

# Supporting the Writing Process with Technology for Students with Disabilities

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## Abstract

Many students with learning disabilities (LD) and emotional/behavioral disorders (EBD) struggle with the writing process. Technology has shown to be effective in supporting prewriting, drafting, revising, proofreading, and publishing of written products. This article explains the use of one technology-based graphic organizer with embedded self-regulated learning strategies as well as universal design for learning (UDL) features that can be used to enhance the writing process for students with LD and EBD. Such technology categories as technology-based graphic organizers, word prediction, speech recognition, talking word processors, as well as multimedia and digital storytelling programs are discussed. All these technologies can improve the quantity and/or quality of student writing.

## Keywords

writing process, technology, technology-based graphic organizers

The process approach to writing instruction is widely used by teachers in K–12 classrooms. Over 30 years ago, researchers influenced the development of the writing process to include planning, drafting, revising/editing, and publishing (e.g., Graves, 1983; Hayes & Flower, 1986). Moving through the intricate process is recursive in nature. The physical act of handwriting can be difficult for students and the metacognitive skills needed to persist through the complexities of the writing process can be challenging for students with learning disabilities (LD) and students with emotional and behavioral disorder (EBD; Gage, Wilson, & Macsuga-Gage, 2014; Wagner et al., 2005). Many students with LD who struggle with writing are less skilled with language and with using self-regulatory skills in order to compose highly organized coherent text (Graham, Harris, & Mason, 2005; Zumbrunn & Bruning, 2013). For individuals with EBD, who are often characterized as disorganized, impulsive, and inattentive (Kauffman & Landrum, 2018), the skill to stop and self-monitor their writing in the iterative process of planning, drafting, revising, and drafting again is only exacerbated. Both student groups tend to produce writing that is shorter, marked with mechanical errors, and lower in overall quality (Kauffman & Landrum, 2018; Troia, 2006). Such limited success only heightens their lack of motivation to write. Therefore, teaching specific strategies is

critical so that students with LD and EBD can use them as a guide for thinking metacognitively throughout the writing process. Moreover, prior research shows that strategy instruction across grade levels and settings is one of the most effective tools for students with LD, students without disabilities, and students who simply do not write well (Graham, Harris, & Santangelo, 2015; Rogers & Graham, 2008).

For example, after teaching eighth graders with EBD a persuasive writing strategy inclusive of a graphic organizer, the students planned for and composed an essay with organized ideas and details (Hauth, Mastropieri, Scruggs, & Regan, 2013). In another study, middle school students with EBD demonstrated successful use of a structured peer revision strategy following a persuasive quick-write response (Cramer & Mason, 2014). Finally, a considerable body of literature provides evidence that the self-regulated strategy

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development (SRSD) model improves the quality of writing for students with LD or EBD and their typical peers (Gillespie & Graham, 2014; Graham & Perin, 2007; Losinski, Cuenca-Carlino, Zablocki, & Teagarden, 2014). SRSD provides students with multiple self-regulatory strategies to use throughout the writing process for planning, drafting, revising, editing, and monitoring their writing. Inclusion of self-regulatory strategies like goal setting encourages orderly thinking when approaching a task and helps to provide motivation for persisting through the task of writing (Schunk, 2003; Schunk & Usher, 2013).

Despite the advances in writing research in general and specifically for students with disabilities, additional research is needed to investigate how instructional manipulations of writing instruction may impact the writing performance of students with LD and EBD (Mastropieri & Scruggs, 2014). One manipulation of instruction to consider is the integration of technology to support components of students' thinking and their overall skills throughout the writing process (Englert, Wu, & Zhao, 2005; Technology Enhanced Learning Environments on the Web). There is evidence that teachers may not be taking advantage of the technological tools that can be used to improve students' ability to write effectively (Bouck, 2016). This article identifies and explains the specific capabilities of one specific web-based writing tool as well as some additional technology tools that can be used to enhance the writing process for students with LD and EBD.

## Technology for the Writing Process

Regardless of the reason to use it, technology aims to make lives easier. Various programs make the writing process easier for students with and without disabilities. For example, word processing has been associated with improving the writing quantity and quality of K–12 students (Graham & Perin, 2007; Morphy & Graham, 2012). Technology-based programs allow students to easily and quickly produce legible characters removing problems associated with handwriting and enhancing the ability to proofread legible text. Students can easily revise their writing by adding and/or deleting text as needed, making complete rewrites unnecessary. Spelling and mechanics of writing are deemphasized, removing the fear of making mistakes and being adventurous with vocabulary choices. Organization and manipulation of ideas are made easier through cutting and pasting, allowing students to focus on what they are writing rather than how (Morphy & Graham, 2012). Indeed, there is a myriad of technology tools on the market that can support students with LD and EBD through the various stages of the writing process: (a) planning, (b) drafting, (c) revising/editing, and (d) publishing.

One free technology-based tool that supports students throughout the writing process is featured in this article.

This tool is a technology-based graphic organizer (TBGO) available for several genres of writing. The TBGO embeds multiple supports such as strategy instruction, self-regulated learning strategies, and universal design for learning (UDL) features including text hints, audio comments, text-to-speech, and color coding. The TBGO was developed as part of Project WeGotIT! (Writing Efficiently with Graphic Organizers—Teachers Integrating Technology; Evmenova & Regan, 2012). One of the TBGO platforms offered by Project WeGotIT! is the web-based graphic organizer for multiple essay genres (i.e., persuasive, persuasive with counterargument, argumentative, personal narrative). The TBGO discussed in this article was developed specifically to work with the Chrome Internet browser (see Note 1) and is available at ([http://bit.ly/wegotit\\_wbgo](http://bit.ly/wegotit_wbgo)). Opening the browser and accessing this site before reading further are highly recommended. This article describes the navigation of the TBGO. The first step is planning, followed by elements of the writing process. Some alternative ideas for using technology to support students in each stage of the writing process are provided as well.

### Planning

The writing process begins with thinking about the topic, planning, and organizing ideas. Planning is a major focal point of writing for students who may not know what to say or may not know how to organize the ideas they have (Hayes & Flower, 1986). A graphic organizer (GO) is a visual, graphic display depicting relationships between ideas within a topic. GOs have shown to be effective for supporting students with LD and EBD in elementary, middle, and high schools across areas such as reading comprehension (Gajria et al., 2007), history (Bulgren, Deshler, & Lenz, 2007), math (Ives, 2007), and even functional skills (Douglas, Ayres, Langone, & Virginia, 2010). Emerging evidence includes the use of graphic GOs for planning writing (Ciullo & Reutebuch, 2013; Dexter & Hughes, 2011; Peterson-Karlan, 2011).

GOs help writers plan and stay on task by keeping the developed ideas in front of the student during the drafting stage of writing. TBGOs provide additional varying degrees of support through outlines and writing guides, pictures to visually represent the relationships between ideas, audio recording capabilities to get the ideas down, and motivational media features. There are many commercially available programs that offer a TBGO. The most popular include Kidspiration (K–5)/Inspiration (6–12)/Webspiration programs. Elementary age students with LD (Gonzalez-Ledo, Barbetta, & Unzueta, 2015), middle school students with LD (Sturm & Rankin-Erickson, 2002), and Hispanic students with LD (Unzueta & Barbetta, 2012) successfully used Kidspiration and Inspiration to increase the total number of words, the total minutes spent

planning, and the number of common story elements they included in narrative essays.

More recently, several studies were conducted to demonstrate the effectiveness of various TBGOs developed by Project WeGotIT! to support students when composing persuasive, argumentative, and narrative essays. Elementary and middle school students with LD and EBD have improved the quality of their writing (e.g., the number of transition words, holistic writing quality) while using the TBGOs and, more importantly, maintained their improvements after the GO supports were removed (Evmenova et al., 2016; Regan et al., 2017a; Regan et al., 2017b). The planning supports a Project WeGotIT! TBGO for the argumentative genre ([http://bit.ly/wegotit\\_wbgo](http://bit.ly/wegotit_wbgo)).

**Technology-based graphic organizer.** Using the provided link (see Argumentative Writing on [http://bit.ly/wegotit\\_wbgo](http://bit.ly/wegotit_wbgo)), access the argumentative TBGO as an example. Students first need to enter their name and type in the prompt they are writing about. The time stamp is added automatically and becomes part of the data report shared with the teacher at the end of the lesson (see the Practical Implications section for more information about the data). It is then time for students to set up their writing goal. They can choose one of the options from the drop-down menu: (a) I will include three facts and one elaboration, (b) I will include three facts and two elaborations, or (c) I will include three facts and three elaborations. In a one-paragraph argumentative essay, students must include three facts, but the number of elaborations with evidence allows for some flexibility based on students' characteristics. After setting up the goal, students can start brainstorming and entering their ideas into the *Brainstorm* window. Since argumentative writing is based on facts, students can either use preselected reading passages or research their topic on the Internet to get the background information. The *Brainstorm* window is where students deposit and save any information they find about the topic without worrying about the organization.

After brainstorming, students are ready to organize their ideas in a four-column, six-row table underneath the *Brainstorm* window. To support students with LD and EBD to recall critical parts to the argumentative genre, a mnemonic is built into the TBGO to provide strategy instruction. The mnemonic IDEAS walks students through the process of organizing their facts and evidence. In the argumentative genre, IDEAS stands for I = identify your claim, D = determine three facts, E = elaborate with evidence, A = add transition words, and S = summarize your claim. The mnemonic is further enhanced with text hints, which appear when the mouse hover overs each letter, and audio comments, which appear when clicking on the image of a light bulb. Both text hints and audio comments remind students what needs to be included in each essay part. For example, if the student hovers over E = elaborate with

evidence, the text will pop up, stating, "Tell us a little more about a fact. How do you know it is true?" The audio comments for the same essay part will say, "E is for Elaborate with evidence. Evidence helps support your claim by providing more information about that fact." Students move the words representing their ideas from the *Brainstorm* window to different rows in the table by copying and pasting, highlighting and dragging, or retyping those words.

### Drafting

The next step in the writing process is the drafting stage. This stage involves a student developing a more cohesive text by translating ideas into well-constructed sentences and putting these sentences into organized paragraphs. It is common for teachers and students to refer to various word processing tools to enhance the drafting phase of the writing process. While word processing can support writing fluency, especially when compared to handwriting rates (Hetzroni & Shrieber, 2004; MacArthur, 2009), many students with LD and EBD may need additional supports such as word prediction or speech recognition programs to produce text.

**Word prediction.** Word prediction was originally developed for individuals with physical disabilities to limit the number of keystrokes they had to make. However, it has been used successfully for students with LD (Evmenova, Graff, Jerome, & Behrmann, 2010; Silio & Barbetta, 2010). Most commercially available programs (e.g., CoWriter, WordQ) offer both word completion and word prediction features. With word completion, students are required to type at least one letter before seeing the options. With word prediction, the list of words appears even before a user starts to type. The predictions are made based on the context. Teachers can also set up the number of predicted options as well as topical vocabularies to offer appropriate options. Most programs can learn the spelling patterns and adjust the predictions based on the frequency of word use.

Benefits of word prediction have been demonstrated in multiple research studies for students who struggle with spelling and have limited vocabulary. For example, Evmenova et al. (2010) found that when compared to word processing alone, several word prediction programs on the market (e.g., Co:Writer, WordQ, WordAssist) improved the spelling accuracy in daily journal writing by third- to sixth-grade students with LD. Silio and Barbetta (2010) found similar improvements in the spelling accuracy, writing fluency, syntax, and overall organization for 6 fifth-grade Hispanic youth with LD when writing with word prediction alone or in combination with text-to-speech.

**Speech-to-text.** Speech recognition or speech-to-text is another category of technology originally developed for

individuals with physical and sensory disabilities that was found to support the drafting and revising stages of the writing process for students struggling with writing. When using speech recognition, students dictate their sentences to the computer through a microphone. Most speech-to-text programs support both the discrete speech (i.e., when there are pauses between words) and continuous speech (i.e., in a normal talking manner). While it sounds very promising, speech recognition is not for everyone. The user must be able to formulate complete sentences in their head to make cohesive writing pieces. As the technology market continues to develop, the cost of speech recognition programs has reduced considerably, while the quality of recognition has much improved. In fact, most operating systems (e.g., Microsoft Windows, Apple macOS, Apple iOS, Chrome OS) now have speech recognition built in as part of their accessibility tools, which is ready to be used without the need to purchase and install a separate program.

Research shows that older students can benefit from using speech-to-text programs. MacArthur and Cavalier (2004) found that high school students with LD demonstrated better writing quality when using speech recognition as opposed to handwriting their essays. Unfortunately, the most studies on the effectiveness of speech-to-text technology are outdated or have been conducted with postsecondary students (Raskind & Higgins, 1995; Wetzel, 1996).

*Technology-based graphic organizer.* Returning to the TBGO in the Chrome browser (see Argumentative Writing on [http://bit.ly/wegotit\\_wbgo](http://bit.ly/wegotit_wbgo)), students continue with their plans to draft sentences. This area is the largest section of the TBGO. The technology supports available in this section of the TBGO include word prediction, drop-down menus, and speech-to-text features. After organizing their ideas, it is time to type full sentences in each row of the TBGO. While writing a whole essay might be a daunting task, writing just a sentence at a time is something students feel they can accomplish. As students are typing their sentences, they can choose transition words from a drop-down menu. The transition words in the drop-down menus change depending on the essay part (e.g., fact #1, fact #2, fact #3, elaboration, summary) and reflect the sequence of the sentences. Students can select the transition words from the drop-down menu at any point, before or after typing the rest of the sentence.

*Chrome extensions.* Since the TBGO was developed for the Chrome browser, students who need additional supports have easy access to such free Chrome extensions as *Read&Write* for Google that offers word prediction or voice-to-text that offers speech recognition, among other features. For example, after a quick and easy download of

the Voice-to-Text Chrome extension, a student puts the cursor in any text box within the TBGO, clicks Start Dictation under the Edit tab and dictates his or her words and sentences. This way TBGO becomes more accessible to students who struggle with spelling or are still developing their vocabulary and language skills through word prediction, while speech-to-text eliminates the need for scribing the oral answers.

### *Revising and Editing*

After drafting, the next stage of the writing process is revising and editing. When students revise or edit their writing, they may correct grammar, spelling, punctuation, or sentence construction. Students may clarify their sentences by rewording or elaborating on their ideas. The writing process is iterative, so sentence-level or paragraph-level changes may occur while writing or after drafting. As anticipated, this stage of writing is the least preferred by students and rarely completed. However, self-regulation is critical during the writing process so that students can ensure that what they wrote is in fact what they intended to write. Self-monitoring and self-evaluation are two relevant strategies to teach.

Self-monitoring is a self-regulated learning strategy that is widely used in such research-based writing interventions as SRSD. For example, in the SRSD model, students can monitor their overall performance by graphing the number of genre elements or parts they include in their essay (Harris, Graham, Mason, & Friedlander, 2008). Self-evaluation is when students take the time to evaluate their performance to not only celebrate their progress and develop future goals but also attribute any strategy use to their progress. When doing so, students can recognize that their efforts were worthwhile. Evaluations can also be collaborative with teachers and/or peers.

Talking word processors or text-to-speech programs are also beneficial for proofreading and revising. This technology reads aloud what is typed, letter by letter, word by word, and sentence by sentence, depending on the option set (e.g., WriteOutLoud, TextHelp: Read and Write, Natural Reader). With text-to-speech, students can hear the mistakes they have made and therefore improve their ability to edit, independently. In addition, students benefit from connecting visual and auditory components of a word. Most talking word processors allow students to control the pace and voice as well as offer other features such as customizable background and the color of the highlight. Just like speech recognition, free text-to-speech is built into all the devices as part of the accessibility package. Cullen, Richards, and Frank (2008) demonstrated that using a talking word processor resulted in improved spelling accuracy and overall writing quality for seven fifth grade students with LD.

*Technology-based graphic organizer.* Returning to the TBGO (see Argumentative Writing on [http://bit.ly/wegotit\\_wbgo](http://bit.ly/wegotit_wbgo)), when students have completed their sentences, they are at the stage of revising and/or editing their work. In the last column to the right of the TBGO is a *check your work* column for self-monitoring. Students check off the parts of the essay as they complete them: (a) I included my claim, (b) I included three facts to support my claim, (c) I included as many elaborations as I planned to have in my goal, (d) I have proper transition words, and (e) I summarized my claim. Students may use the self-monitoring checklist after they complete each sentence or review the entire checklist after completing all of the sentences. When the self-monitoring checklist is complete, all of the sentences are copied and pasted in a paragraph with a click of one button. Students click the Copy button at the bottom of the TBGO page. If they missed any self-monitoring checks, a window will pop up reminding them that their goal has not been met. At this point, students are not prevented from moving forward, but they are encouraged to go back and check to see if all essay parts are included according to the goal they selected at the beginning of the TBGO. After the sentences are automatically copied into a paragraph form with the touch of the Copy button, students are ready to proofread and edit their work. They can use the built-in text-to-speech feature and listen to their sentences. Text-to-speech is activated by double-clicking anywhere in the essay box.

Moving to Part 5 of the TBGO in the Chrome browser (see Argumentative Writing on [http://bit.ly/wegotit\\_wbgo](http://bit.ly/wegotit_wbgo)) is the section of self-evaluation. In the self-evaluation section, students are prompted to double check their final product and make any necessary changes. Students answer such questions as the following: How many words do I have in my essay? (The number of words is entered automatically.) How many sentences do I have in my essay? How many facts do I have in my essay? How many elaborations do I have in my essay? Do all my sentences make sense? How do I feel about my essay? They also set up their next goal.

In the self-evaluation part of the TBGO, students also have a chance to review each other's work and provide some feedback. Students can swap their devices when they are done, listen to their partner's essay using the text-to-speech feature, and share one exceptional component of the essay. The TBGO includes a space at the end of the screen to fill-in the blank for the following statement, "You have included [blank] in your essay, which makes you a great writer." Students like to provide feedback because it is brief and always positive.

### **Publishing**

Following revisions, the final stage in the writing process is publishing. Students are ready to complete the writing

process by sharing or publishing their work. In order to engage reluctant writers who may or may not be motivated to write, sometimes it is important to remember that there are alternative ways for students to demonstrate their writing skills. A myriad of programs exists for creative story writing. Just a few examples include (a) Photo Story, (b) StoryBird for collaborative storytelling, (c) Writing Fix interactive writing prompts, (d) Story Jumper, and (e) VoiceThread (see Table 1 for more information about these programs). These multimedia and digital storytelling tools may include graphics, scenes, props, characters, comics, capabilities to add their own photos, features like text-to-speech and speech recognition, and other ways to publish the final products. In addition to making the writing process more thoughtful and engaging, digital media writing allows students to practice their 21st century digital literacy skills (Butler & Monda-Amaya, 2015). This is when writing tasks begin to resemble how students use technologies outside of school (e.g., playing video games and texting friends) and capitalize on students' interests (Heintzelman, 2016).

*Technology-based graphic organizer.* Once the students fill out the self-evaluation part of the TBGO, the final writing product is complete and students can publish their writing. Students may save their final paragraph as an editable PDF and post it to a shared workspace such as Google Drive or email it to the teacher. At this point, students may elect to present the text in any way they choose to share with others (see Table 1). Students may also find and insert images from the Internet to illustrate their essays. One recommendation is for students to have multiple opportunities with the TBGO to produce essays and then select the one piece they wish to publish.

### **Practical Implications**

This article offered the description of one freely available TBGO with embedded strategy instruction, self-regulated learning strategies and UDL supports ([http://bit.ly/wegotit\\_wbgo](http://bit.ly/wegotit_wbgo)) that can be used with additional tools such as Chrome extensions for word prediction and speech recognitions. Like in any other subject area, technology is effective only if the right tool is used. There are other freely available tools that can support all phases of the writing process. Table 1 provides a summary of other existing technologies that can be used throughout the writing process and provides considerations that should be given while choosing among many available options.

In practice, teachers should closely monitor students' use of the TBGO in order to refine their instruction, as needed and to personalize student instruction, more so. Based on previous research (Evmenova et al., 2016), teacher instruction as to how to use the TBGO varies. Some

**Table 1.** Examples of Existing Free Technologies to Support the Writing Process.

Technology Category	Sample Free Programs	Features for Consideration
Technology-based graphic organizers	Kidspiration/Inspiration Maps Lite App— <a href="http://www.inspiration.com">http://www.inspiration.com</a> ProjectWeGotIT!— <a href="http://bit.ly/wegotit_wbgo">http://bit.ly/wegotit_wbgo</a>	<ul style="list-style-type: none"> <li>• Use of graphics and text</li> <li>• Use of templates and guides</li> <li>• Degree of structure</li> <li>• Editing features available</li> <li>• Transition between planning and writing</li> </ul>
Word prediction	Read&Write for Google Chrome— <a href="https://www.texthelp.com/en-us/products/read-write/read-write-for-google/">https://www.texthelp.com/en-us/products/read-write/read-write-for-google/</a> LightKey— <a href="https://www.lightkey.io">https://www.lightkey.io</a>	<ul style="list-style-type: none"> <li>• Choice between word prediction and completion</li> <li>• Phonetic prediction</li> <li>• Ability to learn word patterns</li> <li>• Multiple vocabulary levels</li> </ul>
Speech recognition	Voice to Text— <a href="https://www.speechtexter.com">https://www.speechtexter.com</a> Dragon Anywhere app— <a href="https://www.nuance.com/dragon/dragon-anywhere.html">https://www.nuance.com/dragon/dragon-anywhere.html</a>	<ul style="list-style-type: none"> <li>• Support of discreet and/or continuous speech</li> <li>• Ability to recognize voice commands</li> <li>• Difficulty of voice training</li> </ul>
Talking word processors/text-to-speech	Natural Reader— <a href="https://www.naturalreaders.com">https://www.naturalreaders.com</a> Read&Write for Google Chrome— <a href="https://www.texthelp.com/en-us/products/read-write/read-write-for-google/">https://www.texthelp.com/en-us/products/read-write/read-write-for-google/</a>	<ul style="list-style-type: none"> <li>• Speaking by letter, word, sentence, paragraph, whole text</li> <li>• Flexible use of font, background color, highlighting</li> <li>• Working across programs</li> <li>• Editing features</li> </ul>
Multimedia/digital storytelling	Photo Story— <a href="http://www.photostory.com">www.photostory.com</a> StoryBird— <a href="http://storybird.com">http://storybird.com</a> Writing Fix— <a href="http://www.writingfix.com">http://www.writingfix.com</a> Story Jumper— <a href="http://www.toryjumper.com">http://www.toryjumper.com</a> VoiceThread— <a href="https://voicethread.com">https://voicethread.com</a>	<ul style="list-style-type: none"> <li>• Ease of use</li> <li>• Use of graphics and text</li> <li>• Editing features</li> <li>• Availability of additional supports (e.g., text-to-speech, speech recognition)</li> </ul>

students will willingly use the embedded features to support their writing, while others will need frequent teacher encouragement and feedback as they navigate through the TBGO. For example, students with EBD typically require more explicit and intensive instruction of high quality (Mastropieri & Scruggs, 2014; Regan et al., 2017a). One feature that may support how teachers can be responsive to student performance is the data report. The data report includes information on all of the TBGO parts completed by the student. If teachers see that students had more relevant facts and evidence in the Brainstorm window that they chose not to use, they may want to discuss the importance of using the most salient facts with the most evidence earlier in the essay.

In addition, when teachers are considering use of the shared TBGO for individual students or whole classroom implementation, the integration of technology presents another layer of instruction to consider when using the strategy. Researchers King-Sears and Evmenova (2007) suggested three premises and four principles for successful technology integration in the classroom. They suggested that in order for technology to be integrated into instruction, the technological proficiency of the students is important. Also, technology must become part of the instruction by connecting to the content and the expected educational outcomes. Furthermore, technology use should be student centered and differentiated to fit the individual needs of each student. Finally, King-Sears and

Evmenova suggested that as integration of technology is occurring it is important to be mindful of the continuous technological advancements and changes while considering technologies that would be economically sensible for a school.

## Closing Considerations

While students with LD and EBD often struggle with writing, technologies exist to support individual needs throughout all phases of the writing process. Apart from the individual studies included in this manuscript, the majority of research on how technology supports writing is outdated (MacArthur, 1998; Raskind & Higgins, 1995; Wetzel, 1996). Further investigations are needed to determine how technology can impact the writing performance of students with LD and EBD. Coupled with research-based strategy instruction, manipulating instruction with technology can only enhance students' writing performance throughout the writing process.

## Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

## Funding

The TBGO discussed in this article was developed under the U.S. Department of Education, Office of Special Education Programs No. H327S120011. The views expressed herein do not necessarily represent the positions or policies of the Department of Education.

No official endorsement by the U.S. Department of Education of any product, commodity, service or enterprise mentioned in this publication is intended or should be inferred.

## Note

1. The technology-based graphic organizer (TBGO) discussed in this article was developed specifically to be used with the Chrome Internet browser available at google.com. Certain functions of this TBGO may not work properly or at all when used with another browser.

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