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ORIGINAL ARTICLE

Teaching American Government Content to Students with Developmental Disabilities Using Technology and Constant Time Delay

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Abstract

Instructional technology plays a role in supporting access to and meaningful participation in general education curriculum for students with developmental disabilities in inclusive classrooms. In this study, two 18-year-old students with developmental disabilities received technology-supported instruction to assist with learning the content in their co-taught American government class. Two interventionists (i.e., a special education teacher and a researcher) implemented video modeling and used constant time delay procedures to teach the pictorial sequencing of three social studies topics on an iPad®. As a secondary measure, students verbally explained the picture sequences. Researchers used a multiple probe design across behaviors and replicated across participants. Visual analysis indicated a functional relation between the use of the intervention and the number of correctly sequenced pictures. Limitations and implications for practice are discussed.

Keywords Academic skills · Constant time delay · Developmental disabilities · High school students · Mobile technologies · Tablet-based intervention · Video modeling

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In the United States, all students with disabilities have the right to a free and appropriate public education (FAPE). However, challenges emerge around the implementation FAPE for high school students with developmental disabilities (DD; e.g., intellectual disability [ID], Down syndrome, autism spectrum disorder [ASD]). For example, researchers have documented concerns related to access to general education curriculum. Often, high-school students with DD are placed in self-contained special education classrooms where educators deliver a functional curriculum (e.g., life-skills program; Browder et al. 2006; Kleinert et al. 2015). Benefits of functional curriculum in self-contained settings include increased opportunities to participate meaningfully in the community that stem from instruction focused on personal management and self-determination (Alberto et al. 2013; Walker et al. 2010). Yet, school districts continue to seek opportunities for students with DD to access the general education curriculum, knowing students with DD need academic content as they transition to their adult lives. To identify ways in which school personnel can promote more access to the general education curriculum, cost-effective and user-friendly resources and supports are needed for students with DD.

One effective way to support acquiring academic content for students with DD involves the use of instructional technologies, such as video models (VM). This type of support allows students to view a complete model, delivered by a peer or adult, of an appropriate behavior or skill set prior to instruction (Catania et al. 2009). In addition, Burton et al. (2013) used video self-modeling, a type of VM where participants view themselves completing a skill, to teach four junior high students with ASD and ID to solve estimation problems related to purchasing items. Not only did all students quickly gain the skill of estimating, but they maintained this skill over a 3-week period when VM self-modeling was faded. Likewise, Yakubova et al. (2015) reported a positive correlation between four high school students' accuracy with subtracting mixed fractions and their use of point-of view VM. In their study, they used a VM with step-by-step explanations of the appropriate skill demonstrated by an adult's hands from a first-person point of view. Within both of these cited studies, participants used an iPad® to watch their VM. In our current study, we combined the principles of VM by having participants use an iPad® application to view completed sequences prior to instruction which included specific audio explanation of each step of the sequence.

Another way to support academic development for students with DD is the use of systematic instruction (SI; Brock and Carter 2013; Pennington et al. 2014; Smith et al. 2011; Spooner et al. 2011). SI is a near-errorless teaching strategy used to teach discrete or chained tasks by incorporating a planned amount of support a student needs to complete a skill at his or her level of independence. Researches used various SI techniques (e.g., constant time delay [CTD], system of least prompts, simultaneous prompting) to teach students with DD in all academic subjects (Spooner et al. 2011, 2012). Additionally, several researchers reported strong effects in pairing systematic instruction with instructional technologies (e.g., Browder et al. 2017; Hua et al. 2013; Hudson et al. 2013; Jameson et al. 2012; Mechling et al. 2007).

Specifically, Browder et al. (2017) used two different systematic instructional techniques, CTD and system of least prompts, to teach story-mapping definitions and procedures to upper elementary students with Autism. During the CTD segment of their study, students used an iPad application to select the correct definition for six story element terms. The interventionist modeled the correct answer for the first session, using a 0 s delay. Then, the interventionist waited for 4 s for subsequent sessions allowing the student to independently respond before providing a model for incorrect or no responses. A functional relation was established for all three student participants with no overlapping data between baseline and intervention. In a similar study, a classroom teacher compared traditional flashcards with digital flashcards on iTouch application and the use of time delay procedures in order for students with DD to learn sight words (Jameson et al. 2012). Both the traditional flashcard and iTouch methods improved students' word-reading accuracy and three of the four students indicated their preference for using the iTouch application. In both of these studies, students mastered discrete skills using technology and CTD, to improve their knowledge of academic content.

According to past studies evaluating the use of SI to teach academic content, researchers have primarily focused on meeting needs of students with DD in the areas of language arts and mathematics (Spooner et al. 2012). Very little research has focused on teaching other content areas, such as social studies, especially in secondary contexts. Students with DD need to learn social studies content (e.g., geography skills, historical events, and politics) because of the close connection to functional skills. For example, social studies concepts (e.g., voting rights, influences of the past on the present, and multiliteracies) connect with full and active participation in a democratic society. As a result, understanding social studies concepts could lead to enhanced self-advocacy and improved communication skills. In line with FAPE, students with DD can benefit from learning their roles, rights, and responsibilities within society.

In the only identified study addressing social studies content and using technology for high school students with DD (Evmenova et al. 2015), the classroom teacher and/or assistant used adapted video techniques (links and closed captioning) within nonfiction academic video clips to teach students with DD about transportation in the United States from the past to present. All four students improved accuracy levels with answering comprehension questions within social studies videos. However, students required several repeated sessions before learning the content, even with the use of these technology adaptations. In addition, students' response patterns indicated difficulty with self-assessing whether their selected responses were correct or incorrect. This finding raises a concern about the pacing of instruction used to deliver general curriculum in inclusive contexts, particularly as it relates to the needs of students with DD. Complementing the use of instructional technologies with systematic instruction would be a unique way to extend Evmenova and colleagues' study, possibly allowing students to meet criteria at an accelerated rate.

The purpose of the present study was to add to the literature on teaching students with DD social studies content paired with readily available classroom mobile technologies and a systematic instructional technique, constant time delay (CTD). Specifically, we used VM and CTD in teaching two students with DD to sequence topics previously taught within their general education co-taught classroom. As a secondary measure, we evaluated students' verbal explanations of the sequenced topics. Three research questions guided our study: (a) What are the effects of using VM and CTD on students' accuracy with sequencing steps in social studies areas?; (b) What are the effects of the intervention on the maintenance of sequencing skills?; and (c) What perceptions do the special education teacher and student participants hold about the feasibility and outcomes of VM and CTD?

Methods

Participants

Mark Mark was an 18-year-old white male student with a primary diagnosis of ASD and a secondary diagnosis of ID. He had an IQ of 54 according to the Wechsler Intelligence Scale - 4th Edition (Wechsler 2003). The Dynamic Learning Map (DLM) alternate assessment (2017) taken a year prior to this study indicated that Mark was proficient in mathematics with basic calculator skills. In reading, he read second-grade-level passages at a rate of 12 words per min with 62% accuracy. He had difficulty summarizing important details. His Individualized Education Program (IEP) goals included increasing reading fluency, reading comprehension skills (i.e., sequencing and retelling), and communication skills. Mark's class schedule included an Instructional English 4, consumer education, foods, inclusive advisory (homeroom), vocational training program, learning strategies class, and co-taught American government/civics.

Tasia Tasia, an 18-year-old white female student with a diagnosis of ID, also participated in this study. When tested in 2012, she had an IQ of 52 according to the Wechsler Intelligence Scale - 4th Edition. Tasia read at a fifth-grade level yet struggled with reading comprehension (i.e., sequencing and retelling). She had IEP goals to increase reading fluency and improve her comprehension skills. Tasia and Mark had similar schedules and had access to paraprofessional and special education teacher supports.

Project Staff

Special Education Teacher Mrs. Smith (pseudonym) served as one of the interventionists and had been a special education teacher for 12 years. She co-taught three classes (American government/civics, world history, and consumer education), taught study skills during learning strategies classes, and taught an instructional English class. During her first block planning period, Mrs. Smith collaborated with the general education American government/civics teacher daily.

Researcher The first author served as a second interventionist for this study. Her previous teaching experience included teaching at the elementary and secondary levels, specializing in teaching general and special education students with all types of disabilities. She had experience teaching academics to students with DD using systematic instruction from the practitioner and researcher standpoint. Both interventionists collaborated on an implementation schedule based on availability.

General Education Teacher Mr. Collins (pseudonym), the American government/civics general educator, had experience teaching social studies for 19 years; his classes regularly included students with learning disabilities and ASD. He used a flipped style of teaching where students watched videos and recorded lectures for homework. During class, Mr. Collins lectured for 10 min to provide a review and then used guided questions in a small group format.

Setting

This study took place in a rural, predominantly white (93%), Midwestern high school with a school population of 530 students. Thirty-two percent of students in the school received free-or-reduced lunch, and approximately 13% of the student population had an identified disability with an IEP. Within their co-taught American government/civics' classroom, Mark and Tasia received academic content instruction from the general education teacher and support from the special education teacher. Mark and Tasia met with the special education teacher and/or researcher (i.e., the interventionist) for approximately 3 min in an adjacent room after the co-taught class. The area was separate from the classroom to avoid carryover effects and to not distract the other students. The interventionist sat next to each student and placed an iPad® in front of him or her. All baseline, intervention, and maintenance sessions were completed in this setting.

Materials

Project staff members met to develop a list of topics to be taught in American government/civics (i.e., the first 7 *Bill of Rights*, the policy making process, and how a President is elected). Based on the results of this meeting, the first author created a task analysis of seven steps, with corresponding pictures for each topic. The first author downloaded the *Advanced Making Sequences* application onto a 32GB classroom Apple iPad4® with WiFi capabilities and imported the copyright free digital images (see Fig. 1 for an example). Using voice recording within the application, the first author stated each task analysis step that corresponded with the pictures in the application (see Fig. 1 for an example of what was stated). Students had not used this application prior to the study. An additional iPad® video recorded all sessions for procedural reliability and interobserver agreement (IOA).

Data Collection

Dependent Variables The interventionists collected data on the students' abilities to sequence seven pictures of the three topics on an iPad® and verbally state the order for each condition of this study (baseline, intervention, and maintenance). Students received a "+" for each independent, correct step sequenced and/or verbal responses or a "-" for incorrect/no response. The researcher graphed the percentage of correct responses for both dependent variables.

Interobserver Agreement Using a data collection sheet and videos collected from each session, a trained graduate student evaluated 100% of the sessions in each phase. Weekly, the researcher compared the graduate student's data with the interventionists' data and calculated IOA using the following formula: the number of agreements divided by the number agreements plus disagreement, then multiplied by 100 (Gast and Ledford 2014). If agreement was below 90%, a coaching session was provided by the researcher to the special education teacher.

Procedural Fidelity The same graduate student evaluated procedural reliability on 100% of sessions using the videos and a checklist of procedures. If procedural fidelity fell below 80%,

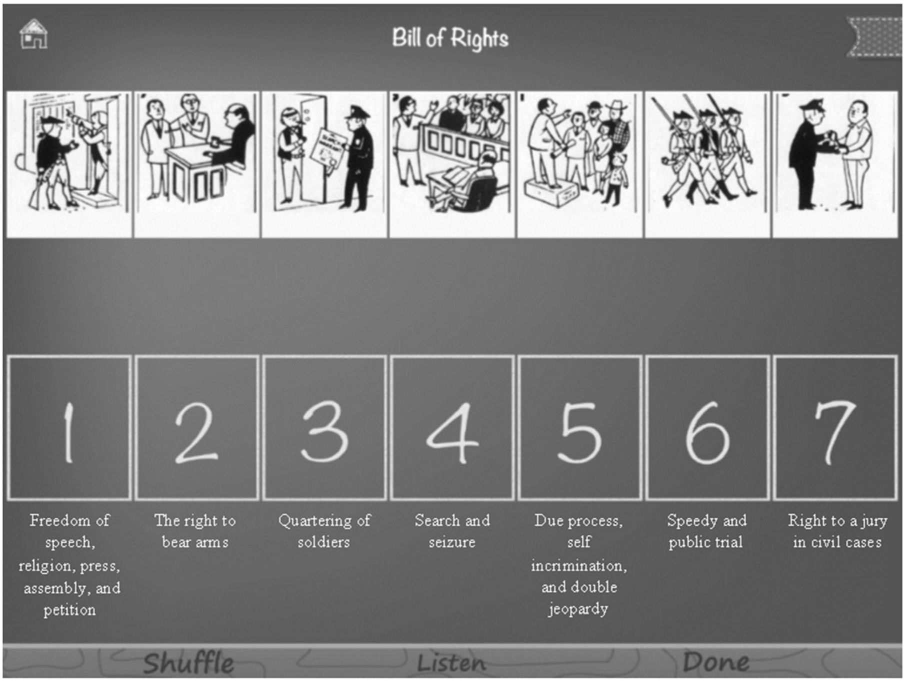

Fig. 1 Sample of the Advanced Making Sequencing application for Topic 1 with typed corresponding task analysis steps

a coaching session was provided by the researcher to the special education teacher. Coaching sessions happened before the special education teacher implemented another session within her classroom, lasting for no more than 10 min. Procedural fidelity required a mean of at least 80% using the formula: the number of observed behaviors divided by the number of planned behaviors and multiplied by 100 (Gast and Ledford 2014). We conducted a training session for the graduate student for both IOA and procedural reliability using mock videos and checklists used within the study until the graduate student reached 100% accuracy for three consecutive instances.

Research Design

A single-case multiple probe across behaviors design (Gast and Ledford 2014) was used to evaluate the effectiveness of VM and CTD on two students' abilities to sequence social studies topics. Students moved into the intervention phase for their first academic topic after attaining stability in baseline (i.e., at least 80% of the data fell within a 25% range of the median; Gast and Ledford 2014) for at least five sessions, and topics discussions were complete within the general education class. The interventionists continued to probe the second and third academic topics intermittently. After Mr. Collins taught the second topic to all students in his class, baseline data included at least five stable data points, and the intervention data for the first topic displayed an upward trend, students moved into the intervention phase for Topic 2. Students met mastery in the intervention phase when they independently and correctly sequenced six of the seven possible pictures (85% accuracy) for two consecutive sessions. Once they met criterion, students moved into maintenance phase for that topic. At least one maintenance probe occurred per topic.

Procedures

Team Planning and Training Project staff members met to discuss course topics and the first author develop task analyses for each topic the students would learn in their co-taught American government/civics' classroom. The first author provided training during Mrs. Smith's planning period over three consecutive days. Training lasted approximately 30 min for the first session and 20 min on each of the following two sessions. The one-on-one training consisted of learning CTD procedures, how to use the application features (i.e., change from the VM screen to the graphic organizer screen), and role-playing. The first author created a treatment of fidelity rubric and evaluated Mrs. Smith during the 20 min role-playing session. We required Mrs. Smith to have two consecutive 0-s and 3-s CTD role-playing sessions with 100% accuracy before providing instruction to the student participants.

Baseline During class time, Mr. Collins taught each topic as a 2- or 3-week unit. The interventionists collected a minimum of five baseline data points for all three topics with each student during their advisory class. For Topic 1, baseline data were collected concurrently with Mr. Collins' instruction. For Topics 2 and 3, the first five baseline sessions were conducted prior to instruction in the general education classroom and then remaining sessions were concurrently conducted. These procedures were implemented to control for carryover effects across the three topics.

Each interventionist started baseline sessions by placing the iPad® in front of the student and using the attentional cue, "Are you ready to sequence?" Once the student responded affirmatively, the interventionist stated, "Sequence the picture of the [topic] and tell me the order when you are finished." This direction was repeated for each of the three academic topics. The interventionists did not provide reinforcement during baseline sessions.

Intervention During each session, the interventionist began with the same attentional cue as in baseline, "Are you ready to sequence?" Once the student replied affirmatively, the interventionist used a stimulus prompt, "Watch the video" to focus the students' attention to the VM and immediately started the video within the iPad® *Advanced Sequences* application. This allowed each student to visually see and hear the topic being sequenced. After the VM finished, the interventionist used the same task direction "Sequence the picture of the [topic] and tell me the order when you are finished."

We selected the systematic instruction technique, CTD, for near-errorless learning using gestural prompts for each picture student participants had to sequence, then a gestural prompt and verbal prompt for students to state the order. The interventionist conducted two sessions of 0 s delay using a gestural controlling prompt for sequencing each of the seven pictures on the iPad®. After the gestural prompt, the student used their finger to place the picture in the correct order on the graphic organizer on the iPad®. If the student had no response, the interventionist provided another gesture prompt. If the student chose the incorrect picture, the interventionist moved that incorrect picture to the top of the screen and gestured to the correct picture. Once the student participant successfully sequenced each picture in the correct order, the interventionist gestured and verbally stated each picture step of the sequence for the second dependent variable. Students were to verbally repeat each step after hearing the interventionist stated the step. If students did not respond correctly or did not respond, the interventionist provided another gestural and verbal prompt followed by the students repeating the prompt. Students received specific verbal praise on a continuous reinforcement schedule for each correctly sequenced picture and verbal response (e.g., "Way to go! You [restate the task step]!").

Upon completion of two sessions with a 0 s delay, the interventionist provided a 3 s delay prior to prompting students to correctly sequence the picture or verbally state the sequence. They used the same attentional cues, stimulus prompt, controlling prompts, error correction procedures, and reinforcement as in the 0 s delay sessions. Each student remained in intervention for each topic until he or she mastered sequencing the topic with at least 85% accuracy for two consecutive sessions. Students moved into a new topic once: (a) Mr. Collins finished teaching the topic; (b) intervention data indicated an upward trend for the previous topic or students met criterion; and (c) baseline for the next topic displayed a low, stable trend indicating more instruction was needed. If students did not meet the criterion after 15 data sessions, the interventionists would add an extra daily session until the criterion was met.

Maintenance We administered maintenance probe sessions once students met criterion for a topic. We collected data approximately 1 week after their last intervention probe and continued for the remainder of the school year. The interventionists did not provide any additional prompts or reinforcements and collected data on correct or incorrect responses. Students received the same attentional cues and task directions as in baseline; however, they did not have the opportunity to watch the VM. Students completed an iPad® graphic organizer by placing the pictures in the correct order and verbally stating the order when finished.

Social Validity

After both students met criterion on all three topics, Mrs. Smith completed a Google Forms survey comprising of Likert scale and short-answer questions on the feasibility of the intervention and training sessions. Additionally, the students completed a paper copy of a survey with corresponding emoji picture faces next to the typed question. The first author individually asked students each question pertaining to the intervention. Descriptive analyses were used to identify mean responses. Short answers were analyzed for themes, compared, and reported.

Results

We visually analyzed line graphs depicting students' responses for both dependent variables in all phases of the study (see Figs. 2 and 3). The visual analyses

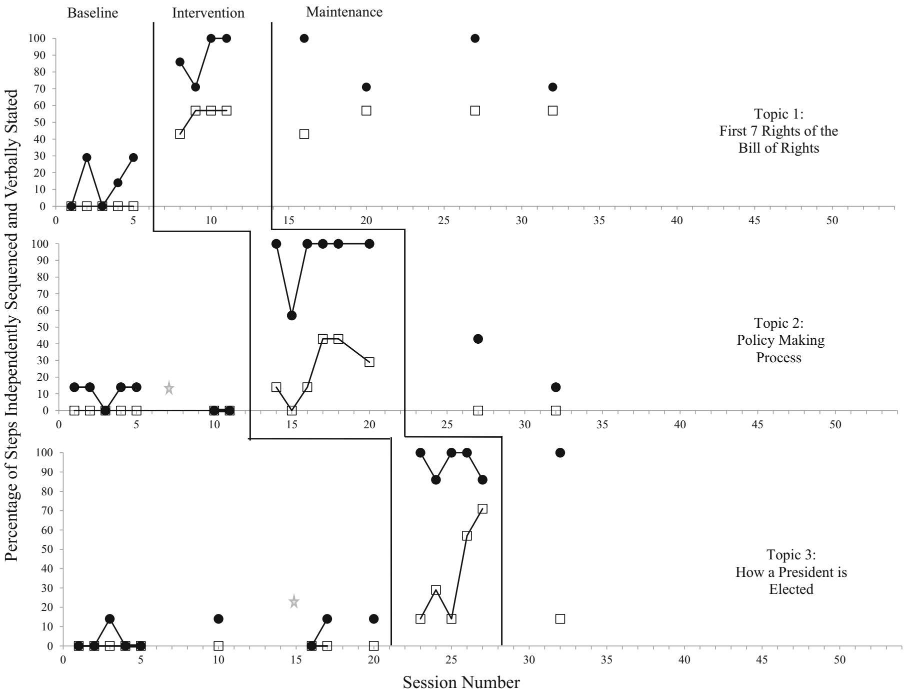

Fig. 2 Mark's percentage of steps independently sequenced (closed circles) and verbally stated (open rectangles) for each topic. The star represents when the general education teacher introduced Topic 2 and 3 in class

included evaluating each student's individual data for patterns within and between phases. The results of the visual analysis revealed functional relations between the independent and both dependent variables for one participant (i.e., Mark). Tasia's data illustrated a demonstration of effect for sequencing pictures for Topic 3 and a demonstration of effect for stating the sequence for Topic 1. Her data for the other topics depicted an upward trend weakening the effect of the intervention. Additionally, we conducted all maintenance sessions for Mark and Tasia with a range of 6–10 days between sessions. Mark maintained his ability to sequence Topics 1 and 3, while Tasia maintained her ability to sequence only Topic 1 for 8 days after reaching criterion.

Accuracy

Mark Mark's picture sequencing data for the Topic 1 ranged from 0 to 29% with a mean of 14% correct during baseline (see Fig. 2). During his first 3 s delay intervention sessions, data accelerated in the direction of improvement to reflect six out of seven pictures sequenced independently. He met criterion of 85% independent correctly sequenced pictures for two consecutive days after only six sessions (including the two 0 s session). For the secondary measure on Topic 1, Mark's data reflected stability, as he did not state any of the sequenced order during baseline. During his first 3 s delay intervention sessions, the data path reflected a level change, as he immediately

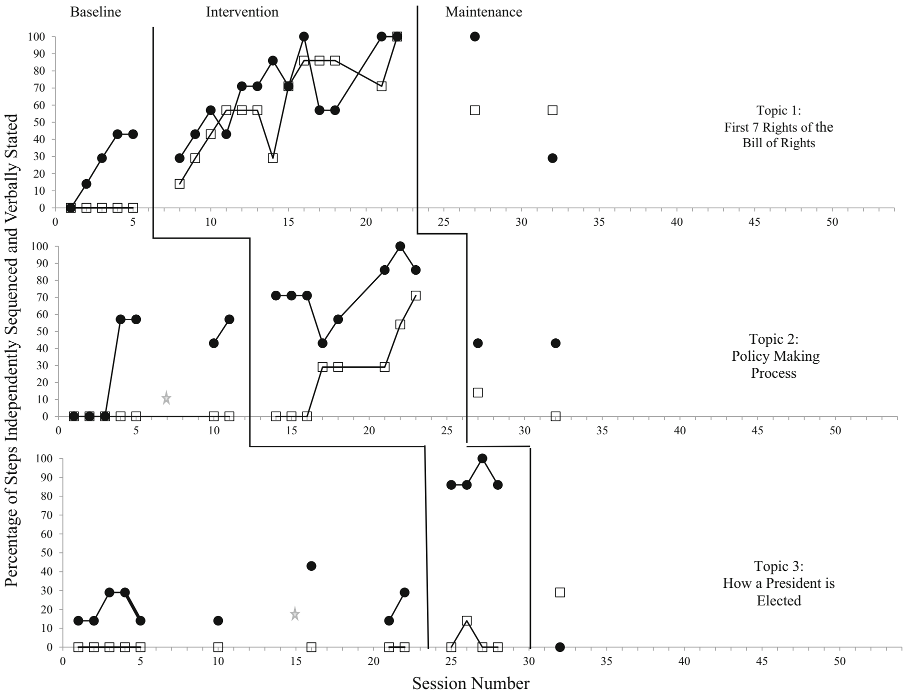

Fig. 3 Tasia's percentage of steps independently sequenced (closed circles) and verbally stated (open rectangles) for each topic. The star represents when the general education teacher introduced Topic 2 and 3 in class

sequenced three pictures (the right to bear arms, quartering of soldiers, and search and seizure). This level of improved performance continued, as he stated these accurately for the rest of the intervention phase for this topic. By the time he met criterion for the first dependent variable, he stated four of seven correctly. Then, Mark moved into intervention phase for Topic 2 in order to stay consistent with the instruction he received in the classroom.

Prior to Mr. Collins teaching a 2-week unit on Topic 2 (the policy-making process), Mark and Tasia received their first five baseline sessions for this topic. Mark's baseline data stabilized at a low level; scores ranged from 0 to 14% ($M=$ 8%) for correctly sequenced pictures. On his last two baseline sessions, Mark was introduced to the policy-making process in his class and he did not sequence any pictures correctly. On his first 3 s delay sessions, Mark sequenced all seven pictures correctly. After a slight decrease at the second 3 s session, he returned to 100%. Mark met criterion after four sessions but continued this phase for two additional sessions while Mr. Collins finished teaching the third topic to the class. For Topic 2, Mark did not state any of the sequenced information verbally during baseline sessions. However, data during 3 s delay intervention sessions depicted an increasing trend and showed very little overlap between phases. Scores in the intervention phase ranged from 0 to 43%; and, he consistently stated the first step correctly.

For Topic 3, we collected the first six data points prior to Mr. Collins teaching this content in class. Mark's last three data points were gathered while Mr. Collins taught Topic 3. Mark's baseline data depicted stability and ranged from 0 to 14% correct (*M* = 6%). This low level of performance indicated that Mark did not fully learn how a President was elected prior to or during class instruction of the topic. Mark met the criterion for Topic 3 after only two sessions; however, we provided three additional sessions to allow him the opportunity to practice verbally sequencing this topic. In baseline sessions, Mark did not recite any picture meanings. However, his intervention data depicted an upward trend; scores reached a higher level and ranged from 14 to 71% (*M* = 33%).

Tasia For the first topic, the first seven rights of the *Bill of Rights*, data depicted an accelerating trend for Tasia's baseline probes; however, she verbally stated phrases of "I don't know what I'm doing" and "That's going to go here, that's going to go here." Baseline data ranged from 0 to 43% (*M* = 26%). Because scores were below or stable at 50%, we started her intervention phase (see Fig. 3). During her first 3 s delay session, she independently sequenced the fifth and seventh pictures. She sequenced three to four pictures in the next few sessions and met criterion after 13 intervention sessions. Data reflect a between-phase overlap; yet, scores stabilize at a higher level in the intervention. For the secondary measure for Topic 1, she did not state the order of any pictures during baseline. Overall, she had a mean of 60% for her 3 s delay intervention sessions with 100% on her final 3 s intervention session.

Tasia's baseline data for Topic 2 reflected variability. On Tasia's sixth and seventh baseline probe sessions, she sequenced three or four pictures correctly. Therefore, she was moved into intervention phase for Topic 2 (the policy making process) when Mr. Collins finished teaching the topic and data for Topic 1 depicted an upward trend. Her data showed a slight level change during her 3 s intervention sessions with a mean of 73% correct which included an additional session while Mr. Collins finished teaching Topic 2. For the secondary measure, data depicted a slow, yet upward trend within her 3 s intervention sessions. During her last session, Tasia verbally stated five of the seven pictures (71%).

For Topic 3 (how a President is elected), Tasia's baseline data depicted slight variability at a low level (range = 14–43%). During her first seven probe sessions, Tasia had no classroom exposure to the information prior to Mr. Collins' teaching the information. Tasia's final two baseline data sessions remained stable at a low level after the content was taught. After only two sessions of 3 s delay, Tasia met criterion. She remained in intervention phase until the end of the week for additional practice with the secondary measure. Overall, she achieved a mean of 90% correct for sequencing the pictures during intervention with 3 s delays. Tasia did not ever state the picture order for the last topic, except for stating the last step during the second 3 s session.

Maintenance

Mark Mark had four maintenance sessions at 7 days, 13 days, 23 days, and 30 days following mastery of Topic 1. He sequenced all seven pictures at day 7. At day 13, this decreased to five pictures. However, at 23 days this increased to all seven correctly sequenced. Thirty days after meeting criterion, he sequenced the first five pictures, but reversed the order of the last two. In addition, Mark verbally stated only three pictures 7 days after meeting criterion but remembered four pictures during the following follow-up sessions.

Due to time constraints, Mark only had two maintenance probes for Topic 2 (at 10 and 17 days following the intervention phase). Ten days after meeting criterion, he sequenced three pictures, followed by sequencing only the first step in the sequence 17 days after reaching criterion. Mark was not able to verbally sequence any pictures from this topic.

For the Topic 3, Mark only had one maintenance probe session 7 days after he mastered the topic. This was his last day of school. He sequenced the pictures with 100% accuracy, but only verbally stated the first step in that sequence.

Tasia Tasia finished intervention for the first and second topic a day apart; therefore, she had fewer maintenance probes than Mark for Topic 1. We conducted maintenance probes with Tasia 8 and 15 days after she met criterion for Topic 1. Tasia remembered all sequenced steps 8 days after she mastered that topic; however, she dropped to 29% 15 days after meeting criterion. Verbally, Tasia had an accuracy rate of 57% for restating both Topic 1 maintenance probes.

For Topic 2, Tasia sequenced the first three pictures correctly (43% accuracy) 7 and 14 days after meeting criterion in intervention phase. However, Tasia only verbally stated one picture sequence at 7 days and did not verbally identify any pictures during her second maintenance session.

Due to time constraints, Tasia only had one maintenance session for Topic 3, 6 days after meeting criterion. She sequenced 29% of the pictures accurately and did not verbally state any pictures correctly.

Social Validity

Teacher Participants Mrs. Smith completed two Google Forms (surveys) after students finished their intervention. Results reflected a mean of 2.75 out of 5, (SD = .46), for items related to the feasibility of the intervention. She perceived CTD procedures to be impractical in the general education classroom as well as for other students with disabilities. Mrs. Smith indicated a neutral stance on whether she would suggest this intervention to other special education teachers. She reported no strong feelings toward the effectiveness of the intervention in this study, yet she viewed CTD as positive overall indicating it “reinforces what is taught in the classroom and can help any student.” In addition, she commented that the use of “visuals are powerful for students” but that the “time, location, and student motivation were an issue with this particular intervention.” Overall, Mrs. Smith was satisfied with the training she received ($M = 4.1$; SD = 0.95). Although Mrs. Smith perceived her training to be successful, she also believed that this intervention was more difficult to implement than she had anticipated due to pragmatic and scheduling concerns. While the extra time spent on individual instruction with each student is a concern, it does and not directly related to the intervention itself. Mr. Collins was given the opportunity to complete a survey, however he did not choose to complete the survey.

Students The first author gave both students a paper copy of the survey and read each question aloud, allowing wait time for them to answer. Overall, Mark and Tasia indicated high levels of satisfaction. Mark's satisfaction scores reflected a mean of 3.38 (SD = 0.65) while Tasia's reflected a mean of 3.69 (SD = 0.85). Both students indicated satisfaction with the amount of knowledge they learned, the intervention, and use of an iPad®. On the open-ended questions, Tasia indicated that this intervention was motivating for her to relearn her the material taught in class. She said she liked being able to look at pictures to sequence them. Mark liked to learn from his mistakes and felt he had gotten better at learning the topics as the intervention went on.

Reliability

Data on sequencing with a graphic organizer reflected a mean IOA of 99.1% for Mark's performance (range = 98.1–100%). Data on verbally sequencing also indicated that Mark earned a mean IOA of 99.7% (range = 99.2–100%). For Tasia, data on sequencing using a graphic organizer reflected a mean IOA of 99% (range = 97.3–100%). For the second dependent variable, Tasia's verbalizations earned a mean IOA of 98.3% (range = 96.1–100%). The mean procedural reliability was 96% (range = 84–100%).

Discussion

This study focused on bridging three literature gaps, specifically the use of affordable technology tailored to students' needs, technology paired with evidence-based interventions, and teaching social studies content to students with DD. It is no surprise that the use of technology continues to grow at a rapid rate (Zheng et al. 2016) with instructional technologies (e.g., SMARTboards and iPads®) as common pieces of technology in today's classrooms. Within this study, students in the co-taught classroom (including student participants) had laptop computers, access to classroom iPads®, and desktop computers readily available to them. Additionally, they used a flipped learning model (Flipped Learning Network 2014) which required technology instruction outside of the classroom (e.g., videos and recorded presentations). The general education teacher chose this format to meet the demands of the fast-paced curriculum in a twenty-first century learning context. Yet, students with DD did not learn the content solely from instruction in the general education classroom with access to these types of technologies, as evidenced by the baseline data. By incorporating the classroom iPad® and installing the *Advanced Making Sequences* application for a minimal fee (USD $4.99), we tailored the technology to what the students needed. We chose this application for: (a) instinctive use for implementer and students, (b) ease of importing class pictures, (c) use of personal voice descriptions of pictures, (d) VM component, and (e) independent picture sequencing. In choosing this application, we investigated materials that bridged the demands of classroom instruction with the students' abilities (Douglas et al. 2012). As researchers and practitioners continue to investigate technology, selecting technology that matches the needs of the students is key to successful interventions.

As displayed in our results, both students had a positive correlation in their ability to sequence academic topics after receiving VM and CTD supports. Having the technology facilitated by a trained interventionist was a key to the success of this intervention. First, the application directly displayed and spoke during the VM portion to help students understand the content through visual and auditory supports. Both students even commented that the use of the VM helped them understand the sequence. Directly following the VM, the interventionist used CTD to facilitate errorless learning. This combination of EBPs, VM and CTD, allowed students to display their understanding of the subject matter in a relatively short time similar to Browder et al. (2017) and Jameson et al. (2012). By providing a quick (less than 3 min) intervention, Mark learned to sequence the topics in less than a week, while Tasia also sequenced Topics 2 and 3 in the same timeframe. Incorporating this package of EBPs could allow students to learn more academic material while keeping up with the demands of the classroom.

In this study, we focused on teaching social studies content, a subject area in which little research has included students with DD. This remains a viable area for exploring ways to support academic content standards with technology applications. With a push towards more access to the general education (IDEIA 2004), students with DD need the opportunity to learn more academic content. Integrating affordable and user-friendly technology devices establishes a promising path for increasing this accessibility. Based on the results reported in this study, technology applications and systematic instruction can be used to support general education curriculum in ways that promote accuracy with the skill of sequencing. Both students met the criteria for sequencing the three topics and verbalized many of the steps associated with the sequences effectively. Similar to the findings from Evmenova et al. (2015), students with disabilities can learn social studies material using technology paired with an EBP in a packaged intervention.

Limitations and Future Research

This study's findings were limited by several factors. First, timing was a major limitation. The intervention was implemented near the end of the school year. This restricted the opportunities to gather of generalization data and assess maintenance effects over a longer term. In addition, the secondary measure of verbally stating the order did not allow the opportunity to reach full mastery. Mark's data depicted a true upward trend for all three topics for the secondary measure while Tasia also displayed an upward trend for her first two topics. Although we can state students learned to sequence the pictures in order, we cannot state they learned a nuanced meaning of the processes represented through pictures. Replications of this study are warranted.

Another limitation was Tasia's overlapping intervention data for Topics 1 and 2. Tasia moved into intervention phase for her second topic because her data depicted an upward trend for Topic 1. As a result of behaviors illustrated with Mrs. Smith, her data decelerated, leading to this overlap for seven 3 s intervention sessions. Tasia met criterion for Topics 1 and 2 on the same day, yet we conducted an additional probe for Topic 2 to gather more data. We controlled for the Hawthorne effect, behaviors not representative of Tasia's normal behavior, by implementing maintenance probes for Tasia towards the end of the study. Researchers should control for overlap by having behaviors meet criteria prior to implementing new topics.

Due to school-based scheduling constraints, this study involved two interventionists. This contributes to a potential limitation wherein patterns in data may reflect differences in students' behavior due to extraneous factors (e.g., personality matches or conflicts). Repeated measurement and procedural fidelity checking were used to mitigate this limitation. Future studies should solely have the special education teacher or another individual in the room be the interventionist as this would be more representative of natural supports and potentially assist with facilitating generalization in other classes.

Implications for Practice

The use of technology in education is growing exponentially; however, there is limited research regarding the use of mobile technologies by high school students with DD when learning academic social studies content, especially within the general education setting. As school districts move towards using one-to-one technology models, practitioners must seek opportunities for students to use mobile technologies that are readily available to students (e.g., iPad®, computers, cell phones) while understanding that technology is not a replacement for teaching (Coleman et al. 2015).

For this study, the *Advanced Making Sequences* application provided a good model for consistency between topics (same size pictures, voice over features for VM, same number of pictures). It was both cost-effective and a time-saver since it took less than 3 min to implement the intervention. Furthermore, the application influenced student learning. Our study identified positive effects on students' accuracy with sequencing steps of key social studies topics. Future students could use this application to sequence a variety of topics related to academic and functional curricula using the VM feature to showcase the full sequence as a guide. Then, teachers could facilitate CTD procedures for students to learn how to sequence those topics/events in order. As an extension, students with DD could learn to use expressive communication skills to explain sequences. For example, students could use the app, VM, and CTD to explain the sequence of historical timelines, events/schedules, days of the week, steps in a recipe, and/or steps to ride public transportation.

Finally, this intervention does not have to take place outside of the classroom in a one-to-one setting nor does this intervention need to rely just on a special education teacher to provide instruction. With brief training, the general education teacher, a paraprofessional, or a peer within the classroom could facilitate this intervention. This would allow the special education teacher to work with other students within the classroom while monitoring the implementation of the intervention for reliability. For example, when all student within a classroom are working in pairs sequencing historical events, a peer could sit next to a student with DD and provide the necessary CTD procedures to help facilitate learning (Jimenez et al. 2012) using an application. This peer interaction/peer tutoring may further enhance the learning experience as such strategies have been found to have positive effects and are inexpensive to implement (Alzahrani and Leko 2018). Furthermore, having multiple options for facilitators allows some choice on the behalf of the student with DD. This enhances motivation, as students are more likely to experience success when individuals with whom they have a positive relationship facilitate learning experiences (Gay 2002).

Compliance with Ethical Standards

Conflict of Interest The authors declare no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the Institutional Review Board and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent All participants and parents/legal guardians signed an informed consent form.

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