

How Speech-Feedback and Word-Prediction Software Can Help Students Write

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J.T. is an energetic, hard-working, and good-natured seventh-grade student who attends a small K-8 school in a rural town in south central North Carolina. J.T. has identified learning disabilities in reading and written expression and receives all of his instruction in a general education classroom. In North Carolina the primary criterion for identification for services for students with learning disabilities is a 15-point discrepancy between an IQ score and a standardized achievement score. J.T. demonstrated a 30-point discrepancy in reading and a 28-point discrepancy in written expression when tested with the WISC-III and the Woodcock Johnson Tests of Achievement. He participates, with some modifications, in all activities expected of general education students. A special education teacher, however, visits his communication-skills class for 1 hour each day to assist with his specific needs, as well as the needs of other students with learning disabilities in the same classroom.

Like J.T., many students with learning disabilities are spending more and more time in the general classroom (McLeskey, Henry, & Axelrod, 1999), where they are exposed to the same wealth and variety of information as their peers. But students like J.T. often face higher expectations of productivity in these inclusive environments than they may have traditionally experienced in separate special education settings. Many students with learning disabilities struggle to be successful with these increased academic demands. One area that is especially problematic for some students with learning disabilities is written expression (Graham, 1990; Houck & Billingsley, 1989; Moran, 1981; Newcomer & Barenbaum, 1991; Thomas, Englert, & Gregg, 1987).

The demands of writing are particularly problematic for children with learning disabilities. As writers compose, they must juggle not only the ideas that come to mind, but also the many requirements associated with different writing formats. They must also consider the audience to whom the work is directed and the purpose of the writing (descriptive, expository, persuasive, and so forth). Students must know whether they have written "enough" information, and if their ideas are all connected and relevant. They must ensure that neither these ideas nor the vocabulary they use is unnecessarily repetitive, and that their words and sen-

tences have been constructed correctly. Students with learning disabilities in written expression can have particular difficulties with many of these issues as they write.

Assistive technology, in particular computer software, can be a valuable tool for many students with disabilities; and students with learning disabilities in written expression are no exception. Word processing, speech recognition, speech feedback, word prediction, and other varieties of software packages may serve to help students with learning disabilities participate in well-developed classroom writing programs. Research about these tools, however, is limited and has generated mixed results (Lewis, 1998).

The case study described here examines the experience of a single student with learning disabilities in written expression and his use of word prediction and speech feedback software during journal writing. The results of the study suggest that instruction and instructional feedback play a critical role in student success, regardless of the availability of technology.

J.T.'s Specific Skills and Needs

J.T. says he "learns best by listening," and although he is in the seventh grade, he reads on a preprimer level. J.T. has difficulty with many aspects of the writing process. He writes slowly (but neatly) and often reverses letters. He also

types slowly, always conscious of keeping his fingers in the correct key position.

J.T. once said in an interview that he "like[s] to write without putting any periods or capital letters." Actually, he seems to have difficulty knowing where either of these writing conventions belongs. J.T.'s reading difficulties, coupled with frequent misspellings (often only writing initial sounds correctly) make it almost impossible for him to revisit a piece of writing to share with the class or to revise and edit. He simply cannot read his work once it gets "cold." As he sorts through the many ideas for writing that he generates, it does not take long for him to "forget" what he has already written (even earlier in the same paper) and needs it to be reread to him.

Even dictation of the first draft to a scribe, which is an accommodation he often uses, does not generally address his need to have work read and reread aloud frequently if he wishes to do any revising. His dictated papers are often lengthy and detailed, but he only writes a few sentences when working independently (using word processing or paper and pencil). Despite these difficulties, his motivation and willingness to work hard are incredible, and he is a joy to all of his teachers.

The Software

Write:OutLoud[®] (Johnston, 1994a) has a speech-feedback component that enables the computer to "read" selected sections of text to students. Also, the software highlights each word as it is being read aloud (Figure 1). These features seemed ideal for J.T., in that he could have his written work read aloud for revision purposes (immediate or later), and at the same time focus his reading on the individual, highlighted words being spoken.

The second tool that J.T. used was Co:Writer[®] (Johnston, 1994b), specifically for its word-prediction capabilities. After a writer has typed the first letter or letters in a word, the software will "predict" (based on letters presented, type of word that would be grammatically correct at this point in the sentence, word frequency in a body of writing)



Computer software can offer students immediate spelling assistance and can read aloud what they have written, as an aid to revision.

what the writer wants to say next. The student can then select (by clicking on the word or typing its corresponding

number from the list) the desired word and continue with the rest of the sentence (see Figure 2).

Figure 1. Write:OutLoud Screen

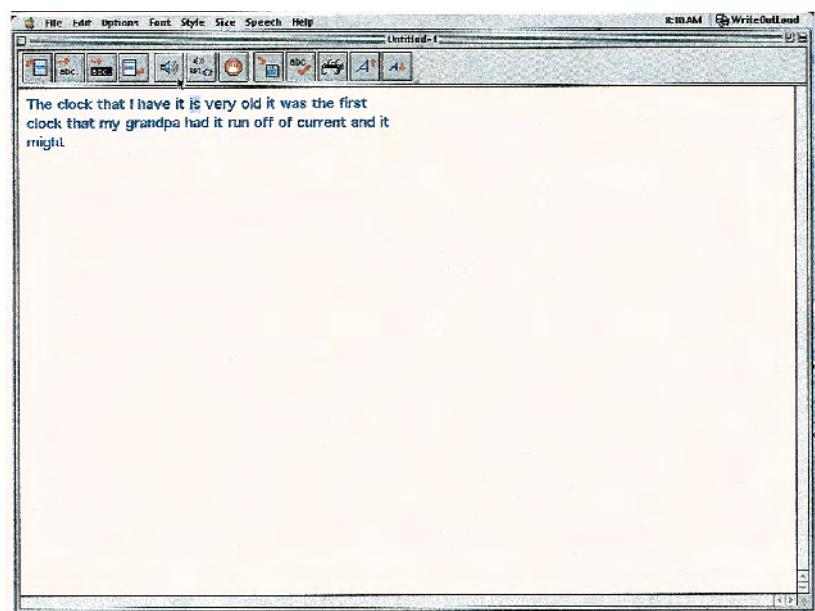
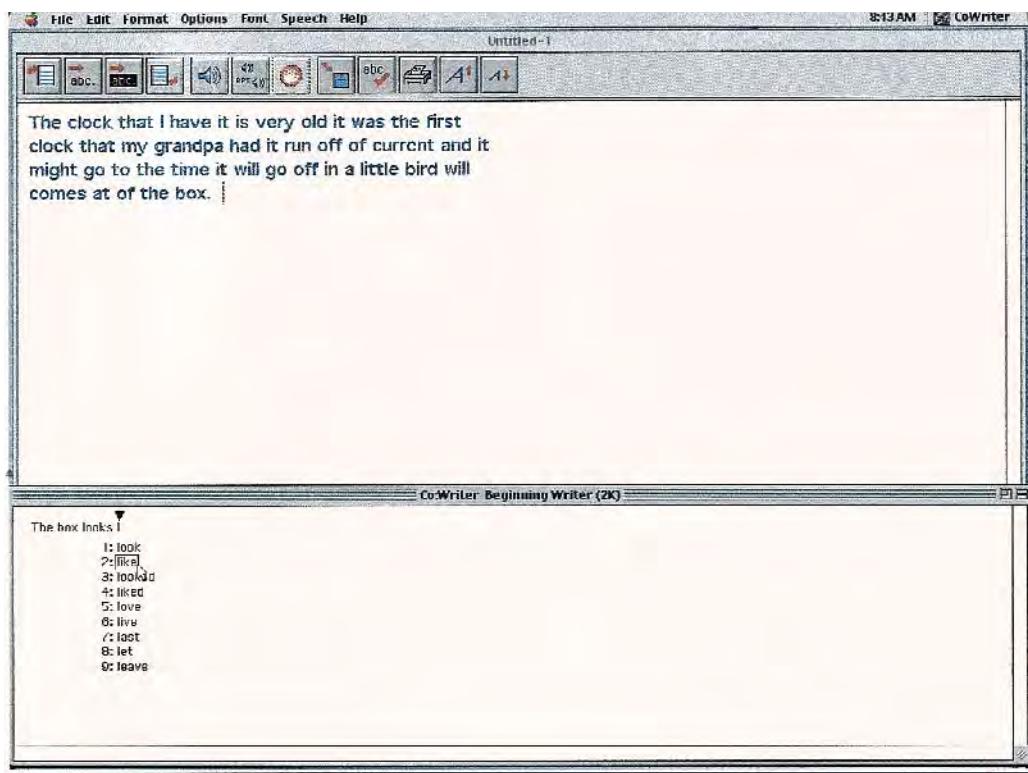


Figure 2. Co:Writer Screen



Originally created as a program to limit the amount of necessary key-strokes for writers with physical disabilities, Co:Writer also seemed to hold much potential for J.T. It offered the spelling assistance he needed and capitalized on his ability to generate initial sounds of words. It provided assistance with capitalization and reduced some of the laborious demands of typing for J.T.

Finally, the predicted choices can be read aloud to students with reading difficulties, which was critical for J.T.'s success.

Similar supports as those offered by this technology can be provided in the form of personal assistance to students in classrooms where technology is not available.

The Intervention

One of the daily assignments in J.T.'s seventh-grade communication skills class was to write for 20 minutes in a journal in response to a designated prompt. The purpose of this journal time was stated to be primarily to provide frequent opportunities for members of the class to write. While an enjoyable task for many of the students in the class, this often was laborious and frustrating for those with learning disabilities in written expression. J.T. and five other students with learning disabilities agreed to participate in a study in which they used Co:Writer and Write:OutLoud during these daily journal-writing sessions. J.T., who in many ways experienced the most success when using this software, is highlighted here.

During the time allotted for journal writing, J.T. and the other participants went to the school's computer lab and used word processing software to write in response to the prompt they were given in class. They were given 20 minutes to work in their journals, and they returned to class just as the other stu-

dents were finishing the same task.

Results for J.T.

Although each student experienced success with this software combination, it seemed to be particularly suited for J.T. Figures 3 and 4 show a graph of his performance during baseline and intervention phases from the study (Williams, 2000).

Number and Variety of Words

During the study, we made a count of the total number of words J.T. typed in each journal entry (depicted in Figure 3 with the solid line). Also, the number of

different words (type-token ratio) he used was calculated. This second count, represented in Figure 3 with the dotted line, was taken in an effort to see if J.T. extended the repertoire of words he used in journal entries instead of continuing to rely on the same words over and over.

J.T. used the word prediction capabilities of Co:Writer to reduce the key-strokes he needed to type, as well as to assist with his spelling needs. The length of his papers increased from an average of 36.9 words during baseline to an average of 60.28 when using the software. As should have been expected, in these longer passages, he actually had the opportunity to repeat common words more often, which lowered the type-token ratio. Therefore, he may have been using a larger vocabulary, but it was not captured in this ratio.

Journal entries from each phase of the study were evaluated (by an blind reviewer) using a holistic scoring system. These scores are represented with the solid line in Figure 4. In addition, the number and type of questions J.T.

Figure 3. Word Count and Repertoire of Words: Data for J.T.

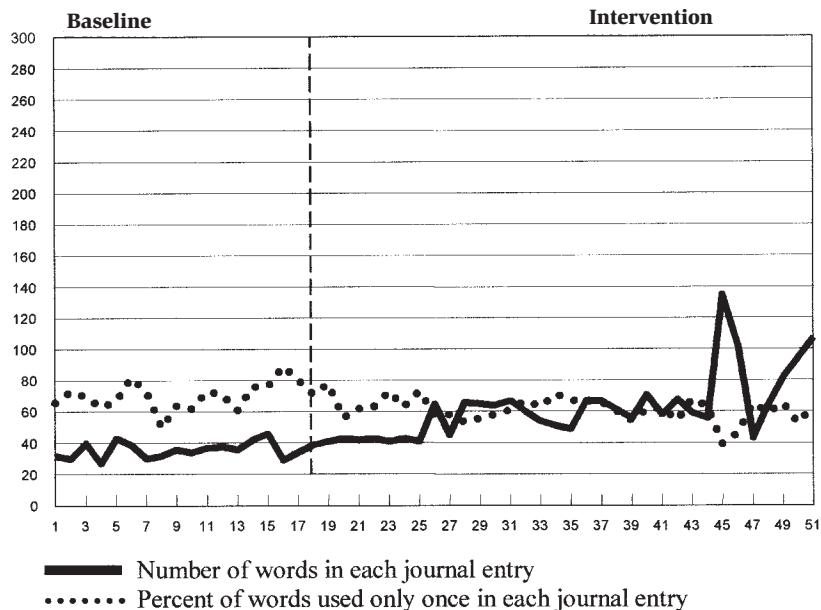
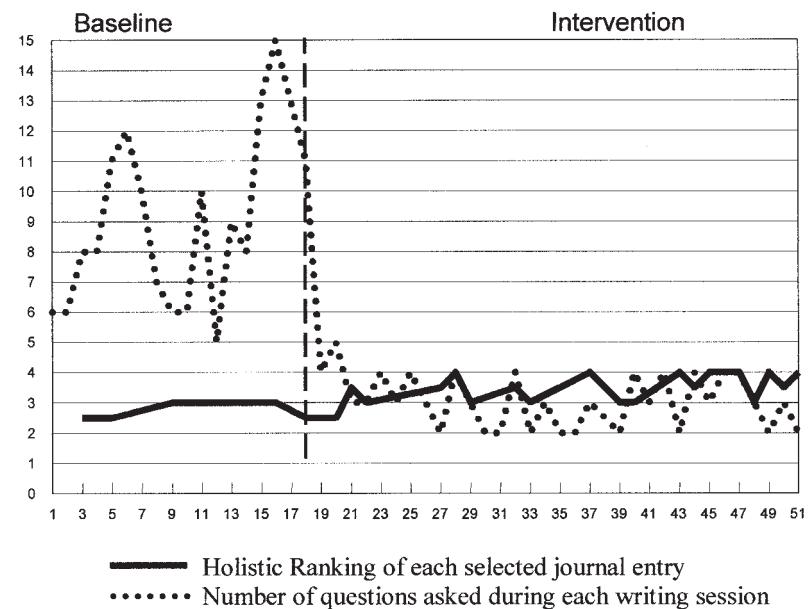


Figure 4. Holistic Score and Independence: Data for J.T.



asked was recorded each day (depicted by the dotted line in Figure 4).

Introductions and Processes

J.T. and his peers were introduced to the software by a brief explanation and demonstration. They then typed a sample journal entry with guidance in respect to their use of the program. One

legitimate concern about introducing word prediction is that the program itself may be difficult to learn and manage, thus adding an additional burden to the writing process (MacArthur, 1998a). Since the purpose of this software is to reduce the mechanical demands of writing, it must be relatively easy to learn and use by the students.

J.T. began using the software after one brief training session, and experienced little difficulty from then on. He did express disappointment with the speed with which the program worked. The computers in the lab caused the program to run slowly. While this is not a limitation of the software itself, many schools rely on similar outdated computer systems for student use. J.T. rarely had to ask for assistance with this new technology. Actually the average number of questions he asked during journal sessions (primarily for spelling assistance throughout the study) decreased from an average of 9 questions per session during baseline to 3 questions per session.

Comparisons to Nontechnical Writing Support

Similar supports as those offered by this technology can be provided in the form of personal assistance to students in classrooms where technology is not available. For example, J.T. often depended on a scribe to write and read back the content he wanted to include in an essay. Although these supports are available, and used often for students with learning disabilities, the software used here allowed J.T. to work much more independently. He could have his work read aloud as many times as he wanted without having to depend on someone else for this assistance.

Scoring

J.T.'s writing quality scores as measured on a 7-point holistic scoring rubric (from a score of 1, nonscorable, to 7, developed discussion) increased almost 1 full point; from an average score of 2.78 during baseline to an average score of 3.5 with the software. See Figure 5 for an excerpt from J.T.'s writing before (November) and during (February) the study. Although some people might not consider a change of 1 point as dramatic, it often takes quite a bit of improvement to merit an entire level change on such an evaluation scale. Therefore, for some students with severe writing difficulties, this might be an educationally significant change. (Note: I have presented J.T.'s scores for illustration purposes only; the complete study shows

J.T. indicated in an interview that working with the software was “fun.”.

more detailed results of all participants over time.)

One unexpected outcome was J.T.'s ability over time to produce the sounds necessary to spell the words he desired much more quickly. Vowel sounds seemed to be J.T.'s most frequent stumbling block. We learned together that the majority of words that he wanted were predicted in Co:Writer with the typing of three letters or less. Therefore, if a word he desired was not predicted within three keystrokes with the letters (and vowel) he had tried, he would "back up" and try a different vowel. While using this strategy, he had much practice listening to the way various vowel selections sounded in words, and eventually he was able to type the correct sounds much more quickly and use the program more efficiently.

The Plus of J.T.'s Attitude

Before this study began, J.T. already had an exceptionally positive attitude toward school. He consistently completed assignments, entered into class discussions, and worked diligently in group situations. But he was conscious of the fact that he had to do things differently from his peers. Although he knew it was a necessity, he disliked the fact that everyone saw him dictating his stories to the teachers.

Once this program was in place, he frequently asked if he could go over to the computer to do his work with the software. He even asked if he could bring his own headphones from home to donate for the classroom computer so that he, and other students, would have a comfortable set. In addition, he volunteered to teach others in the class how to use the programs.

When the study was over, one student, in particular, had been targeted to receive help from J.T. and to begin using the software during class assignments. J.T. indicated in an interview that working with the software was "fun," an adjective that his teachers seldom heard him apply to writing before.

J.T.'s enthusiasm remained high through the duration of the study.

Implications

The use of software with speech-feedback and word-prediction capabilities offers promise for students like J.T. who struggle to meet the writing demands of the general classroom. J.T. wrote longer passages that were judged to be of higher quality with the use of these supports. J.T.'s involvement in the larger study, however, supports the recommendation by MacArthur (1998a) that decisions to select these assistive technologies for students must be made on a case-by-case basis. Of the participants in the larger study, J.T. had the most severe difficulty with transcribing his ideas into writing.

Other students with different written expression needs may find little use for this software, and production rate may even be hindered by it (Lewis, Graves, Ashton, & Kieley, 1998). This may be illustrated with a brief description of the performance of other students who participated in the same study (see box, "Variety of Student Supports").

As always, these tools can only be as effective as the way in which they are used (MacArthur, 1998b). J.T. and the other participants of this study had access to the software only during daily journal writing sessions. Students had the opportunity to share these entries by reading them aloud in class on a voluntary basis, but they never received any direct or explicit feedback on what they had written. While there is merit to providing frequent opportunities for students to write in journals free from evaluation from teachers or peers (Hillocks, 1984), this may not be the writing situation in which students use these assistive technologies to their fullest advantage.

During the course of this study, no journal entries were ever extended into a piece of writing that was evaluated by the teacher or shared with other students for feedback. For writing assignments that students did take to a final draft, the intervention software was not made available by the classroom teacher. J.T. continued to utilize a scribe in these situations, and depended heav-

Figure 5. J.T.'s Writing Samples—Before and After

Each day during the study, J.T.'s class received a descriptive writing prompt, and then had 20 minutes to address this prompt in a journal entry. The entries shown here depict a prompt and J.T.'s corresponding journal response. On November 21, J.T. had not been introduced to the features of Co:Writer and was using word processing capabilities Write:OutLoud with the speech component disabled. By February, J.T. was using the intervention software when he composed his journal entries. This entry is a typical example of the longer entries he generated using Co:Writer and Write:OutLoud.

November 21

Prompt: Describe your idea of the “ideal” thanksgiving dinner

MY FAVORITE FOOD IS A GRILL HOG IN A PUMPKIN IN A ROAST HAM IN A MAYBE A TURKEY my favorite DESSERT food strawberry pie THE END

February 27

Prompt: Describe your favorite clock

The clock that I have it is very old it was the first clock that my grandpa had it run off of current and it might go to the time it will go off in a little bird will comes at of the box. The box look like a house in it has a to pendulums on the bottom of the house inside of the house it has people in it. On the outside it has to door on it in it has to windows the color is color is brown on the top of the clock it is black.

Variety of Student Supports

All six participants in the study wrote longer papers and expressed less writing apprehension while using Co:Writer and Write:OutLoud. They also quickly learned to use the software and capitalize on the features that they needed and to turn off those features that were of little personal assistance.

Before the study began, the special education teacher had rated each student's writing skills in relation to the Flower and Hayes (1981) model of the writing process that includes planning, translating, and reviewing. Although all students demonstrated needs in all aspects of the writing process, the two students that exhibited the most improvement overall were the only two students for whom the special education teacher had rated as having the most need in the area of translation. They had difficulty with spelling and typing, as well as understanding sentence structure, punctuation, and capitalization. Also, the teacher rated both of these students as having relative strengths in the area of planning. She felt that they both frequently had a fairly clear idea about what they wanted to say in mind before they ever began to write, but were unable to effectively get these thoughts on paper.

J.T. was highlighted here because he seemed to fit this description most clearly. For the other four students, who had been rated highest in the area of translating and lowest on planning, the overall results were not as strong. The teacher expressed that these four students engaged more in online planning (they planned as they typed), giving little thought to organization and writing purpose.

This intervention primarily addresses the translation process, so those who need less support for translation and more in other areas will also need strategies designed specifically to enable them to plan more effectively.

ily on his teachers or peers for reading and spelling assistance. Given the limited use of the journal assignments during actual writing instruction, J.T. and his peers had little external motivation to improve the quantity and quality of these writings, especially in respect to mechanics. In this light, the improvement that J.T. demonstrated may be considered even more striking.

As is evident from his writing samples, J.T. still has a long way to go to perfect his writing skills. More research must be done to evaluate the use of these tools for long-term assignments. Without the software, J.T. produced very brief drafts of writing, which provided a limited foundation to use for targeted instruction and meaningful feedback. Future research could evaluate if the longer, and more legible, passages students like J.T. may produce using assistive technology could facilitate this critical exploration of the entire writing process.

Assistive technologies such as these hold the potential to be powerful writ-

ing supports for students with learning disabilities. The conflicting evidence provided by research to date may be as much a reflection of the nature of instruction and instructional feedback that accompanies use of the technologies as it is a reflection of the efficacy of the technologies themselves. Regardless of their power, assistive technologies are not a replacement for instruction. J.T. does provide some evidence, however, that just as free writing can have a positive, albeit minimal, effect on the quality of written composition, the mere introduction of technologies to support some children with learning disabilities in written expressions can have a positive effect on written composition. Perhaps most importantly, J.T. was pleased with his ability to express himself on paper much more effectively than he was without the use of these tools. When some of the mechanical struggles he had with writing were eliminated, he could focus more on what he had to say, which was certainly worth reading. J.T. has found a tool that he

can use far beyond the walls of the public schools.

Getting Started in Your Classroom

Software such as that used with J.T. is not intended to teach writing skills. Instead, the technology fits nicely into existing programs and allows students with similar difficulties more access to the benefits of writing instruction and feedback. J.T. and his peers demonstrated that they only needed a brief introduction to the software and its features, as well as an initial practice session before they felt comfortable with these tools.

This software is not just for "writing class"; it can be used for any curriculum area that requires writing. J.T., for example, used the technology later in the year to compose a paper for a science class. If assistive technology is truly to be viewed and used as a tool by students, they will need to generalize its use to many environments. Therefore, for best results, students would need to have access to the software any time they complete writing assignments, such as essays, reports, and possibly even test questions. Students in this study had access to several computers in the computer lab equipped with the software. The programs were also installed on a classroom computer. If only one or two students in a classroom require this intervention, the classroom computer (or a laptop) may be the ideal set-up, because it would allow students to use the technology without leaving the classroom.

Students can use the features of the software as needed when writing. For example, students may take advantage of the spelling assistance of a word pre-

Computer software can offer students immediate spelling assistance and can read aloud what they have written, as an aid to revision.

J.T. volunteered to teach others in the class how to use the programs.

diction program for an initial draft of writing. Later, as students revisit and revise their work, they may use the “read aloud” features of programs with speech feedback. Indeed, student interviews from this study indicated that the participants felt they did use Write:OutLoud some for immediate feedback about whether they had “said what they wanted to say,” but that they felt they would use it more often when developing writing beyond a first draft.

Special education often boils down to the word flexibility. Once mastered by a student, speech feedback in programs such as Write:OutLoud can be used in a variety of situations. For example, for students who have reading difficulties, although speech feedback is valuable when proofing their own writing, it can also be useful for reading other materials aloud. Tests and stories can be downloaded and read aloud to students. Students can then use the word prediction features of programs such as Co:Writer to help with spelling and keystroke reduction as they type responses to questions and readings.

Word prediction can also be used in conjunction with programs other than a word processor. For example, Co:Writer can be used with the Inspiration® software as students create a graphic organizer to plan a paper or respond to a class assignment.

The key will be to use these programs not just for the sake of using technology, but to match the characteristics of the software with the needs of the student.

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