Michael Dunn
Darcy Miller
washington State University

Improving Story Writing: Integrating the Story Mnemonic Strategy With iPad Apps for Art and Keyboarding

Abstract

Students with learning disabilities in writing often experience challenges with many or all of the components of creating text. According to the National Center for Education Statistics (2012), 95% of 8th- and 12th-grade students with disabilities failed to score within the proficient range in writing. This multiple-baseline-across-participants study investigated the use of a mnemonic strategy, STORY, integrated with art, evidence-based instruction, and technology. The results show that three participants' texts improved in level and trend for written content and quality. One participant initially improved but developed a negative trend as the intervention phase progressed into maintenance. Study outcomes extend the research on the effectiveness of mnemonic strategies for improving students' writing and demonstrate that art, evidence-based instruction, and technology have the potential to make positive contributions to writing instruction.

Recent years have seen a renewed emphasis on writing proficiency, as reflected in the writing standards in the Common Core State Standards (CCSS) (Council of Chief State School Officers and the National Governors' Association [NGA], 2010) and aligned assessments (e.g., Smarter Balanced, 2015, Partnership for Assessment of Readiness for College and Careers, n.d.). However, managing the task of writing is a significant challenge for many students. For example, assessing fourth-grade writing through a computer-based pilot program, the National Assessment of Educational Progress (NAEP) found that almost 39% of the students had low or marginal skills in writing, demonstrating a lack of correct grammar and mechanics (White, Kim, Chen, & Liu, 2015).

Students with learning disabilities in writing often experience even more challenges with many or all of the components of writing (Gonzalez-Ledo, Barbetta, & Unzueta, 2015; Harris, Graham, Mason, & Friedlander, 2008; Mather, Wendling, & Roberts, 2009). Thus, the Nation's Report Card: Writing 2011 (National Center for Education Statistics, 2012) concluded that 95% of 8th- and 12th-grade students with learning disabilities wrote at or below a basic level. The process of planning, organizing, developing a story line, generating phrases and a first draft, and finessing a final copy of text can all pose great challenges for these students (Graham & Perin, 2007a, 2007b; Mason, Harris, & Graham, 2011; Saddler & Graham, 2007; Sitko, Lane, & Sitko, 2005). Specifically, students with a learning disability in writing may have difficulty with executive function and self-regulation of skills, such as choosing a story topic, feeling confident about what a story outline and plan entails, knowing how to create connected text for a first draft, and recognizing what edits to make in subsequent drafts to render a polished text (Graham, MacArthur, & Fitzgerald, 2013; Polloway, Patton, & Serna, 2005). In addition, attentional issues can also pose challenges for these students (Morin, 2015).

Integrated within the renewed emphasis on writing proficiency in the CCSS is a call for students to use technology to manage learning and

Dunn, M., & Miller, D. (2016). Improving story writing: Integrating the story mnemonic strategy with ipad apps for art and keyboarding. *International Journal for Research in Learning Disabilities, 3*(1), 11-28.

writing tasks. The CCSS include handwriting only to the end of first grade, whereas in second and subsequent grades students are to use technology tools (NGA, 2010). Indeed, writing interventions that integrate technology have been shown to improve the writing quality and skills of students with disabilities (Carnahan, Williamson, Hollingshead, & Israel, 2012; Graham & Perin, 2007a, 2007b; Hetzroni & Shrieber, 2004; MacArthur, 2009; Silio & Barbetta, 2010; Williams, 2002; Wissick & Gardner, 2011), and many studies point to the continuing potential of technology to help students with disabilities improve their academic outcomes in writing (Ahrens, 2011; Bouck, Doughty, Flanagan, Szwed, & Bassestte, 2010; Edyburn, 2006; Englert, Zhao, Dunsmore, Collings, & Wolbers, 2007; Goldberg, Russell, & Cook, 2003; Haq & Elhoweris, 2013; Mason et al., 2011; Patti & Garland 2015; Peterson-Karlan & Parette, 2007; Sitko et al., 2005; Sturm & Rankin-Erickson, 2002).

Bouck et al. (2015) describe a variety of technology supports that show potential for writing intervention and can be integrated into writing instruction to improve outcomes for students with learning disabilities. Speech-to-text software, for example, allows students to voice their ideas while a technology device encodes the text for them, thus providing a means to manage the cognitive load of having to sequence story ideas in lieu of handwriting or typing at the same time. Finally, students with disabilities have been found to be more motivated to write when technology tools are used in instruction (Goldberg et al., 2003; Sturm & Rankin-Erickson, 2002). This is an important consideration given that motivation is a key factor in writing (Boscolo & Gelati, 2013).

Several evidence-based instructional approaches that integrate technology hold promise for teaching writing to students with disabilities. For example, self-regulatory writing practices (Graham & Harris, 2011), composition and mechanics (Edyburn, 2006; Mason et al., 2011), planning, scaffolding, and organization (Englert et al., 2007; Saddler & Asato, 2007; Sitko et al., 2005), concept mapping (Sturm & Rankin-Erickson, 2002), idea generation and organization (Carnahan et al., 2012; Hetzroni & Shrieber, 2004), and procedural facilitators (Graham & Perin, 2007b), all with a technology component, have been shown to improve the writing quality and skills of students with disabilities. However, the key to technology integration is that it is used with evidence-based instruction.

Use of evidence-based practices in teaching writing is recommended by professional organizations and also promoted in government policies (Haynes, 2015). Several evidence-based approaches to teaching writing have yielded positive results, including strategy-regulated strategy instruction (Graham & Harris, 2005), use of mnemonics (e.g., DARE: Develop your topic sentence; Add supporting ideas; Reject arguments for the other side; End with a conclusion; Harris et al., 2008); self-talk/verbalization (e.g., TAPS: Tell the person what you liked about the paper; Ask questions about parts that are unclear; Provide suggestions for making the paper better; Share the revised paper; Mather et al., 2009); and visual imagery (e.g., oral discussion, demonstration of ideas with art, then write a draft text; Graves, 1994).

To address the writing challenges of students with learning disabilities, strategy instruction (Perin, 2013) has been found beneficial. For example, Graham and Perin's (2007a, 2007b) meta-analyses of writing instruction concluded that strategy instruction, which often includes a mnemonic, attained one of the highest effect sizes both for struggling writers and for adolescents in general. Similarly, Gillespie and Graham (2014) concluded that strategy instruction had a statistically significant impact on the writing quality of students with a learning disability.

Strategy instruction, specifically self-regulated strategy development (SRSD), offers educators and students a means to manage the instruction and learning process (Ferretti & Lewis, 2013; Graham et al., 2013; Reid & Lienemann, 2006). The instructional design of SRSD consists of six components: developing and activating background knowledge, discussing the strategy, modeling the strategy, memorizing the strategy, and practice to support the use of the strategy.

Mnemonics are effective additions to strategy instruction as they help students with meanings, understandings, concepts, and the procedures for completing tasks, often referred to as semantic memory (Yee, Chrysikou, & Thompson-Schill (2013). MacArthur and Philippakos (2010) found that using strategy instruction with embedded mnemonics improved the quality of writing and resulting text structure elements for students with learning disabilities. That is, by learning and applying a mnemonic strategy, students can approach writing

tasks in a sequential-step manner (e.g., POW: Plan, Organize, Write [POW], Saddler, Moran, Graham, & Harris, 2004; Chia-Ju & Chiang, 2014; Scruggs & Mastropieri, 2000).

One story grammar mnemonic that has provided struggling writers with an effective means to create and organize content is the WWW, W=2, H=2 mnemonic (Graham & Harris, 1989). The letters making up the mnemonic refer to questions about who is in the story, where the story takes place, when the story takes place, what happens, what happens next, how the story ends, and how the characters feel. Exploring knowledge building, teaching modeling, self-regulation strategy instruction, and the WWW, W=2, H=2 mnemonic, Saddler et al. (2004) concluded that students' use of WWW, W=2, H=2 contributed to improved story content.

Further, self-talk/verbalization (part of strategy instruction and some mnemonics) can promote improvement in students' writing skills (Fidalgoa, Torranceb, Rijlaarsdamc, van den Berghd, & Álvarez, 2015). For example, the Cognitive Strategy Instruction in Writing (CSIW) (Englert et al., 1991; Englert & Mariage, 2003; Troia, 2011), which includes specific self-questions in the stages of the writing process that focus on introducing the topic and details, has been shown to help students include more elaborate content in their writing. Further, using the Think, Talk, Text mnemonic (Think about your story ideas, Talk them out loud, and then generate your written Text), Katahira (2012) found that verbalizing story ideas enabled students to make auditory idea edits before generating text, as advocated by Hayes and Flower (1980). Gardner (2000), in turn, suggested that the auditory domain can help students manage the concurrent aspects of a task such as writing. Finally, verbalizing ideas seems to facilitate automaticity in the writing process and can produce much more elaborate text (Boyle & Charles, 2010; Graham, 2008; MacArthur, 2009).

In addition to strategy instruction, mnemonics, and verbalization, visual imagery can also be helpful for effective story writing (National Center for Learning Disabilities, 2011). Thus, incorporating the arts into the process of planning for writing offers students an option to illustrate what they are thinking and compensates for spelling and text-generation difficulties. For example, with recursive planning and thinking, an image initially thought to be simplistic can become intricate and motivating as the thought processes become more elaborate in "seeing" the image (Patterson, 2011). For writers, using art for planning can be a powerful tool given that during planning almost all of their mental energies can be devoted to the image and what it represents, with the potential of creating more elaborate content and quality text.

Purpose of the Study

The purpose of the present study was to explore the benefits of strategy instruction with a mnemonic that integrated technology and visual imagery. Specifically, the study examined the functional relationship between the STORY mnemonic (Dunn, 2015b) within strategy instruction and the content and quality of participants' typed (keyboarded) texts (and spoken/scribed story plans as a secondary/comparative measure).

Method

A multiple-baseline-across-participants design was employed to explore the use of strategy instruction with a mnemonic using technology and visual imagery. The researchers examined the effects of a mnemonic strategy (STORY) embedded in strategy instruction on participants' spoken/scribed texts (quality and content) and the number of words written over the course of the intervention. The study also explored participants' perceptions of the usefulness of the strategy (social validity) through a qualitative interview process following the study.

Setting

The study took place at a suburban elementary school in the Pacific Northwest region of the United States. The school enrollment was approximately 500 students (males, 53%; females, 47%); American Indian/Alaskan Native, 0.2%; Asian, 2.9%; Native Hawaiian/Other Pacific Islander, 2.7%; Black/African American, 1.2%; Hispanic/Latino, 16.6%; White, 62.5%; two or more races, 11.9%).

Twenty-three of the students had a learning disability and individualized education program (IEP) writing goals. Over 48% of the students par-

ticipated in the free/reduced-price lunch program and 14% received special education services. In the most recent state assessment of writing, a computer-based assessment, 42.3% of the students scored below grade level according to the assessment criteria. The study activities were carried out during the regularly scheduled reading/writing period.

Participants

Participants were recruited from the population of 23 students who had been identified as having a learning disability in the elementary school (see Table 1). The special education teacher (resource room) in the elementary school provided the researchers with a list of all students with identified learning disabilities who also had writing goals in their IEP. The teacher sent letters home with students describing the intervention and the study to elicit interest.

Four students agreed to participate in the study with their parents' consent. All four (a) were identified as having a learning disability, based on the state-mandated intelligence/achievement discrepancy method; (b) were receiving special education services; and (c) were of Caucasian race/ethnicity. According to the *Benchmark Assessment System* (Fountas & Pinnell, 2011) administered by the school, two of the participants, Evan and Kate, were reading at the end-of-first-grade level, whereas the other two, Madoka and Nancy, were reading at the end-of-second-grade level.

Instrumentation

Writing interest interview. Prior to baseline, participants were interviewed using the Writing Interest Interview (Rhodes, 1993). The interview protocol consists of nine questions on a range of topics about writing, including the participants' understanding of writing (What is writing?), their history of writing (Who helped you learn to write?), the challenges of writing (When you are writing and you have a problem, what do you do?), the enjoyment of writing (What do you really like about your writing?), and the improvement of writing (What would you like to improve about your writing?). Emma, the intervention teacher (an education graduate student at the researchers' university), read aloud each question and scribed each participant's answer.

Curriculum-based measurement. Participants completed randomized curriculum-based measurement (CBM) probes on precise and consistent days (i.e., six CBM probes spaced across the baseline, the last three before training; at least five

Table 1
Description of Participants

Participant	Gender	Age	Standard Scores Intelligence	Reading Academic Achievement	Standard Scores in Writing Achievement	Grade Level	Level of Special Education Placement	Minutes per Week in Special Education Placement
Evan	M	9-5	88[1]	1.9[3]	64[4]	4th	Resource Room	240
Kate	F	9-7	78[1]	1.8[3]	79[5]	4th	Resource Room	420
Madoka	M	11-0	78[2]	2.8[3]	58[5]	5th	Resource Room	507
Nancy	F	10-6	83[1]	2.7[3]	93[5]	5th	Resource Room	466

Note. Pseudonymns used.

[1]*Differential Ability Scales II* (Elliot, 2007); [2]*Wechsler Intelligence Scales for Children IV* (Wechsler, 2003); [3]*Benchmark Assessment System* (Fountas & Pinnell, 2011); [4]*Woodcock-Johnson Tests of Achievement III* (Woodcock, McGrew, &Mather, 2001); [5]*Wechsler Individual Achievement Test – Third Edition* (Pearson, 2009).

spaced across the intervention phase with the first three being after training; and one in maintenance) to document change in students' writing ability during baseline and intervention phases.

The CBM assessments consisted of presenting the participants with a simple cartoon picture (different for each student and at each session). The researchers provided Emma with a folder with randomly assorted probes, which she could notate and file to ensure that no two students would do the same probe on a given day or twice during the project. In response to the probes, participants planned and wrote a story about the image or another topic of their choosing. They had 10 minutes to plan their text and 15 minutes to type it on an iPad, provided by the researchers with some initial practice sessions. These timelines reflected the authors' teaching experience of what works well for students and fit the overall 45-minute daily lesson plan.

Story content scores represented the number of WWW, W=2, H=2 (Graham & Harris, 1989) story grammar questions addressed in the participants' story texts. Many studies have used WWW, W=2, H=2 as part of writing interventions with positive effects (e.g., Zumbrunn & Bruning, 2013).

The story quality rubric used was based on Harris and Graham (1996) and the 6+1 Traits of Writing (Education Northwest, 2016). Participants' story quality scores resulted from how each text compared to a 0-7 list of exemplars representing increasing levels of elaborate and finessed prose: 0 = no text, 1 = a few words; 2 = a short description of the picture prompt with incomplete sentences and no sense of story line; 3 = a short description with simple sentences but no sense of story line; 4 = some sense of a story line, no clear introduction and conclusion, and evident grammatical and syntactical errors; 5 = some evidence of an introduction, main event, and conclusion with grammar and punctuation mostly correct but no use of paragraphs or voice; 6 = evident introduction, main event, and conclusion with some use of paragraphing and voice and grammar and punctuation mostly correct; 7 = a clear introduction, main event, and conclusion with use of paragraphs and voice and almost completely correct use of grammar and syntax.

Reliability of the story quality rubric was based on the first author's published studies about story writing, Harris and Graham's (1996) model, and the 6+1 Traits of Writing, with a reliability coefficient of .94 for fifth-grade writing (Coe, Anita, Nishioka, & Smiley, 2011).

Exit interview. At the end of the study, a short exit interview was conducted with each participant consisting of the following questions: What did you like about STORY? What would you change? Do you think other students would benefit from STORY? Have you or will you use STORY in your classroom or at home for other writing tasks? Emma read each question aloud and scribed participants' responses.

Procedures

A multiple-baseline-across-participants design was employed (Kratochwill & Levin, 2014; Kratochwill et al.,, 2010) consisting of a baseline phase, training phase, intervention phase, and maintenance phase. Random assignment determined each student's placement in the sequence of the study (e.g., who was first to receive training in STORY).

The operational definition of the independent variable (IV) was the STORY mnemonic strategy. The four dependent variables (DVs) were spoken and written content and spoken and written quality. Stability at baseline was defined as the last four data points demonstrating a level or declining trend. Kratochwill et al.'s (2010) criteria (e.g., level, variability, stable or negative trend during baseline, overlap, immediacy of effect) helped determine if a functional relationship existed between the IV and DVs (i.e., written story content and quality).

Independent variable. The STORY mnemonic developed by the researchers is grounded in research on language, learning, and writing instruction (e.g., Boyle & Charles, 2010; Dunn, 2015a, 2015b; Dunn & Finley, 2010; Graham, 2008; Graham & Harris, 1989; Harris & Graham, 1996; MacArthur, 2009; Patterson, 2011; Scruggs & Mastropieri, 1992; Troia, 2011; Vygotsky, 1986) (see Figure 1).

The STORY mnemonic and processes employ SRSD elements (developing and activating background knowledge, discussing the strategy, modeling the strategy, memorizing the strategy, and practice to support the use of the strategy) and emphasize questioning and verbalizing story aspects, illustrating stories using technology (e.g., iPads with the Doodle Buddy [2015]), verbalizing story

organization, reflective revisions, reading stories aloud, and obtaining feedback from others. Doodle Buddy, a digital art app, offered students colors and pre-made objects (e.g., houses, trees) to illustrate their story ideas before generating their first draft of typed text.

Teaching the application of the STORY mnemonic involved verbal and physical modeling, guided practice, and the use of cue cards. The daily lesson plan used to implement the STORY mnemonic is included in Figure 2.

STORY

Start thinking about your story by asking key questions such as Who? When? Where? What happened? What happened next? How did the story end? How did the main character feel; the other characters feel? (Graham & Harris, 1989).

Think about your answers and illustrate them on the iPad (Author, 2014).

Organize your thoughts further by verbalizing your ideas aloud and editing them as you type them.

Revise your text to make it more elaborate with descriptive words, better syntax, and grammar.

Your story is now ready for you to read it to someone, receive feedback, and make final edits.

(Dunn, 2015b)

Figure 1. Elements of the STORY mnemonic strategy.

Time (minutes)	Phase and Activity Descriptions
	Baseline
25	Students plan and write about a CBM cartoon picture (no dialogue balloons) or on another topic of their choosing (10 minutes to plan, 15 minutes to write).
	Intervention phase (45 minutes per session; after sessions of SRSD training)
3	Meet and greet.
7	Students listen to a page or two from a book; discuss the reading with the intervention specialist.
5	Spelling practice: students write 3-5 words from the reading; the intervention specialist reviews words/provide corrective feedback.
5	Writing sentences: with a picture book, the intervention specialist has students verbalize some simple sentences. The intervention specialist writes them on a whiteboard. Students copy. The intervention specialist reviews students' writing and provides corrective feedback.
	Combining sentences: The intervention specialist writes two sets of simple sentences on the whiteboard. She asks students to rephrase each pair into one combined sentence with *and, but, or*. She writes them on the whiteboard. The students then write them.
25	Students practice applying the STORY mnemonic strategy.
	On selected days, students begin with doing a CBM probe: students do a cartoon (or personally chosen topic) story probe assessment (10 minutes to plan, 15 minutes to write).

Figure 2. Daily lesson plan.

Initial tasks. Before the start of the study, Emma completed three training sessions with the researchers on the design of the study, the SRSD, the STORY strategy (e.g., modeling of materials and processes to follow), the standard lesson plan for the study, conducting CBMs, administering the writing interest interview/exit interview, and designing keyboard practice sessions. Participants met with Emma 1:1 during the school day for each session in a corner of the school library media center. All study data were collected during these sessions.

Each daily session supplanted 45 of the 60 minutes of the writing instruction typically offered in the general education classroom. The remaining 15 minutes of writing instruction in the general education classroom was not a part of this study, and the STORY strategy was not used during that time. Activities, with the use of technology (e.g., iPads, Chrome Book) for an hour per day, consisted of the following: practice and teacher feedback for prewriting using a graphic organizer; writing an authentic text based on a randomized prompt (e.g., creating a personal narrative about experiences the previous weekend); stating an opinion (introduction, reasons, concluding statement); and revising and editing with the use of reference materials.

General instructional procedures. Following participants' assent to participate in the study, Emma met with each student (always 1:1) to introduce herself and provide an overview of the purpose of the project (i.e., help students improve their story writing skills with technology tools), tell them that they would meet for 45 minutes four times per week (over nine weeks), and inform them that a pizza/sundae lunch would be offered at the end of the project as a thank-you for their participation and a celebration of their work.

During the first pre-data session, each participant met individually with Emma to complete the student assent form and the writing interest interview (Rhodes, 1993), and to practice using the keyboard to type text using the Matcha app (InterArePT, 2014), a plain text word-processing app that includes spell check and a "save to Dropbox.com" feature. Participants practiced typing by entering non-story information (e.g., directions for how to get from point A to B, a recipe for making a meal) and then practiced with the keyboard again at a second session.

Dependent variables. During baseline, participants completed a CBM (Deno, 2003) story probe (randomized across participants). Provided with a black-and-white cartoon picture without dialogue text balloons and the keyboard, each participant was asked to write a story either about the cartoon picture or about another topic of their choosing. They had 10 minutes to plan their text and 15 minutes to type. When they finished a probe, students returned to their general education classroom.

Baseline. With an initial short greeting conversation and completion of the probe, baseline sessions lasted no more than 30 minutes. Since completing even one CBM probe would be challenging for these students with known disabilities in writing, it was deemed best that they complete a CBM probe (be assessed) every few sessions, to balance the need for baseline data with the limits of the participants' motivation.

Training. After at least five CBM probes, the participants, in sequential order as predetermined by random selection, began the training phase. In the first session, Emma discussed with each student how they felt about writing (e.g., referencing participants' answers from the writing interest questionnaire [Rhodes, 1993]) and explained how learning a new mnemonic could help them improve (develop and activate background knowledge). She then presented STORY, described what each letter of the mnemonic represented, and demonstrated the process (discuss the strategy). Emma verbalized all of her thoughts and ideas aloud, such as "I need to get my iPad and open the Doodle Buddy app to create my story plan. I need to think of a story topic. I know; I will write about my trip to the park with my son. I can draw: a sun to illustrate day time, a swing, and my son and I playing soccer. He scored two goals. He jumped for joy that he scored. A house will show that we then went home." These comments enabled students not only to see the story plan and text being created but also to hear Emma's thought processes explaining her illustrated art plan and typed text.

In Session 2 of the training phase, Emma presented STORY with an example again (model the strategy). In two or more story examples during that session, she invited the students to offer more and more input into ideas and content for the plan and text. The students reviewed the STORY mnemonic as a means of improving their recall of STORY and its sequential steps (memorize the strategy).

In Session 3 (as well as Session 4, for some participants), Emma collaborated with each stu-

dent to plan, draft, edit, and finesse more story texts (support the strategy). The aim was to help students attain independence in completing the STORY steps (independent performance). After each text, the students counted the number of words they had written (NWW) and recorded it on a chart – a step that was repeated for each story during the remainder of the study.

Emma and the researchers reviewed each student's text from Session 3. If a student demonstrated an increase of three levels over the lowest scores since Session 1 for written content and at least one level for written quality, the training phase ended; if not, one or more additional training sessions were provided until the student was able to demonstrate the required level of improvement.

Intervention. In the intervention phase, participants applied the STORY mnemonic strategy in each session. For the first four of the intervention sessions (range: 6-24), Emma provided cue cards with the STORY phrases and the WWW, W=2, H=2 questions. Participants subsequently completed the session tasks from memory.

For each session, Emma followed the designated lesson plan (1:1). She greeted the participant at the beginning of each session; read a short story or a portion thereof; discussed the text with the participant by asking questions; had the student make predictions; and, finally, reviewed a few words from the story by asking the participant to spell them on the keyboard. If the words were incorrect, Emma clarified the error and asked the participant to retype. Then, she provided two simple sentences on the whiteboard and asked the participant to combine them into one using *and, or*, or *but*. During the remainder of the session, the participants applied STORY.

Emma reviewed each participant's text at the end of the session and offered feedback on how the prose could better address the STORY components and be more elaborate. According to single-case design methods (Kratochwill & Levin, 2014), selected sessions were designated for the participant to complete a CBM probe. Following the last intervention session, Emma completed the short exit interview with each participant. Two weeks later, each student completed a maintenance probe.

Dependent variables scoring. When participants completed a CBM probe, Emma uploaded their spoken and typed stories as well as their planning documents or images to a password-protected Dropbox.com folder shared with the researchers as a data repository for the project. Two adults with college degrees in education were trained to score the stories. The training involved reviewing the content and quality rubrics, scoring three sample stories (not from the participants) together, independently scoring three sample stories, and, finally, comparing and discussing scores. The scorers obtained 100% inter-scorer reliability on three sample stories before scoring the study participants' stories. Scorers were told to focus on the overall text, meaning, and quality in scoring; spelling, grammar, and syntax errors were considered as a minor element.

On the days when participants had completed a CBM probe, the scorers did their initial scoring independently and then discussed the results via Skype to obtain a 100% agreement. The first author conducted reliability checks (i.e., reviewing the rubric and referencing story texts from past studies) after the scoring of every seventh day's text(s). These scores were then emailed to the researchers for graphing, analyzing trends, and making decisions about each participant's progression through the phases of the project. The number of words written (NWW) was computed by copying/pasting each spoken and typed text into Microsoft Word® and then in Microsoft Excel to obtain the average score per participant, per phase.

Maintenance. Three weeks after the completion of the intervention phase, the participants completed a CBM probe during the maintenance phase (one session). Emma did not review STORY prior to the participants completing the probe nor did she provide cue cards. Participants were asked to plan and type a story either about a cartoon picture or a topic of their choosing.

Fidelity of implementation. Treatment fidelity was ensured in two ways. The researchers and Emma discussed participants' learning and writing each day via email, text message, or phone conversation. Emma's interactions with each participant was observed by one of the researchers for 12 sessions across the phases of the study (about 33% of the sessions of the study). In addition, the designated lesson plan provided a means to note what was completed in each session. From the two types of treatment fidelity data, it was concluded that Emma completed the activities with 99% fidelity.

Results

Students' data included qualitative comments about their perspectives about writing, content and quality scores for the spoken and written texts, and qualitative comments from an exit interview about the STORY mnemonic and the processes of the project.

Writing Interest Interviews

Emma completed a writing interest questionnaire with each student (1:1) by the end of the second session. Evan expressed that he could improve in all aspects of his writing and stated that he liked to write about science topics. Kate stated that good writers practice to improve and that she wanted to be a better writer and was willing to ask for help with spelling. "This year, I can write more words, but I still need help with them. I like writing because you can discuss the good things in your life." Nancy and Madoka said that they appreciated the help that teachers provide for writing. Madoka's goal was to improve her spelling. "I like writing because I can write about what they want." Nancy wanted to improve her punctuation skills and said, "I am getting better at spelling."

Content and Quality Outcomes

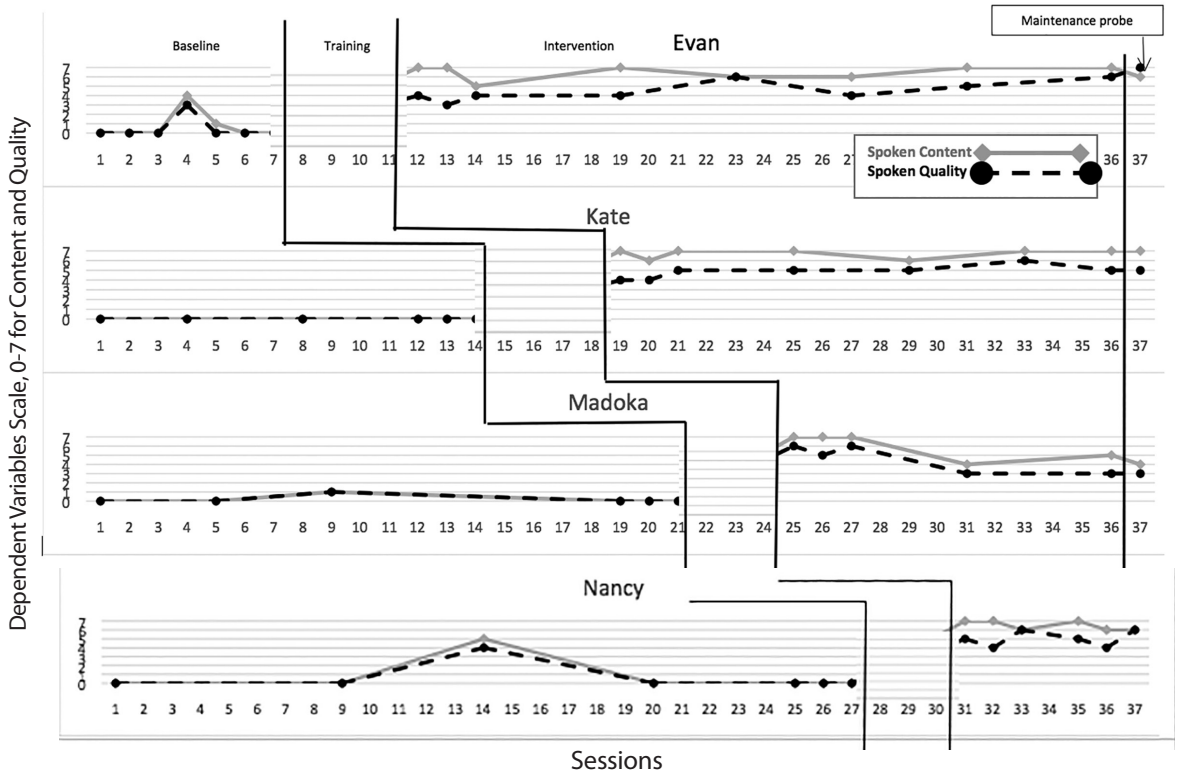
In the sessions that followed, students practiced keyboarding skills, completed the baseline phase during which they wrote stories using any previously learned strategies, completed the training phase to learn STORY, and participated in the intervention phase where they applied the mnemonic strategy. An example STORY product is illustrated in Figure 3. The final session represented a maintenance phase and was held three weeks after the completion of the previous session.

The participants' changes in story content and quality for both spoken and written (typed) texts across the timeline of the project are illustrated in Tables 2 and 3. The participants chose to write about the cartoon prompt for 60% of the sessions while choosing their own story topics for 40% of the sessions. Participants' number of words written is included in Table 4.

Spoken Story	Visual Story Plan	Typed Story Text
A girl and her mom were going to pick out a tree. They saw that most of the trees were already decorated. They picked a tree and tied it on their car. When they got home, all they had to do was put it on the stand. Then they had to eat dinner and get ready for bed. Then they woke up and opened the presents. When they first got up, their dad got home because he was at work. They didn't know that he still had one more present for before they had to go to bed. The girl got a stuffed animal and three iPads. The boy got some books and two laptops. The family was happy.		A tall girl and her littl mom were going to pick out abig tree. They saw that most of the trees were already decorated. They picked a tall tree and tied it on the car. When they got home, all they had to do was put it in the stand. Then they had to eat a bug dinner and get ready for bed. Then they woke up and opened the presents. When they first got up, their dad got home because he was at work. They didn't know their dad still had one more present for before they had to go to bed. The girl got a stuffed animal and three ipads. The boy got some books and two laptops. The family was happy and went to bed.

Figure 3. Kate's session 35 story plan and text.

Table 2
Spoken Content and Quality Scores



Note. All names are pseudonyms.

Table 3
Written Content and Quality Scores

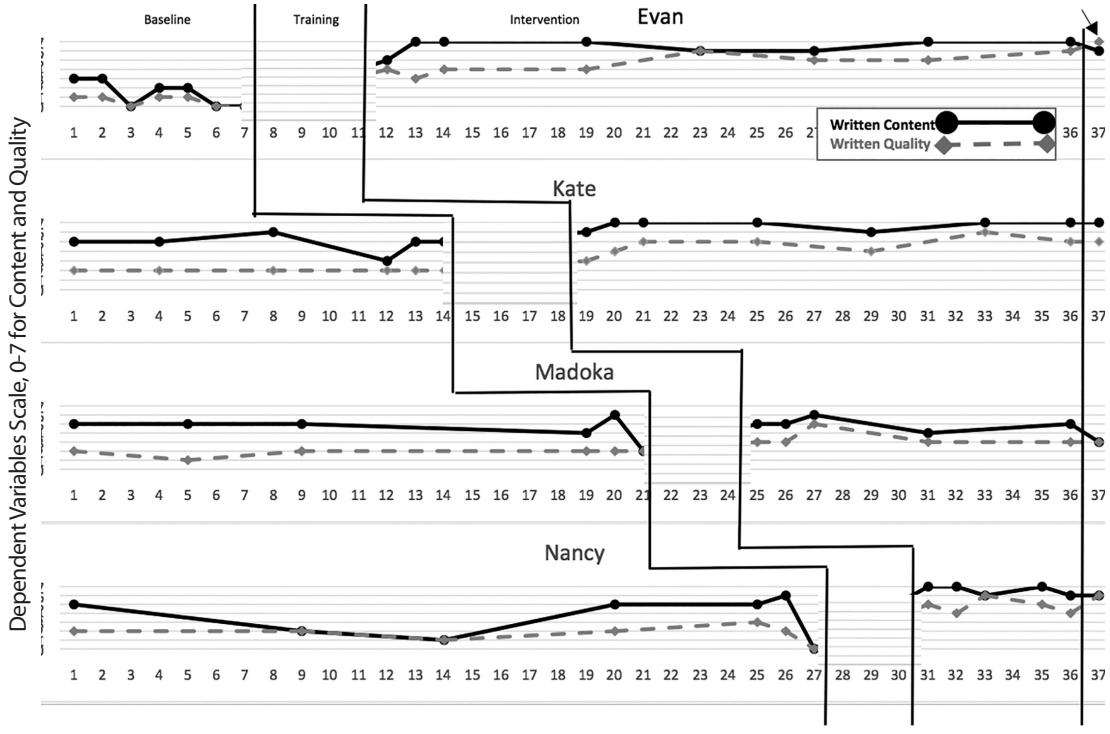


Table 4
Mean Number of Words Written by Phase and Story Type

	Practice Keyboarding	Baseline Text		Intervention Text		Maintenance Text	
		Spoken	Typed	Spoken	Typed	Spoken	Typed
Evan	12	62	9	121	97	69	116
Kate	112	4	64	60	81	82	98
Madoka	47	12	45	130	67	150	137
Nancy	158	57	45	87	73	82	100

Session 31 spoken:

I'm playing a game in my room at the moment called Pokémon Y. I deleted my original file, so I can't have different nicknames. I do not know why I deleted my saved file. I have the whole world face palm. Plus, I was so far. There is actually two other reasons why. One reason is that I wanted my Pokémon to be a higher level. I wanted different Pokémon. I know those are pretty good reasons, but not enough of a reason to delete the file when I'm at the elite four. I feel angry.

Session 31 typed:

I am playing Pokemon y in my light blue room at the moment and I deleted my original game file so I can have different have nicknames. Have the whole world face palm pulse I was so far there is 2 other reason why. One reason is that I wanted my Pokemon to be a higher level. I wanted different Pokemon. I know those are pretty good reasons, but not enough of a reason to delete the file when Im at the elite four. I feel very angry.

Figure 4. Madoka's session 31 spoken and typed texts.

In the practice keyboarding scores, Evan and Madoka had the lowest scores but demonstrated an increasing mean across phases. During baseline, Madoka, Kate and Nancy spoke more text than they typed; Evan did not. During the intervention phase, Evan and Nancy typed less text. In maintenance, only Madoka typed less text than she spoke. Madoka's Session 31 spoken and typed texts, provided in Figure 4, offer an example from near the end of the intervention phase.

Spoken and written content. Evan, Kate, and Nancy increased in level and trend for spoken and written content from baseline to intervention, whereas Madoka increased in trend by the intervention phase for spoken but not for written content. All four participants had 100% non-overlapping data for spoken content; Evan had 100% non-overlapping data for written story content compared to Kate, Madoka, and Nancy, who had 86%, 0%, and 92%, respectively.

Spoken and written quality. Improving quality is challenging given the collective aspects of sentence creation, word choice, story structure, flow of ideas, and so on, involved. Yet, all four participants demonstrated a noticeable increase in level and trend for spoken quality by the intervention phase; Madoka was the only one who had a negative trend. Kate and Madoka had 100% non-overlapping data between baseline and intervention phases for spoken quality. Evan and Nancy had 93% and 83% non-overlapping data, respectively.

Evan and Nancy demonstrated a noticeable increase in level of written quality by the intervention phase. Kate's and Madoca's intervention-phase change in level was positive by one point. All four participants had 0% overlapping data for written quality.

Exit Interviews

In individual interviews at the conclusion of the study, the participants commented that they liked using STORY and found it useful for similar tasks in their schoolwork. Evan said, "I like to draw, and having a picture to look at made thinking about what to write easier for me." Kate mentioned that STORY helped her include more descriptive words in her writing. "I would add a step to STORY: Check your spelling after typing." Madoka and Nancy thought that STORY would be helpful for other children who have difficulty with writing.

Discussion

The findings from this study support the body of research on the effectiveness of mnemonic-strategy instruction for helping students with a learning disability in writing improve their writing skills (Graham & Perin 2007a, 2007b; Perin, 2013; Reid & Lienemann, 2006) and add to the literature about the use of self-regulated strategy development (SRSD) (Graham, MacArthur, & Fitzgerald, 2013) in learning and applying the STORY mnemonic strategy with technology apps. Although it comes as no surprise that evidence-based instructional approaches (e.g., SRSD) improved student learning, it is interesting to note that the use of art in planning and keyboarding to generate text contributed to the outcomes; however, it is not clear how much these two factors influenced the outcomes or what specific elements of writing they impacted. Therefore, while these findings extend the literature base by indicating that art and technology may be important elements of instructional strategies for improving writing skills, further research on their impact on writing is warranted.

The participants' progress demonstrated relative stability from early in the intervention phase throughout the sessions. For example, it was encouraging to see that STORY helped these students with learning disabilities demonstrate gains after only three to four training sessions. Strategy instruction, as can be assessed in a single-subject design study, can make a positive difference for students with learning disabilities in writing (Ferretti & Lewis, 2013; Graham et al., 2013; Kratochwill, & Levin, 2014; Kratochwill et al., 2010; Perin, 2013; Reid & Lienemann, 2006). All four participants' CBM probe data improved with spoken and written texts in content and quality, but only three participants (Evan, Kate, and Nancy) demonstrated a functional relationship across the four dependent variables.

Madoka increased her performance in level for spoken content and quality as well as written quality, but written content proved to be a challenge for her, as all of her data overlapped with baseline. It is interesting that she improved in level of spoken content and quality as well as written story quality (e.g., idea generation, word choice, spelling, sentence creation, story structure), a more difficult component of writing than content (e.g., answering and stating who, when, where). Yet, she did not sustain a positive trend as the intervention phase continued. Emma noted that Madoka tended to fixate on one or a few details while writing, as illustrated in her Session 31 story. To fully understand why students like Madoka continue to have difficulties with some aspects of writing after learning and applying evidence-based instructional tools such as STORY, further research is needed.

The data on the participants' NWW support the researchers' assumption that the participants would type more text as the phases of the study progressed. Indeed, Evan's, Kate's, and Madoka's spoken stories included larger NWW counts from baseline to intervention to maintenance. Nancy's NWW increased from baseline to intervention, but her maintenance total was five words fewer than the previous phase; yet her spoken content and quality scores increased in level, and she had 0% overlapping data compared to baseline.

The conclusion that may be drawn from these data is that students become more focused as they write so as to make each word and sentence count, as demonstrated in the intervention and maintenance phase data. Alternatively, some students have difficulty expressing ideas well with words. For example, Madoka typed many words (e.g., 67 or more), but they did not progressively translate well to improved content and quality.

Participants demonstrated improvement in content and quality while using technology. With initial practice and continued use of the STORY mnemonic across the sessions, participants' composition of more elaborate texts improved. Specifically, Evan commented that using Doodle Buddy to draw was helpful.

Implications for Practice

The results of this study offer insights into how to promote improvement of the writing skills of students with learning disabilities. First, the study highlights the multifaceted nature of learning disabilities in writing. Writing is a challenging domain, but with ongoing practice and teacher interaction, student performance can improve. Teachers should implement as daily practice a review of and references to published stories, working with words and sentences, modeling, guided practice, including examples of how writing-skills practice can help with various forms of writing (e.g., story narrative, informational, and argumentative/persuasive) (NGA, 2010).

Through focused intervention with teacher modeling, guided practice, and students developing independence in managing the writing task, students in this study enhanced their writing (Graham & Harris, 2005). In doing so, they increased the number of words written (NWW) and learned to develop word-choice skills that improved both content and quality. In practice, these approaches can be further explored.

Also, technology tools (e.g., mobile devices) offered students access to practice tools and imagery supports, providing an example for the field of how these tools can be used. Infusion of the arts, such as visual media, gives students an opportunity to benefit from visual cues, an evidence-based practice for students with learning disabilities (National Center for Learning Disabilities, 2011).

Technology tools allow writing tasks to be more current and reflective of students' world today (Bouck, Meyer, Satsangi, Savage, & Hunley, 2015). Students see people around them using technology tools, so using these tools in their school work will not only seem natural, but also potentially motivating and engaging. Further, technology helps alleviate the task of generating text as it reduces the visual-motor integration challenges that often impact handwriting and manuscript printing for students with learning disabilities. In short, keyboarding helps free mental energy for idea generation, storyline planning, and creating elaborate text.

Limitations and Future Research

The participating school assessed students for a learning disability, but those types of assessments are typically more focused on reading than writing, so it is difficult to gauge the extent of participants' writing "disability." However, as illustrated, students' written work during baseline demonstrated a need for learning and using the STORY mnemonic. The existence and widespread use of a multidisciplinary evaluation with a focus on writing could help teachers understand students' writing strengths and weaknesses and, therefore, better focus their instruction. For example, in-depth writing assessment data might have offered more insight into Madoka's change in scores across the project.

The students' choice of writing about the assigned topic (the cartoon) for 60% of the sessions and writing about a topic of their own choice for 40% of the sessions present possible confounds to study results, including such factors as familiarity with the topics, motivation, and previous writing experiences impacting the results more than the independent variable. Future research in this area, therefore, will need to control for these potential confounding variables to ascertain their impact on interventions.

Conclusion

Writing is a multicomponent process – from idea generation to planning to final copy – during which an interaction of strategies occurs. As reflected in this study's results, students demonstrated gains in story-writing content and quality. The contributions to participants' improvement of (a) the novel use of technology, (b) fluency with typing on a virtual keyboard, or (c) merely not having to write with a pen and paper, remain unclear. While participants' spoken vs. typed texts offer some insight into the differences, more research on their thoughts at each stage of the process would be beneficial for developing effective writing interventions.

References

Ahrens, K. (2011). Build an assistive technology toolkit. *Learning and Leading with Technology, 39*, 22-24.

Boscolo, P., & Gelati, C. (2013). Best practices in promoting motivation for writing. In S. Graham, C. A. MacArthur, & J. Fitzgerald (Eds.), *Best practices in writing instruction: Second edition* (Kindle eBook Location 5552-6063). New York, NY: Guilford Press.

Bouck, E. C., Doughty, T. T., Flanagan, S. M., Szwed, K., & Bassette, L. (2010). Is the pen mightier? Using pentop computers to improve secondary students' writing. *Journal of Special Education Technology, 25*(4), 33-47.

Bouck, E. C., Meyer, N. K., Satsangi, R., Savage, M. N., & Hunley, M. (2015). Free computer-based assistive technology to support students with high incidence disabilities in the writing process. *Preventing School Failure: Alternative Education for Children and Youth, 59*(2), 90-97. doi:10.1080/1045988X.2013.841116

Boyle, B., & Charles, M. (2010). Using socio-dramatic play to support a beginning writer: "Daniel the doctor and the bleeding ball." *International Journal of Early Years Education*, *18*(3), 213-225.

Carnahan, C. R., Williamson, P. S., Hollingshead, A., & Israel, M. (2012). Using technology to support balanced literacy for students with significant disabilities. *Teaching Exceptional Children, 45*(1), 20-29.

Chia-Ju, L., & Chiang, W. (2014). Theory, method, and practice of neuroscientific findings in science education. *International Journal of Science and Mathematics Education, 12*, 629-646.

Coe, M., Anita, M., Nishioka, V., & Smiley, R. (2011). *An investigation of the impact of the 6+1 trait writing model on grade 5 student writing achievement*. Washington, DC: US Department of Eductaion, Institute of Education Sciences. Retrieved from http://files.eric.ed.gov/fulltext/ED527445.pdf

Deno, S. L. (2003). Developments in curriculum-based measurement. *The Journal of Special Education, 37*(3), 184-192.

Doodle Buddy. (2015). *iPad art application*. Retrieved from www.pinger.zendesk.com.

Dunn, M. W. (2015a). Students with dysgraphia: Applying assistive technology tools to help with pre-writing. *The Journal of Educational Policies and Current Practices*, *1*(1), 99-111. doi:10.15340/2147336612844

Dunn, M. W. (2015b). Struggling writers' use of iPad art and text apps for story writing. *Canadian Journal of Action Research, 16*(2), 6-21.

Dunn, M. W., & Finley, S. (2010). Exploring children's thoughts about writing: Offering storytelling, visual arts, and keyboarding to promote narrative story writing. *Multicultural Education, 18*(1), 33-42.

Education Northwest. (2016). *6+1 trait writing.* Retrieved from http://educationnorthwest.org/traits.

Edyburn, D. L. (2006). Cognitive prostheses for students with mild disabilities: Is this what assistive technology looks like? *Journal of Special Education Technology, 21*, 62-65.

Englert, C. S., & Mariage, T. (2003). The sociocultural model in special education interventions: Apprenticing students in higher-order thinking. In L. Swanson, K. R. Harris, & S. Graham (Eds.), *The handbook of learning disabilities* (pp. 450-467). New York, NY: Guilford Press.

Englert, C. S., Raphael, T. E., Anderson, L. M., Anthony, H. M., Stevens, D. D., & Fear, K. L. (1991). Making writing strategies and self-talk visible: Cognitive strategy instruction in writing in regular and special education classrooms. *American Educational Research Journal, 2*, 337-372.

Englert, C. S., Zhao, Y., Dunsmore, K., Collings, N. Y., & Wolbers, K. (2007). Scaffolding the performance of students through technology. *Learning Disaability Research and Practice, 20*, 184-198.

Ferretti, R. P., & Lewis, W. E. (2013). Best practices in teaching argumentative writing. In S. Graham, C. A. MacArthur, & J. Fitzgerald (Eds.), *Best practices in writing instruction: Second edition* (Kindle eBook Location 2153-2735). New York, NY: Guilford Press.

Fidalgoa, R., Torrance, M., Rijlaarsdamc, G., van den Berghd, H., & Álvarez, M. L. (2015). Strategy-focused writing instruction: Just observing and reflecting on a model benefits 6th grade students. *Contemporary Educational Psychology*, *41*, 37-50.

Fountas, I. C., & Pinnell, G. S. (2011). *Benchmark assessment system*. Portsmouth, NH: Heinemann.

Gardner, H. (2000). *Intelligence reframed: Multiple intelligences for the 21st century*. New York, NY: Basic.

Gillespie, A., & Graham, S. (2014). A meta-analysis of writing interventions for students with learning disabilities. *Exceptional Children, 80*, 454-473.

Goldberg, A., Russell, M., & Cook, A. (2003). The effect of computers on student writing: A meta-analysis of studies from 1992 to 2002. *Journal of Technology, Learning, and Assessment, 2*, 1-52.

Gonzalez-Ledo, M., Barbetta, P. M., & Unzueta, C. H. (2015). The effects of computer graphic organizers on the narrative writing of elementary school students with specific learning disabilities. *Journal of Special Education Technology, 30*(1), 29-42.

Graham, S. (2008). *The power of the word processing for the student writer*. Wisconsin Rapids, WI: Renaissance Learning. Retrieved from http://doc.renlearn.com/KMNet/R004215628GH546B.pdf

Graham, S., & Harris, K. R. (2005). *Writing better: Effective strategies for teaching students with learning difficulties*. Baltimore, MD: Paul H. Brookes Publishing Co.

Graham, S., & Harris, K. R. (1989). A component analysis of cognitive strategy instruction: Effects on learning disabled students' compositions and self-efficacy. *Journal of Educational Psychology, 81*, 353-361.

Graham, S., & Harris, K. R. (2011). Writing and students with disabilities. In J. M. Kaufman & D. P. Hallahan (Eds.), *Handbook of special education* (pp. 422-433). New York, NY: Routledge.

Graham, S., & Harris, K. (2013). Common core state standards, writing, and students with LD: Recommendations. *Learning Disabilities Research & Practice, 28*(1), 28-37.

Graham, S., MacArthur, C. A., & Fitzgerald, J. (2013). *Best practices in writing instruction: Second edition*. New York, NY: Guilford Press.

Graham, S., & D. Perin. (2007a). *Writing next: Effective strategies to improve writing of adolescents in middle and high schools – A report to Carnegie Corporation of New York.* Washington, DC: Alliance for Excellent Education.

Graham, S., & Perin, D. (2007b). A meta-analysis of writing instruction for adolescent students. *Journal of Educational Psychology, 99,* 445-476.

Graves, D. H. (1994). *A fresh look at writing.* Portsmouth, NH: Heinemann.

Harris, K. R., & Graham, S. (1996). *Making the writing process work: Strategies for composition and selfregulation*. Cambridge, MA: Brookline Books.

Harris, K. R., Graham, S., Mason, L., & Friedlander, B. (2008). *Powerful writing strategies for all students*. Baltimore, MD: Brookes.

Haq, F. S., & Elhoweris, H. (2013). Using assistive technology to enhance the learning of basic literacy skills for students with learning disabilities. *International Journal of Social Sciences and Education*, *3*(4), 880-885.

Hayes, J. R., & Flower, L. S. (1980). Identifying the organization of writing processes. In L. W. Gregg & E. R. Steinberg (Eds.), *Cognitive processes in writing* (pp. 3-30). Hillsdale, NJ: Erlbaum.

Haynes, M. (2015). *The next chapter: Supporting literacy within ESEA*. Washington, DC: Alliance for Excellent Education. Retrieved from http://all4ed.org/wp-content/uploads/2015/08/LiteracyWithinESEA.pdf.

Hetzroni, O. E., & Shrieber, B. (2004). Word processing as an assistive technology tool for enhancing academic outcomes of students with writing disabilities in the general classroom. *Journal of Learning Disabilities, 37*(2), 143-154.

InterArePT. (2014). *Matcha: Writing app & text processor*. Retrieved from https://itunes.apple.com/us/app/matcha-writing-app-text-processor/id576774808?mt=8

Katahira, J. (2012). *Note writing in the primary classroom*. Retrieved from http://www.readwritethink.org/classroom-resources/lesson-plans/note-writing-primary-classroom-285.html

Kratochwill, T. R., & Levin, J. R. (2014) *Single-case intervention research: Methodological and statistical advances*. Washington, DC: American Psychological Association.

Kratochwill, T. R., Hitchcock, J., Horner, R. H., Levin, J. R., Odom, S. L., Rindskopf, D. M., & Shadish, W. R. (2010). *Single-case designs technical documentation*. Retrieved from http://ies.ed.gov/ncee/wwc/pdf/wwc_scd.pdf.

MacArthur, C. A. (2009). Reflections on research on writing and technology for struggling writers. *Learning Disabilities Research & Practice, 24,* 93-103.

MacArthur, C. A., & Philippakos, Z. (2010). Instruction in a strategy for compare-contrast writing with students with learning disabilities. *Exceptional Children, 76*, 438-456.

Mason, L. H., Harris, K. R., & Graham, S. (2011). Self-regulated strategy development for students with writing disabilities. *Theory Into Practice 50*, 20-27.

Mather, N., Wendling, B. J., & Roberts, R. (2009). *Writing assessment and instruction for students with learning disabilities.* San Franciso, CA: Jossey-Bass.

Morin, A. (2015). *Understanding ADHD*. Retrieved from https://www.understood.org/en/learning-attention-issues/child-learning-disabilities/add-adhd/understanding-adhd#item1

National Center for Education Statistics. (2012). *The nation's report card: Writing 2011* (NCES 2012-470). Washington, DC: U.S. Department of Education, Institute of Education Sciences.

National Center for Learning Disabilities. (2011). *Learning disabilities and the arts*. Retrieved from http://www.ncld.org/in-the-home/parenting-issues/play-enrichment-aamp-holidays/learning-disabilities-and-the-arts

National Governors Association Center for Best Practices, Council of Chief State School Officers. (2010). *Common core state standards for English language arts and literacy in history/social studies, science, and technical subjects*. Washington, DC: Authors.

Partnership for Assessment of Readiness for College and Careers. (n.d.). Retrieved from http://parcc.pearson.com/

Patterson, F. (2011). *Photography and the art of seeing: A visual perception workshop for film and digital photography.* Toronto, Canada: Key Porter Books.

Patti, A. L., & Garland, K. V. (2015). Smartpen applications for meeting the needs of students with learning disabilities in inclusive classrooms. *Journal of Special Education Technology, 30*(4), 238-244.

Pearson Education. (2009). *Wechsler individual achievement test – Third edition*. New York, NY: Author.

Petersen-Karlan, G. R., & Parette, H. P. (2007). *Supporting struggling writers using technology: Evidence-based instruction and decision making*. Washington, DC: National Center for Technology Innovation. Retrieved from http://www.techmatrix.org/researchProfile.aspx?rid=411

Perin, D. (2013). Best practices in teaching writng for college and career readiness. In S. Graham, C. A. MacArthur, & J. Fitzgerald (Eds.), *Best practices in writing instruction: Second edition* (Kindle eBook Location 1127-1617). New York, NY: Guilford Press.

Polloway, E. A., Patton, J. R., & Serna, L. (2005). *Strategies for teaching learners with special needs* (8th ed.). Upper Saddle River, NJ: Pearson.

Reid, R., & Lienemann, T. (2006). *Strategy Instruction for students with learning disabilities.* New York, NY: Guilford Press.

Rhodes, L. K. (1993). *Literacy assessment: A handbook of instruments*. Portsmouth, NH: Heinemann.

Saddler, B., & Asato, K. (2007). Increasing story quality through planning and revising: Effects on young writers with learning disabilities. *Learning Disability Quarterly, 30*, 223-234.

Saddler, B., & Graham, S. (2007). The relationship between writing knowledge and writing performance among more and less skilled writers. *Reading and Writing Quarterly, 23*, 231-247.

Saddler, B., Moran, S., Graham, S., & Harris, K. R. (2004). Preventing writing difficulties: The effects of planning strategy instruction on the writing performance of struggling writers. *Exceptionality, 12*, 13-17.

Scruggs, T., & Mastropieri, M. (2000). The effectiveness of mnemonic instruction for students with learning and behavior problems: An update and research synthesis. *Journal of Behavioral Education, 10*, 163-173.

Scruggs, T. E., & Mastropieri, M. A. (1992). Classroom practices of mnemonic instruction: acquisition, maintenance, and generalization. *Exceptional Children, 58*, 219-229.

Silio, M., & Barbetta, P. M. (2010). The effects of word prediction and text-to-speech technologies on the narrative writing skills of Hispanic students with specific learning disabilities. *Journal of Special Education Technology, 25*(4), 17-32.

Sitko, M. C., Lane, C. J., & Sitko, C. (2005). Writing tools: Technology and strategies for struggling writers. In D. Edyburn, K. Higgins, & R. Boone (Eds.), *Handbook of special education technology research and practice* (pp. 571-598). Whitefish Bay, WI: Knowledge by Design.

Smarter Balanced. (2015). Retrieved from http://www.smarterbalanced.org/

Sturm, J. R., & Rankin-Erickson, J. L.(2002). Effects of hand-drawn and computer-generated concept mapping on the expository writing of middle school students with learning disabilities. *Learning Disabilities Research & Practice, 17*, 124-139.

Troia, G. (2011). *Instruction and assessment for struggling writers: Evidence-based practices*. New York, NY: Guilford Press.

Vygotsky, L. (1986). *Thought and language*. Cambridge, MA: The M.I.T. Press.

Wechsler, D. (2003). *Wechsler intelligence scales for children IV*. New York, NY: Pearson Education.

White, S., Kim, Y., Chen, J., & Liu, F. (2015). *Performance of fourth-grade students in the 2012 NAEP computer-based writing pilot assessment: Scores, text length, and use of editing tools* (NCES 2015-119). Washington, DC: U.S. Department of Education, National Center for Education Statistics, Institute of Education Sciences.

Willams, S. (2002). How speech-feedback and word-prediction software can help students write. *Teaching Exceptional Children, 34*(3), 72-78.

Wissick, C. A., & Gardner, J. E. (2011). Technology and academic instructional considerations for students with high-incidence cognitive disabilities. In J. T. Kauffman & D. P. Hallahan (Eds.), *Handbook of special education* (pp. 181-500). New York, NY: Routledge.

Woodcock, R. W., McGrew, K. S., & Mather, N. (2001). *Woodcock-Johnson tests of achievement III*. Itasca, IL: Riverside Publishing.

Yee, E., Chrysikou, E. G., & Thompson-Schill, S. L. (2013). The cognitive neuroscience of semantic memory. In K. N. Ochsner & S. Kosslyn (Eds.), *The Oxford handbook of cognitive neuroscience, Volume 1: Core topics*. New York, NY: Oxford University Press.

Zumbrunn, S., & Burning, R. (2013). Improving the writing and knowledge of emergent writers: The effects of self-regulated strategy development. *Reading and Writing, 26*(1)*,* 91-11