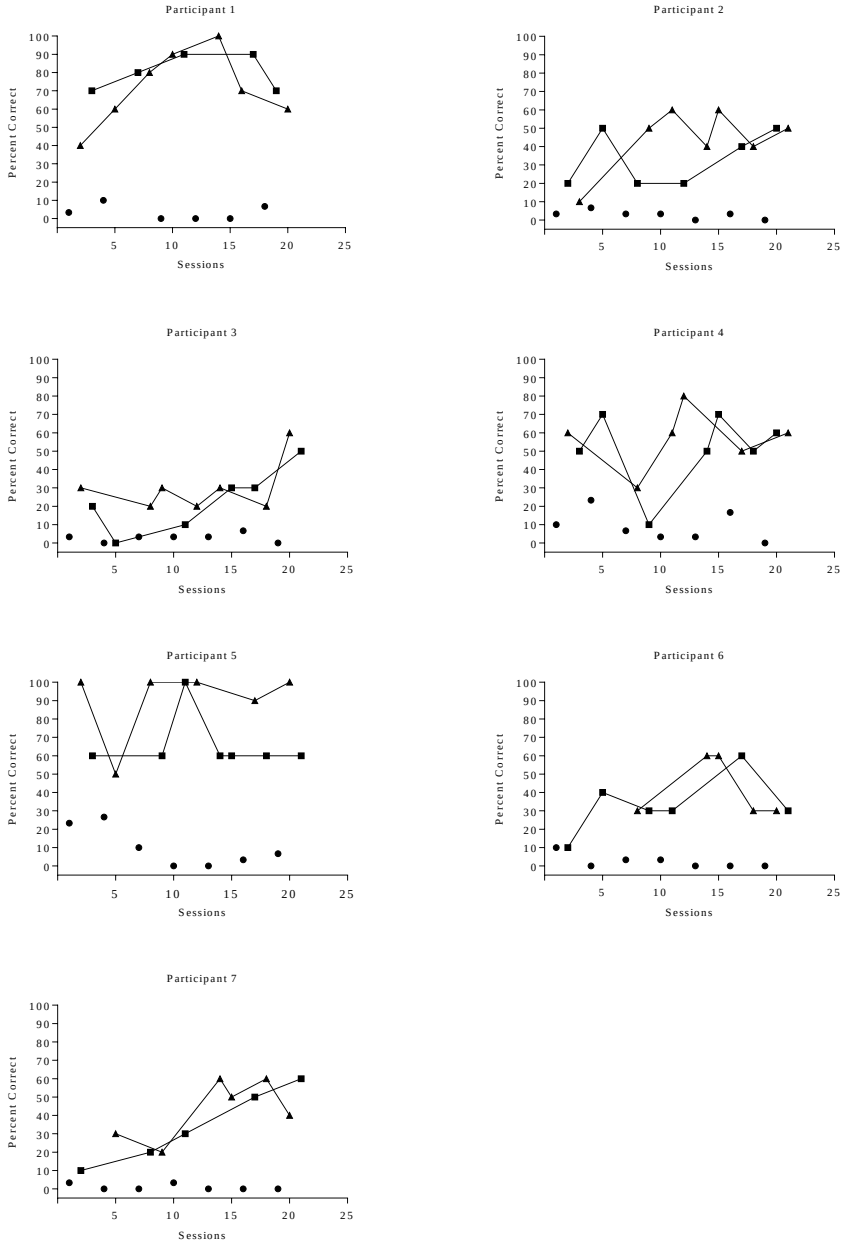

Figure 1. **Percent correct during interactive notebook and Quizlet on the iPad conditions and a series of pretest control probes. Circles represent pretest control probes. Squares represent the interactive notebook condition. Triangles represent the Quizlet on the iPad condition. Pretest control probes consisted of 30-question tests and post-lesson tests were 10 questions.**

Results

All participants demonstrated improvements in their test scores during both intervention conditions (see Figure 1). Two participants (Participants One and Five) improved more substantially than the remaining participants. Questions from the post-lesson tests were comprised of those that participants answered incorrectly during the series of pretest probes, and therefore, participants' performances on the post-lesson tests are compared to zero. However, the graphs presented in Figure 1 display participants' percent correct responding for both intervention conditions and the percent correct responding on the series of pretest probes so that an analysis of potential confounding variables could be conducted (i.e. history, maturation, multiple treatment interference). All students received seven pretest probes except for Participant One who was absent for one of the probes.

Participant One

Participant One's scores improved during both treatment conditions (see Figure 1). During the series of pretest probes, her mean correct responding was 3.33% correct (range 0.00-10.00%). These data were stable with little performance variability.

During the interactive notes condition, the mean correct responding was 80% (range 70-90%). There was a slight ascending trend in the data at the beginning of the intervention but the data path descended toward the end of the intervention. During the Quizlet on the iPad condition, the mean score was 71.43% (range 40-100%). There was a moderate ascending trend for the first five data points but the final data points descended. There was no overlap between the intervention data paths and the series of pretest probes. There was, however, overlap between both intervention data paths.

Participant Two

Participant Two demonstrated an improvement in test scores under both intervention conditions (see Figure 1). His mean score during the series of pretest probes was 2.86% (range 0.00-6.67%). These data were low and stable with little performance variability.

During the interactive notebook condition, his mean score was 33.33% correct (range 20-50%). The data path had an ascending trend toward the end of the intervention. Under the Quizlet on the iPad condition, his mean score was 44.29% (range 10-60%). There was an ascending trend during the beginning of the intervention with slight variability toward the end. There was no overlap between the series of pretest probes and both intervention conditions. There was an overlap of data paths between both intervention conditions, with the exception of the middle data points.

Participant Three

Participant Three's performance scores during both conditions and the series of pretest probes are presented in Figure 1. His performance data during the series of pretest probes were low and demonstrated stability (M=2.86%, range 0.00-6.67%).

Under the interactive notebook condition, the mean correct responding was 23.33% (range 0.00-50%), indicating a low performance level. These data were relatively stable with a slight ascending trend. During the Quizlet on the iPad intervention, his mean score correct was 30.00% (range 20-60%). These data were stable with the exception of the final data point. The performance level was low-to-moderate. Toward the final sessions, there was a greater spread between the intervention data paths and the series of pretest probes. There was overlap between both intervention data paths throughout the study, however.

Participant Four

During the series of pretest probes, Participant Four's scores were low and stable with a mean of 9.05% (range 0.00-23.33%; see Figure 1). This participant's scores indicate that he made gains during both intervention conditions. Participants Four's mean score under the interactive notebook condition was 51.43% correct (range 10-70%). These data were variable with no trend. During the Quizlet on the iPad condition, his mean score was 56.67% (range 30-80%). Again, these data were variable with no trend. There was minimal overlap between the intervention conditions and the series of pretest probes. However, there was considerable overlap between the intervention data paths.

Participant Five

Participant Five made learning gains during both treatment conditions (see Figure 1). During the series of pretest probes, his mean correct score was 10.00% (range 0.00-26.67%). These data were stable with little performance variability.

During the interactive notebook condition, the mean correct responding was 65.71% (range 60-100%). These data were mostly stable with no trend with the exception of the third data point, which accelerated drastically but returned to its prior level by the fourth data point. During the Quizlet on the iPad condition, the mean score was 90.00% (range 50-100%). These data were stable with a slight ascending trend except for the second data point, which decelerated but returned to an ascending trend by the third data point. Both interventions were effective. There was no overlap between the intervention data paths and the series of pretest probes. Moreover, there was minimal overlap between the two interventions indicating that Quizlet on the iPad was superior to the interactive notebook intervention.

Participant Six

During the series of pretest probes, Participant Six's scores were low and stable with a mean of 2.38% (range 0.00-10.00%; see Figure 1). Participants Six's mean score under the interactive notebook condition was 33.33% correct (range 10-60%). The data points for his overall percentage correct varied over the course of the study but showed an ascending trend. During the Quizlet on the iPad condition, his mean score was 42% correct (range 30-60%). Using Quizlet on the iPad, the data for percentage correct were variable and showed a descending trend the final four data points. There was a low-to-moderate spread between the pretest probe data and the intervention data paths. There was, however, considerable overlap between the intervention data paths indicting that both interventions were possibly equal.

Table 2. ***Percent Correct on Matching and Fill-in-the-Blank Questions***

Participant	Pretest Probes			Interactive Notes			Quizlet on the iPad		
	Matching %	Fill-in %	Overall Mean	Matching %	Fill-in %	Overall Mean	Matching %	Fill-in %	Overall Mean
1	5.56	1.11	3.34	96.00	64.00	80.00	85.74	57.14	71.44
	(0.00-13.33)	(0.00-6.67)	(0.00-13.33)	(80.00-100.00)	(40.00-100.00)	(40.00-100.00)	(40.00-100.00)	(20.00-100.00)	(20.00-100.00)
2	5.72	0.00	2.86	46.67	20.00	33.34	60.00	28.57	44.29
	(0.00-13.33)	(0.00)	(0.00-13.33)	(20.00-80.00)	(0.00-60.00)	(0.00-80.00)	(20.00-100.00)	(0.00-80.00)	(0.00-100.00)
3	4.67	0.95	2.81	43.33	3.33	23.33	54.29	5.71	30.00
	(0.00-13.33)	(0.00-6.67)	(0.00-13.33)	(0.00-100.00)	(0.00-20.00)	(0.00-100.00)	(20.00-100.00)	(0.00-20.00)	(0.00-100.00)
4	15.24	2.86	9.05	74.23	28.57	51.40	80.00	33.33	56.67
	(0.00-40.00)	(0.00-6.67)	(0.00-40.00)	(20.00-100.00)	(0.00-60.00)	(0.00-100.00)	(20.00-100.00)	(0.00-60.00)	(0.00-100.00)
5	20.00	0.00	10.00	85.71	45.71	65.71	96.67	83.33	90.00
	(0.00-53.33)	(0.00)	(0.00-53.33)	(20.00-100.00)	(20.00-100.00)	(20.00-100.00)	(80.00-100.00)	(20.00-100.00)	(20.00-100.00)
6	3.81	0.95	2.38	40.00	26.67	33.34	68.00	16.00	42.00
	(0.00-20.00)	(0.00-6.67)	(0.00-20.00)	(0.00-60.00)	(0.00-60.00)	(0.00-60.00)	(40.00-100.00)	(0.00-20.00)	(0.00-100.00)
7	1.91	0.00	0.96	52.00	16.00	34.00	60.00	26.67	43.34
	(0.00-6.67)	(0.00)	(0.00-6.67)	(0.00-100.00)	(0.00-20.00)	(0.00-100.00)	(40.00-100.00)	(0.00-60.00)	(0.00-100.00)

Note. The top number represents the individual mean for percent correct and the bottom numbers represent the range of scores.

Participant Seven

Participant Seven demonstrated learning gains under both intervention conditions. Figure 1 provides data for percentage correct during the two conditions. His mean score on the series of pretest probes was 0.95% (range 0.00-3.33%). His data were low and stable with little performance variability.

During the interactive notebook condition, his mean percent correct score was 34% (range 10-60%). These data were stable with a moderate ascending trend. Under the Quizlet on the iPad condition, his mean score was 43.33% (range 20-60%). These data were stable with an ascending trend during the beginning of the intervention. The last data point showed a deceleration in the data path. In the beginning of the study, there was little spread in the data paths for both interventions. Towards the end of the study, however, there was a moderate spread between the two data paths. Notwithstanding this difference, there was overlap between both intervention data paths throughout the study. However, there was no overlap between the intervention data paths and the series of pretest probes.

Multiple Choice vs Fill-in the Blank

An analysis of participants' accuracy between question types (i.e., matching and fill-in-the-blank) was also conducted. Table 2 presents participants' percent correct responding across the series of pretest probes and both intervention conditions. Participants scored better on matching questions during both intervention conditions as well as the series of pretest probes.

Social Validity

A social validity questionnaire was administered to participants at the end of the study. All seven participants reported that they felt using Quizlet on the iPad helped them learn U.S. history content. Moreover, six participants reported they preferred learning U.S. history with Quizlet, direct instruction, and note-taking versus direct instruction and note-taking only. One participant indicated a preference for learning U.S. history via direct instruction and note-taking only. When participants were asked if they would use Quizlet on an iPad to study U.S. history in the future, five participants said yes, one participant said maybe, and one participant said no.

Discussion

The purpose of this study was to demonstrate and compare the effects of two ASR systems, when used during instruction and independent student reviews of content, on learning U.S. history among middle school students with SLD. The results of this study indicate that both interventions had a degree of effectiveness on students' ability to make learning gains. The mean scores of participants' post-lesson tests suggest that Quizlet on the iPad produced slightly better results for five participants. For one participant, Quizlet on the iPad was substantially better. For the remaining participant, the use of the interactive notebook generated a slightly higher mean level of responding. Even though these gains were not enough for most participants to achieve passing scores on their post-lesson tests, they were substantial particularly given the limited amount of time the participants engaged in U.S. history content. It is clear that these participants' academic challenges may have been too

substantial to overcome given this limited amount of instructional and study time they had on each unit (i.e., one lesson only).

Literature in the field of special education suggests that students with SLD and other disabilities benefit academically from multiple opportunities to respond and repeated practice (Barbetta et al., 1993; Haydon et al., 2013). Perhaps if students were given more exposure and opportunities to practice, they would have performed better. For example, if they had several review sessions via the interventions across several days, the outcomes may have been more substantial. Nevertheless, given that they had only one lesson per class session with one 15-minute review session, the improvements were considerable. Two constraints of the current study that necessitated this limited instruction format included: (a) a set curriculum with timeframes and (b) the school operated on a block schedule, where participants attended their history class 2-3 days per week. Therefore, time spent on any one unit was limited and participants' opportunities to practice were affected. Nevertheless, the findings from the current study extend the literature in several ways.

Interactive Notebook

The first intervention in this study required participants to study from their hand written notes using the interactive notebook. The ASR component of this intervention occurred during the lesson while the participants actively took notes. While during the end-of-session review, they passively studied their notes. According to Heward's (1994) definition of ASR, the interactive notebook could be considered a type of ASR strategy during the teacher-led instructional component. Indeed, students are required to respond (e.g., write, draw, highlight, underline) to a set of antecedent stimuli (e.g., teacher instruction; Heward, 1994). An examination of the results showed that all seven participants demonstrated learning gains over their pretest scores, and a visual analysis of the data showed that there was an immediate effect of the intervention for six out of seven participants.

The literature in education does support the use of strategic note-taking strategies for students with SLD and other disabilities (Heward, 1994; Konrad et al., 2009; Taylor et al., 2009). However, there is a paucity of empirical studies on the use of the interactive notebook. To our knowledge, Mallozzi and Heilbronner (2013) conducted the only study on this strategy and reported that science instruction embedded with the interactive notebook strategy helped students achieve learning gains in that subject area. Although the results of the current study extend this research line, additional data are needed to judge the utility of the interactive notebook.

Quizlet on the iPad

The results of the current study support the findings of Harmon (2011), Haydon et al. (2012), and Neely et al. (2013). In those studies, participants demonstrated increases in learning gains in the content areas of reading or math when using tablets. The results of the current investigation extend these findings to the content area of social studies. An important consideration, however, is how the tablet was used. That is, in the current study, it was a mediator of an ASR system.

The Quizlet App on the iPad allowed students to respond and receive supportive and corrective feedback, features of teaching and learning that are supported

in the literature (e.g., Barbetta & Heward, 1993; Barbetta et al., 1993). In the learn mode, participants typed in their responses and if a response was incorrect or misspelled, Quizlet provided participants with the correct answer and re-prompted them to enter the correct response. In the match mode, if participants matched the wrong term and definition, their selections immediately turned red alerting participants that their selection was incorrect. If participants selected the correct matching set, their selections turned blue and immediately alerted them that their response was accurate. Thus, the Quizlet App on the iPad provided participants additional opportunities to actively respond to instructional antecedents. It also provided immediate and direct feedback that increased the opportunity for participants to enter the correct response, and this may have facilitated, in part, the increased post-lesson test scores observed.

General Post Session Review

Both interventions were effective in producing higher post-lesson test scores. However, a visual analysis of the data illustrates that there was considerable overlap of the intervention data paths for five of the seven participants, lending to the argument that differences between the interventions in this study were negligible. These results may suggest that the implementation of a post-session review, whether it is with a review of notes from the interactive notebook developed during instruction or an ASR system on a high-tech device (i.e., iPad and Quizlet), might bring about learning gains. Because both interventions were effective, they could both be considered viable post-lesson review options for students with SLD. Nevertheless, six out seven participants indicated a preference for using Quizlet on the iPad over studying from their interactive notes. Perhaps, because both were effective, students could choose the study method they prefer. It is important to emphasize again that the ASR component of the interactive notebook intervention occurred during the lesson and not during the review session. The results may very well have been different had there not been any active note taking during instruction.

Matching Versus Fill-in-the-Blank Question Types

Although participants' post lesson-test scores improved compared to the series of pretests probes, their mean scores were higher on matching items versus fill-in-the-blank items during both conditions. This may be due to fill-in-the-blank items requiring the production of a response whereas matching items require the recognition of a response from a list of choices (Hinze & Wiley, 2011; Larsen, Butler, & Roediger, 2008). Hinze and Wiley (2011) suggest that fill-in-the-blank items are more difficult than matching due to the learner having to split his or her attention during the retrieval process between tested information and untested information. As such, fill-in-the-blank items place a greater demand on retrieval skills and working memory. This is a challenge for students with SLD because they are often characterized by weaknesses in working memory and difficulty trying to manipulate and manage information (Bulgren, Deshler, & Lenz, 2007; Gersten & Okolo, 2007). Therefore, these students may know the content but cannot retrieve that knowledge without a prompt or cue, such as a list of responses associated with the questions (Hinze & Wiley, 2011).

Implications for Practice

The results of this study have implications for history classrooms serving students with SLD. This study suggests that the use of an interactive notebook during instruction and its review at the end of the lesson may help students with SLD learn history facts. Teachers should consider using this approach to assist students with structuring their notes. The study also suggests that the use of a mobile, multimedia ASR system, such as the Quizlet App on the iPad, may help secondary students with SLD study U.S. history content and increase their scores on various assessments. This study taught students historical facts, not historical analysis. Therefore, the results of the current study are limited to the teaching of historical facts. History teachers should consider implementing the use of mobile devices as an ASR review system into their classrooms to enhance content area learning gains. However, teachers should be cautious in relying too heavily or solely on mobile devices as they are not the singular determining factor in student achievement. Although instructional technology did have a positive effect on learning gains, participants also learned with the use of the interactive notebook alone. Quizlet on the iPad was one application out of many learning applications that exist. There are other interactive, multimedia applications that may be more successful in helping students with SLD acquire content area skills. Further, when such applications are used, teachers should consider increasing the amount of time that students are exposed to the applications as repeated ASR and multiple opportunities to practice skills may help students achieve greater learning gains (Barbetta et al., 1993; Jerome & Barbetta, 2005).

Regarding classroom instruction for students with SLD, teachers should continue to employ evidence-based instructional practices and consider using mobile devices as ASR systems to supplement those practices. With the growing trend of mobile devices in schools and the implementation of BYOD programs, educational professionals should pair these devices with sound practices and use these devices as an extension of what students have already been taught in order to maximize their knowledge. For teachers of students with SLD in inclusive classrooms, technology may be a viable tool to accommodate the needs of learners who may require more individualized practice while simultaneously meeting the needs of other learners without learning disabilities (Akpan, Beard, & McGahey, 2014).

Another recommendation from this study would be to implement a post-session review directly after a lesson and right before a test. In this study, students with SLD showed learning gains when they studied from Quizlet on the iPad and when they studied using handwritten notes directly after a lesson and right before an assessment. Teachers of students who struggle with content area material should also consider introducing students to a note taking system so that students can learn how to organize new information and concepts in their notebooks (Bower & Lobdell, 1999; Mallozzi & Heilbronner, 2013; Young, 2003).

Direct and explicit instruction was a constant during both interventions in this study. Teachers of students with SLD should include this practice in their repertoire of strategies to meet the range of abilities represented in their classrooms (Archer & Hughes, 2011). Direct and explicit instruction enriches the academic experience of students with SLD by providing them with corrective feedback and increased opportunities for active participation, among other features (Archer & Hughes, 2011).

Limitations

Although the results of this study are promising, there are limitations that must be considered. First, single subject designs, by nature, include small populations. As such, initial external validity is limited; however, this can be resolved through direct and systematic replication studies. Additionally, the present study was limited to students in Grade 8 studying U.S. history content who were identified as having SLD. The results of this study cannot be generalized, at this time, to students in other grades, with other disabilities, and learning other content areas. A third limitation is that participants were exposed to each content lesson and end-of-session reviews with the interventions only once. Given this constraint, participants were given only a limited amount of time to study the content. Additionally, the combined matching and fill-in-the-blank format may have been a limitation. Many of the participants struggled with the fill-in-the-blank items. This may have suppressed their overall scores. Another limitation is that there was no maintenance phase, so the long-term effects of the interventions cannot be determined. Lastly, because the results of this study reflect performance outcomes with direct and explicit instruction as a constant during both intervention conditions, it is not possible to compare either condition to a direct and explicit instruction only condition.

Future Research

There are several recommendations for future research. In the current study, all of the participants were Hispanic middle school students with SLD and there was only one female participant. Future studies could include more culturally and linguistically diverse students in elementary or high school settings and include more females. Such studies might lead researchers to understand any cultural and gender differences not only in the area of performance but also issues related to social validity. This study also focused on one particular facet of social studies, U.S. history. Future research should examine other topics such as civics, geography, or economics.

Future researchers could investigate different Apps on different mobile devices. This study used Quizlet designed for use on Apple's iOS operating system. Perhaps other studies could explore different interactive, multimedia applications designed for wireless devices running Android or Windows operating systems.

Different testing formats could also be explored in the future. Future studies could observe student outcomes on the use of all multiple choice questions, fill-in-in-the-blank items with a word bank, oral question-answer format, or a combination of formats. Moreover, future researchers could increase the length of time students spend studying during post-lesson reviews, as well as compare either post-session review with a direct and explicit instruction alone condition. This research used Quizlet on an iPad as an end-of-lesson review following instruction with interactive notebooks. It did not investigate the effects of Quizlet with instruction when students take their own notes without the assistance of the interactive notebook. A future study with students taking their own notes and then using Quizlet to review would add to the findings of this study. Finally, future researchers should consider using different research designs such as a multiple baseline or reversal designs, or if they use the alternating treatments design, they should consider having it end with the best treatment phase to reduce concerns of multiple treatment interference.

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