Technology *in Action*

Enhancing Content Literacy

Software Tools Help Struggling Students

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Find out how teachers can combine scientifically-based reading strategies with carefully selected software tools in response to curriculum goals and student needs to ensure success.

Technology and Media Division

Difficulties in Content Literacy

Beginning in grade four, national and state standards require that all students develop content literacy skills, defined as the ability to use reading and writing to acquire new content. Whether it is in social studies or science, students with disabilities often exhibit difficulties in identifying relevant facts, sorting information, perceiving levels of importance, and composing a response that requires inference (Kendall & Marzano, 2000; Wong, 2001). They also are likely to have difficulty connecting ideas in a reading passage, relating their knowledge to what they read, identifying a purpose for reading, and using active comprehension strategies (Donovan & Pellegrino, 2003; Pressley, 2000; Tovani, 2000). Difficulties such as these create a formidable barrier to making meaning in content-rich classrooms.

Helping Students Succeed

Today, special educators, inclusion specialists, assistive technology specialists, and classroom teachers are looking for ways to improve the performance of students in general education classrooms who struggle with reading. Fortunately, research suggests that help is available from two sources:

- **Scientifically-based content reading strategies** can help all students, particularly those with disabilities, to develop critical comprehension skills (NICHD, 2000). These include monitoring comprehension, use of cooperative learning, use of graphic and semantic organizers, answering questions, generating questions, helping students use text structure, and summarizing.

- A variety of **software tools** can support reading comprehension (Englert, Wu, & Zhao, 2005; MacArthur, et al.,

2001; Sternberg, Kaplan, & Borck, in press). For example, researchers are finding that students benefit from the use of electronic text with speech recognition capabilities, the use of hypertext, visual concept-organization programs, writing templates, and word-prediction software (Castellani & Jeffs, 2001; Sherman & Kurshan, 2005). Such tools can provide valuable assistance to all readers, particularly students with disabilities.

Combining Literacy Strategies and Software Tools

What happens when scientifically-based reading strategies are combined with carefully selected software tools in response to curriculum goals and student needs, particularly the needs of students with disabilities? This is the question researchers at Education Development Center, Inc. (EDC) have been studying for the past four years. Drawing on our work, this *Technology in Action* provides three concrete examples that illustrate how general and special educators have combined instructional strategies and software tools in:

- Fifth grade social studies and English/language arts.
- Eighth grade social studies.
- Tenth grade biology.

Each example is divided into three parts: background information, a classroom-based vignette, and steps for implementing the technology.

Fifth Grade Social Studies and English/ Language Arts

Background

The first example comes from one fifth grade classroom located in a rural school district in western Massachusetts. Of the 14 students, two had an Individualized Education Program (IEP) and one had a Section 504 plan. The teacher was concerned that students with learning problems had difficulty with some of the basic skills (e.g., identifying main ideas and finding supporting details).

The teacher used an EDC-developed curriculum unit called The American History Idol (AHI), inspired by the popular TV reality show, *American Idol*. The premise of the unit was that a panel of AHI judges required the students' help in selecting an American History Idol from among three finalists—Lewis and Clark, Thomas Jefferson, and Jane Addams—all of whom had made important contributions to American history. Instruction was designed to help students identify main ideas, locate supporting information, understand levels of importance, and write a short persuasive essay to convince the panel of the worthiness of the candidate.

The teacher employed the following research-based instructional strategies to teach students these skills:

- Eliciting/linking to prior and background knowledge.
- Helping students actively engage in categorizing information from biographical text by providing them with prompting questions: Who was the candidate? Why did the candidate want to accomplish something? How did the candidate accomplish his or her goal? What was the result of the candidate's accomplishment?
- Helping students identify levels of importance in text (related to main ideas and supporting details) based on the categorization of information.
- Using discussion and question generation to clarify thinking.
- Using think alouds to model "expert" thinking.
- Using graphic organizers to depict relationships among pieces of information.
- Encouraging students to manipulate information actively.
- Using rubrics to guide and assess work.

Although the AHI curriculum unit was implemented across a school year, it was divided into three mini-units, each featuring a different historical figure and introducing skills that built sequentially upon one another. An introductory session preceded the first mini-unit and a culminating activity, in which students voted for the AHI, ended the unit.

To enhance the instructional strategies and support students with a range of abilities and needs, a technology tool was needed that could:

- Provide a structure for students as they gathered, organized, and manipulated information.

- Meet the needs of students with disabilities, yet be used successfully by all students.

- Enable customized presentation of text.

- Provide navigational tools allowing movement within a document.

- Present visual representations of text and a summarized or condensed way of viewing text, such as a concept map.

- Offer notational tools, such as electronic highlighting, note gathering, and outlining.

Draft:Builder (published by Don Johnston, Inc., 2002, **www.donjohnston.com**) was selected because it had the above-mentioned features. [See the text box, *Outlining/ Graphic Organizer Software*, for other options.] The teacher received training in how to use the software, and in turn trained her students.

Vignette

For the second mini-unit, after reading the biography of Thomas Jefferson (see the text box, *Thomas Jefferson: American History Idol Finalist*), the teacher asked students to identify main ideas and supporting details in the text by writing key information on sticky notes. Students placed their sticky notes on an activity sheet containing four question boxes titled: Who? Why? How? What?

On the following day, students worked in the computer lab where the computers were loaded with Draft:Builder software. The teacher reviewed with students what they had done the previous day and asked them to open a template with an outline for main ideas and support-

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Outlining/Graphic Organizer Software

Inspiration/Kidspiration

www.inspiration.com

ThinkSheet

www.fishermarriott.com/thinkshe.htm

Spark Space

www.spark-space.com/edlearner.shtml

Thomas Jefferson: American History Idol Finalist

Thomas Jefferson is known as a "founding father" of our country. This is because he was an important part of the early days of the United States. The work he did then has helped to shape our country's government.

Thomas Jefferson was born in Virginia before the United States existed. Virginia was then one of the colonies of Great Britain. His parents were farmers but believed in education, and Thomas went to school and became a lawyer. He was an especially smart man interested in many different areas of learning. He believed that the government should give everyone a free education.

From the time he was a young man, Jefferson was unhappy with the way the British government treated the people in America. Jefferson was also a skilled writer. He wrote many papers against British rule. When the colonies decided to break free from England, he was chosen to write the Declaration of Independence in 1776. This important declaration said that the 13 American colonies were free from Great Britain. It listed the ways the British king ruled the colonies against their will. It told about the basic rights each person would have in the new country founded on democracy. It was the foundation for what American democracy would be.

Later, he helped to write an important law in his home state, Virginia. The law called for the complete separation of church and state. This meant that government could not tell people which religion to believe in. This law became part of our country's basic laws, and was called the Bill of Rights.

Jefferson became our third president and worked to build a strong country. He died on July 4, 1826. This was the 50th anniversary of the Declaration of Independence. His thinking and writing about how democracy should work have been a great influence on our democratic form of government.

ing details. She asked students to think carefully about sorting information and determining its level of importance before placing it in the template's outline.

Three students—Charlene, Thomas, and Devon (pseudonyms)—who often struggled with organizing information drawn from text were engaged with the task and quickly placed main ideas under the relevant questions in the outline. Finding and assigning supporting details proved more challenging, but looking back at their sticky notes and the text helped. According to the teacher, "Access to the program is an incentive for struggling students. It helps them organize their ideas and allows them to move them around easily." [See the text box, *Devon's Screen Grab*, for an illustration.]

Technology in Action Steps

Distilled from one of the mini-units in the AHI curriculum is a set of instructional steps that teachers might find helpful. Think about how these can be modified, as needed, to meet curriculum goals and your students' needs.
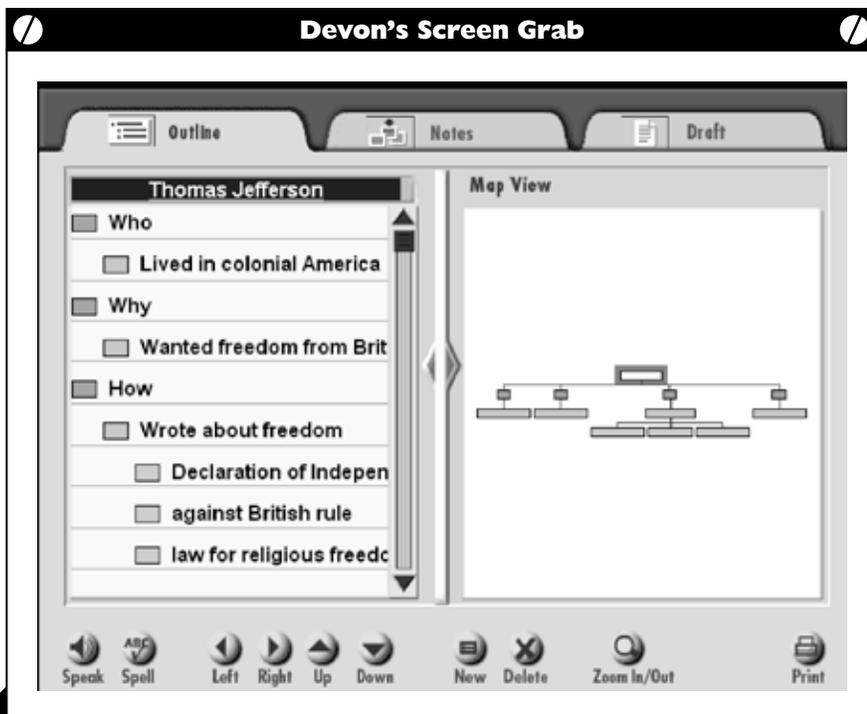
Preparation. Find a biography that can be useful. There are many websites that might be helpful, such as those in the text box, *Websites with Links to Biographies*.

Set the context.

1. Introduce the AHI finalist and show a picture, if possible, that you have downloaded from the Internet.

2. Remind students about the overall goal—to explain, based on the biographical text, why a finalist should be the AHI.

3. Elicit and record prior knowledge about the person.

Conduct the activity.

1. Read the biographical text aloud; ask students to re-read silently.

2. Distribute an activity sheet that has been divided into four categories or boxes. Boxes contain the following prompts:

   - **Who**? Facts that tell *who* a person is (background information).

   - **Why**? Facts that tell *why* a person did something (the goal).

   - **How**? Facts that tell *how* a

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> "It is a digital report. It lets you get all of the basic ideas into notes and an outline and a draft for doing a report."
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> —Devon, after discovering that he could rearrange information within different parts of his outline
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Devon's Screen Grab

person worked toward a goal (the steps).

- **What**? Facts that tell *what* the person accomplished (the results).

Distribute four sticky notes to each student.

3. Have students work in pairs to find information from the biographical text, write it on the sticky notes, and sort the notes into the four categories/boxes on the worksheet—answering the questions: Who? Why? How? What? Encourage students to paraphrase and abbreviate on the sticky notes as much as possible.

4. Review the notes and their placement on the activity sheet with the students.

5. Model the thinking behind the way you organized your notes and elicit student responses and their rationale for the way they placed their notes. Encourage rethinking, resorting, and replacement of notes, as needed.

6. Explain that the most important ideas—the answers to the Who? Why? How? and What? questions—are called "main ideas." Less important information that adds to or describes the main ideas is called "supporting details."

7. Have students open a prepared template in Draft:Builder and go to the outline section. Tell students that the outline contains the information that the AHI judges selected as the main idea for each of the four categories (Who? Why? How? What?). Ask students to identify the four most important ideas (main ideas). Ask students to identify less important pieces of information (supporting details) and move them under the main ideas to which they belong in the outline. Have students

Websites with Links to Biographies
www.biography.com The website for the *A&E Biography* show has born-on-this-day, searchable biographies of various people.
http://www.infoplease.com/people.html A website with a variety of information; one page is dedicated to bios of famous people in different categories (e.g., science and technology, arts and entertainment, etc.).
http://nobelprize.org/nobel_prizes/lists/2006.html The Nobel Prize website has biographies of each winner (Peace Prize as well as those in literature, physics, economics, chemistry, etc.).
en.wikipedia.org Although the information may not always be perfectly accurate, it is good as a supplemental source.
http://scienceworld.wolfram.com/biography/ A website with biographies of great scientists.
http://www.whitehouse.gov/history/presidents/ Students can read full biographies of each U. S. president.
http://www.ipl.org/div/subject/browse/ref15.00.00/ The Internet Public Library has dozens of links to biography websites.

complete the outline by moving all supporting details under the main ideas to which they belong.

Conclude the activity.

1. Discuss students' decisions/reasons for placement of information in the outline.

2. Ask students to review their work, think about what details go with which main idea, and rearrange the supporting details as needed.

3. Remind students to save their work, print it out, and put it in their AHI contest folder so it can be used for the next session.

Eighth Grade Social Studies

Background

We draw this example from a middle school in suburban Massachusetts that serves 893 students in grades six through eight. Approximately 14 percent of the students have special needs. This newly renovated school is well equipped with modern technology resources, including SmartBoards, projectors in every classroom, mobile laptop labs with wireless Internet technology, and one computer for every six students.

The eighth grade social studies teacher was team teaching with a special education teacher. In one of their classes, approximately 50 percent of the 22 students were identified by the teachers as struggling learners and many had an IEP. The teachers were concerned about the students' understanding of key vocabulary words and phrases that were critical for building understanding of key concepts.

Teachers looked to four scientifically-based strategies for teaching vocabulary:
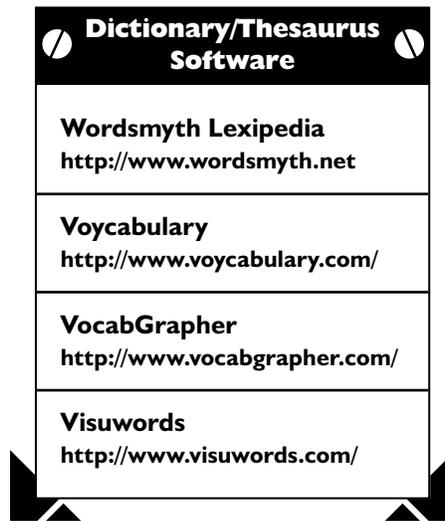
- Using words in context.
- Direct instruction.
- Active engagement.
- Providing opportunities for incidental learning.

The textbook used in this class came in two versions: print and CD-ROM. Given that the text was available electronically, the teachers wanted students to access definitions as they were reading the text online. They wanted to anchor the vocabulary instruction within the context of the social studies unit.

A software tool was needed that had the following features:

- Be accessible online as students were reading.
- Provide more than just a definition (e.g., images).
- Be easy to use and motivating to students.

After reviewing several options (see the text box, *Dictionary/Thesaurus Software*), we recommended the

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Dictionary/Thesaurus Software

Wordsmyth Lexipedia
http://www.wordsmyth.net

Voycabulary
http://www.voycabulary.com/

VocabGrapher
http://www.vocabgrapher.com/

Visuwords
http://www.visuwords.com/

Visual Thesaurus (published by Thinkmap, Inc., 2004, **www.thinkmap. com**).

Visual Thesaurus (VT) is designed to build word knowledge by allowing the reader to look up a word directly from a piece of electronic text. The tool provides a visual array of word meanings in web format. It opens before the viewer's eyes, adding descriptors around the focal word. If the viewer wishes to make a different word in the display the focal word, she clicks on it and the array moves to reorient items around that word. This mobile, three-dimensional quality is immediately appealing to adults and young people.

Further, a viewer can adjust the display to include a narrow or wide range of word meanings. For example, the word "sail" can be a noun (part of a boat), verb (guide a boat through the water), or adjective (sail cloth, sail boat). The VT can be constrained to define just the noun

or the verb. Students can manipulate the array of meanings (e.g., to focus on a synonym or expand the array of descriptors) and see it move quickly in response. Additional features allow students to search the Internet for images related to the target word, hear the word read aloud, perform searches in a variety of languages, and access VT from Microsoft Word (PCs only).

Vignette

The teachers developed a list of target vocabulary words that students would need in order to understand the content in each section of the chapter. They then created word web activity sheets that allowed students to record each step of the word exploration. [See text box, *Social Studies Activity*

"I am amazed at how much my struggling students participated and how they became involved in exploring relationships among words."

—Eighth Grade Teacher

Social Studies Activity Sheet

Name: Date: Chapter/Section:

Sentence from text: Opening the Grand Canal boosted Imperial China's economy and made it much cheaper and faster to ship food and goods north and south.
Vocabulary word: economy

ECONOMY

Rephrase the sentence using one of the synonyms you chose. What does this sentence mean?

Sheet.] These activity sheets provided scaffolding and direction for the class as students worked together to make meaning of the text. It was particularly beneficial for students with disabilities. For each targeted word within the electronic version of their social studies textbook, students first brainstormed possible word meanings independently.

For example, if the selected word was "empire," students would spend three to five minutes coming up with words or phrases that could define the word. Students then shared their ideas as a whole class before turning to VT. As the class looked up each word together, the teachers asked students about the various synonyms and meanings revealed in the VT word window.

Although the class felt the word "empire" was familiar and brainstormed suggestions that were very close to the actual definition (citadel, place under one rule, kingdom, government), they did not know that empire (when capitalized) also could refer to a "dessert apple or eating apple." Students found this tidbit quite interesting and continued to ask questions about the various meanings of the word. [See the text box, *Word Web Screen Grab*.]

This level of engagement was maintained with each word they looked up. Students became visibly excited whenever a word was expanded or read aloud. When the special education teacher decided to expand further on the word "government," students commented, "This is going

to be so cool!" and "This is awesome!" When the expansion of the word "government" resulted in a word web almost too large for the screen of the digital white board, students reacted with gasps and exclamations.

Several students were heard to say, "Look at all the synonyms for government!" This level of interest is in stark contrast to the students' reactions during their first class session with VT, when students complained about having to do vocabulary and did not contribute to class discussions. After several sessions with the tool, all students (even those who had been reluctant to participate) were actively engaged in exploring word meanings.

One struggling student described her exploration of the word, "arsenal." The context in the social studies book focused on the military meaning. However, the student's search led her to a soccer team named the Arsenal. Upon reflection, the student determined that even though the definition about weaponry did not have anything to do with soccer, the word was probably being used figuratively. "If one player is really good, she might be the team's secret weapon—one of the weapons in the team's arsenal."

Technology in Action Steps

The instructional process used by these teachers, not only in this vignette, but also across the span of

Word Web Screen Grab

the unit, can be broken down into a series of teaching steps that you might want to consider in your planning: getting ready, doing the activity, and concluding the activity.

Set the context.

1. Show the students the tool and allow them to play with or explore it by looking up words of their own choosing, such as "blue" or "basketball."

2. Open a reading selection.

3. Discuss the reading comprehension question related to the text.

Conduct the activity.

1. Call on a student to begin reading the text aloud from the screen.

2. Read one sentence or paragraph at a time.

3. Pause at regular intervals and ask students to restate what they just read to measure comprehension.

4. Have students select potentially difficult words that are important for concept building.

5. Look up one of these words using the VT.

6. Read around the VT-created web to see which of the definitional words the students already know.

7. Discuss the meaning of the target word and accompanying definitions as shown in VT.

8. Click on the read-back function so students can hear the word pronounced correctly.

9. Read and discuss the definition from the column on the right of the screen as well as the definition that appears when the mouse rolls over the word.

10. Use antonyms, if appropriate, to help build the concept.

11. Reorganize the web by placing other words in the center to check definition.

12. If appropriate, use the VT to search the Internet for images or related content. For example,

searching for Syria would bring up maps, pictures, and related content.

13. Discuss the meaning of the target word as it appears in the sentence or paragraph.

14. Explore relationships between several words from the reading (e.g., the relationship between Mecca and Mohammed, the location of Mecca, why it is now a holy city, etc.).

15. Relate words to others that have similar meanings (e.g., prosperous, merchant).

Conclude the activity.

1. Return to the overall reading comprehension question.

2. Ask students to retell three important big ideas after concluding the reading.

3. Debrief with students about using VT.

Tenth Grade Biology

Background

A small college preparatory high school in Boston offers the third example. Serving 318 students with diverse backgrounds, the school focuses on careers in technology, computer science, and engineering. Technology is a cornerstone to learning. Each student has access to a laptop computer and each classroom is outfitted with a SmartBoard.

Sixty-one percent of students are eligible to receive free and reduced lunch, and 15 percent of the students are identified as having a disability.

A tenth grade biology teacher developed literacy instructional activities to help students with a wide range of abilities improve their understanding of the biology textbook and other materials downloaded from the Internet. She used the following reading comprehension strategies, all of which have been found to be particularly relevant to content area literacy at the high school level:

- **Selectively underlining**. Students underline only the words, phrases, and ideas that are central to understanding the piece.

- **Understanding question-answer relationships** (QAR). Students learn that sometimes answers can be found directly in the text, while at other times the reader must draw on his or her prior knowledge.

- **Summarizing**. Students restate key ideas in a more concise form.

- **Making inferences**. Inferring is the process of creating meaning from text where students combine what is read with relevant prior knowledge.

A technology tool was needed that would allow students to:

- Highlight, copy, and move text.

- Create note cards.

- Make an outline.

The software also needed to offer text-to-speech capabilities. We found all these features in SOLO (published by Don Johnston, Inc., 2005, **www. donjohnston.com**). [For other options, see the text box, *Reading/ Writing Environment Software.*]

SOLO is a multi-faceted software tool that builds learning skills in reading, writing, planning, organizing, revising, and editing for all students, including students who struggle to succeed. To offer all of these features, SOLO combines four different programs to support reading and writing: Read:OutLoud, Draft:Builder, Write: OutLoud, and Co:Writer.

Vignette

The tenth grade biology teacher used strategic underlining and summarization and components of SOLO to help students comprehend an article within a unit on genetics. As preparation before a lab experiment on gel electrophoresis, she asked her students to read and summarize an electronic version of an article about electrophoresis in SOLO. She also created a set of prompts to set a purpose for the reading and explicitly identify the steps for writing a summary. In SOLO, students were able to see the article in an electronic format and the accompanying prompting questions on the right side of the screen. [See the text box, *Screen Grab Biology.*]

To introduce the lesson, the teacher opened SOLO in Read:OutLoud and projected the article onto the wall. She explicitly reminded students about the characteristics of a summary (e.g., it must be in the student's own words, be shorter than the original piece, and get across the important ideas of the article). She recommended that students read the article independently and then selectively underline (highlight) key ideas. If they wanted to take advantage of the text-to-speech feature in Read:OutLoud, they could use the earphones. She modeled this by having SOLO speak the first few lines of the article.

The teacher then reviewed the guided reading prompts appearing on the right side of the screen. She pointed out that they would be asked to

Reading/Writing Environment Software
Kurzweil 3000 v.8 http://www.kurzweiledu.com/
Read, Write 8 Gold http://www.texthelp.com/
Microsoft Reader http://www.microsoft.com/reader/
AspireREADER 4.0 http://www.cast.org/products/ereader/index.html

Screen Grab Biology
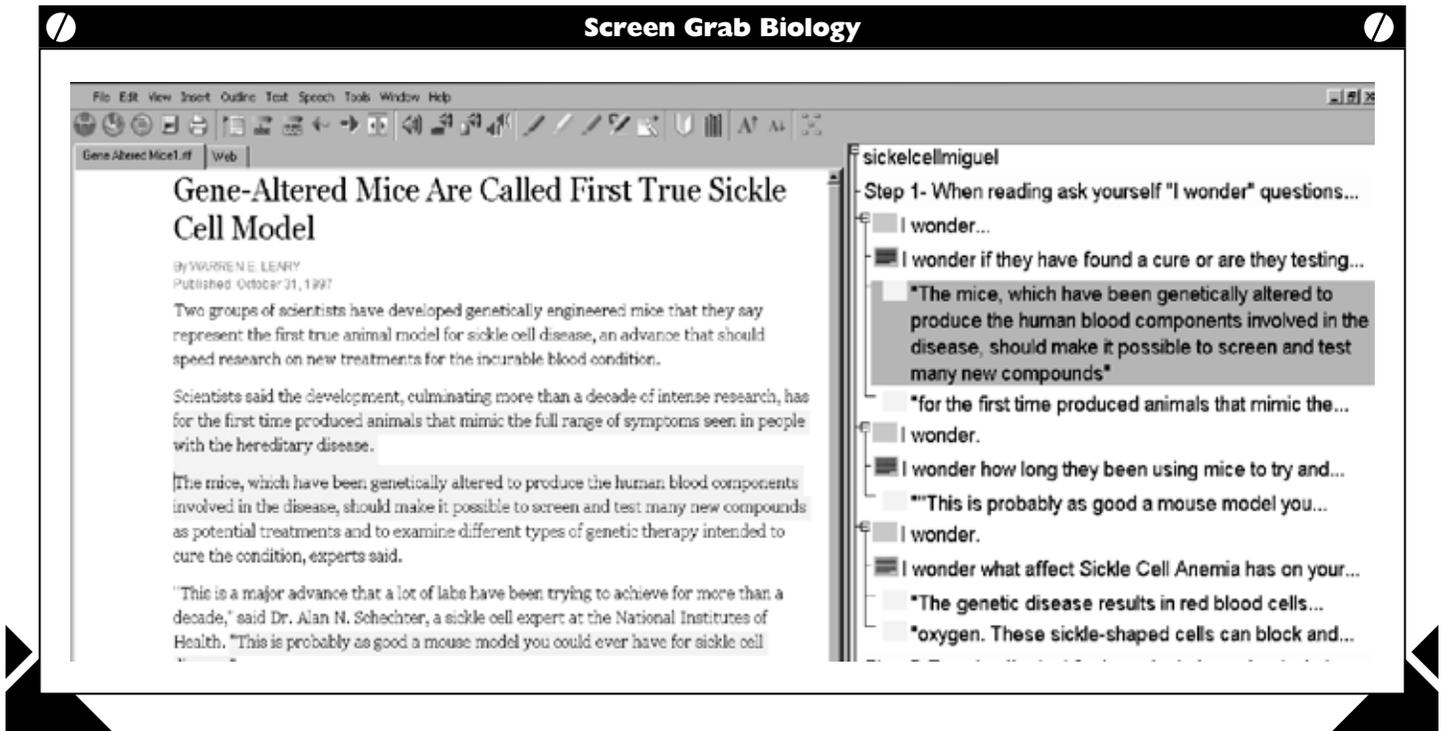
identify a topic sentence and collect key points. She explicitly reviewed the thinking or meta-cognitive process she expected her students to use (she had been guiding students throughout the winter semester) by first demonstrating a think-aloud. Using the first paragraph, she highlighted key points in the passage, which were automatically copied in the outline. She explained why she thought these should be included in the summary.

Next, the teacher attached a note that elaborated her ideas to the text in the outline. She continued to explain the reasoning behind her thinking. After this review, she asked students if there were any questions and then directed them to begin. She walked around the class to assess students' understanding and check in with individual students as needed. She stopped at the desk of each struggling student and was pleased to see that each was able to carry out the learning activity as intended. Later, their post-unit test scores reflected their understanding of core concepts.

Technology in Action Steps

Here is an example of how teachers can model the skill of summarizing using the strategy of deletion. The first step (preparation) is to find appropriate text that aligns to the curriculum,

Summarizing	
What To Do	**What Not To Do**
• Always state the main idea of the text or reading. • Use your own words. • Include only the most critical information. • Keep the same order of the original information. • Include information that supports the main idea.	• Do not copy from resource text and just change a couple of words. • Do not switch the order and just change a few words. Summarizing is the rewriting of a reading that shows an understanding of the text as it relates to the research question. • Do not change the original intent of the author.

then set the context, carry out the activity, and conclude the activity.

Set the context.

1. Define summarizing and explain its value. Explain to students that a summary is a brief statement in the reader's own words that captures or condenses the main points. Summarizing proves the reader's understanding of what the author has written. Summarizing provides practice in decision making and sequencing.

2. Discuss the do's and don'ts of summarizing. [See text box, *Summarizing*.]

Conduct the activity.

1. To introduce the concept of inclusion and deletion, guide learners to help you answer the question, "What are the important details here?" Highlight and format the information to make it stand out.

2. Guide learners to help you answer the question, "What is critical information to keep?" and "What text can I delete because it is not relevant?" Use the software tool to mark the remaining text for deletion by highlighting text that does not need to be included in the summary. In the toolbar, click the Mark for Deletion button.

3. As you move through the text, repeat the process (identify main idea, important details, and unnecessary information) for each of the remaining paragraphs.

4. When you have read and formatted all paragraphs, point out that you now have a marked text with the main ideas and the key details indicated.

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> "Because when you are reading, you are more focused on the questions and trying to answer the questions. It makes you want to read more."
>
> —Tenth Grade Student explaining why he liked the text and the guiding questions available at the same time
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Conclude the activity. Review the summary steps you modeled:

1. Read the text.
2. Pull out the main idea(s).
3. Identify key details and phrases.
4. Draft a summary.

Before You Begin

This article presents several of the ways in which instructional practices and technology tools can be combined to meet the needs of students in general education classrooms who struggle with reading. We hope that these images and suggestions help you—a special educator, inclusion specialist, assistive technology spe-

cialist, or classroom teacher—find meaningful connections for your students. As you begin planning, always remember to ask yourself questions such as the following:

- What are my curricular goals?
- What are my students' abilities and needs?
- What skills will I focus on?
- What type of content do I need?
- What instructional strategies do I want to use to teach these skills?

Based on the answers to these questions, you can select the technology tool(s) that will be the most useful for building your students' content knowledge.

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