Technology *in Action*

Using Technology to Provide Access to the General Education Curriculum— Techniques To Try

John Castellani, Johns Hopkins University
Tara Jeffs, East Carolina University

> As individuals use technology to create content for accessing the general education curriculum, research-based instructional strategies should be provided as the foundation.

Providing access to the general education curriculum and improving achievement for students with disabilities are primary goals of the *Individuals with Disabilities Education Act of 1997* (IDEA), and the *No Child Left Behind Act of 2002* (NCLB). However, many students with disabilities have reading and writing difficulties that make it difficult for them to achieve these goals.

To accommodate such students, teachers increasingly are using differentiated instructional strategies that enable them to participate and progress in the general curriculum. Differentiated strategies provide teachers with a means of providing additional support to students who need it during the course of regular instruction, thereby individualizing instruction for diverse groups of learners. The use of differentiated instruction can open the door to classroom content, making it accessible for diverse learners.

Differentiated instruction can be enhanced with the use of technology scaffolds. When integrated appropriately, technology scaffolds have been found to increase teacher capacity to individualize instruction for students with disabilities who have difficulty reading (Castellani, 2000; Castellani & Jeffs, 2001). Three instructional areas where technology scaffolds show promise in increasing student access to knowledge contained in text are:

- Providing **strategic instruction** to help students organize reading and writing activities.

- Using **diversified materials** to provide several entry points into the content material.

- Enhancing reading comprehension by teaching students how to **summarize big ideas**.

This **TAM Technology in Action** describes selected technology scaffolds in each of these areas. Technology scaffolds were chosen for their promise in helping teachers individualize learning to ensure that students with disabilities who have reading problems can better access general education curriculum materials. The strategies are organized in the following way:

Technology and Media Division

- Common learner characteristics of students with disabilities who tend to benefit from this instructional approach are identified. Use this information to think about issues students with disabilities often have with common instructional tasks.

- An overview of the instructional technique is provided and what we know about its effectiveness is considered. Use this information to think about its potential for differentiating instruction.

- Technology scaffolds that show promise for enhancing the learning process are described. Use this information to consider how you might augment instructional strategies through the use of instructional and assistive technologies.

Strategic Instruction

Use this strategy for students who:

- Have difficulty organizing information and ideas, identifying mistakes, and applying corrections.

- Do not follow strategic processes when reading and writing.

- Are slow and labored when decoding.

- Have difficulty sounding out unfamiliar words.

- Substitute and/or confuse letters/syllables and their sounds when forming words.

- Avoid or skip over words they do not know.

Overview of Strategic Instruction: What We Know

Hall (2004) defines the characteristics of strategic instruction as:

- Curriculum design that integrates big ideas.

- Content that is applicable to multiple contexts.

- The integration of confusing concepts and facts as they are mastered.

Strategic instruction is designed to teach students how to apply techniques, principles, or rules in order to solve problems and complete tasks successfully and independently. Strategic instruction provides a structure that can help students become more independent, self-regulated learners. It has proven successful in helping students with disabilities read (Scanlon, Deshler, & Schumaker, 1996).

Technology Scaffolds

There are a variety of different technologies that can help students structure their learning. Examples of selected techniques follow.

Picture Cards

Teachers may use picture cards as a visual prompt or scaffold to aid recall and retrieval of appropriate vocabulary. Frequently, students with written language deficits find symbols less confusing, therefore making it easier to learn vocabulary—especially if the appropriate picture is accompanied by text. Such prompts provide a means of bypassing the need to rely solely

on decoding print to sound and then sound to meaning. The picture symbol combined with the written word provides an opportunity for the learner to use visual association. The use of picture symbols lightens the cognitive load (working memory) and allows students to begin reading instruction (word identification) without initial failure (Biemiller & Siegel, 1997).

Picture cues can be used to establish a familiar set of vocabulary words and/or daily activities within the learning environment—book, table, chair, music, and art, to name just a few. Simple one word picture cards can provide the foundation for classroom literacy tasks such as decoding, vocabulary development, phonics, and word attack and helps students move toward more multilevel tasks such as sequencing and sentence making activities.

The first step in developing reading instruction using picture cards or visual supports is to create pictures or icons of nouns (e.g., animals, transportation, and food), verbs or actions (e.g., run, swim, and jump), and adjectives (e.g., color, size, hard, and soft). The teacher then provides meaningful associations and learning activities through labeling and attaching a symbol to the object or place that it is to represent. These picture symbols are later assembled into simple sentences that the students both read and write.

Software programs may be used to create picture symbols. Examples are found in Figure 1.

Text Readers

Students with disabilities often encounter unknown vocabulary and/or ideas while reading. Hearing or isolating the difficult word in the context of a reading passage is important for building word recognition. When not using the computer, a teacher or student can highlight or circle unknown words, create word lists from a reading passage, and/or look up words in a dictionary. However, text readers offer more versatile tools for this purpose.

For example, teachers can use text readers when working with students on letter recognition, word blends, vocabulary building, sentence structure and paragraph writing. Coaching students to type specific letter blends allows them to practice the sound of each blend and create new words by adding additional appropriate letters. For example, a student could type in the letters **at**, listen to the sound of the text, and then add letters in front of the sound blend to create familiar words

---

Figure 1: Commercial Software for Creating Picture Cues

Boardmaker

A picture driven database that contains more than 3,000 symbols. Pictures are available in both black-and-white and color format. An additional 2,000 symbol icon library provides symbols for specific topics. *Boardmaker* symbols can be used to make individual icons, symbol storyboards, worksheets and calendars. This software is extremely popular in providing a picture-rich environment. It is available in many languages. [Mayer-Johnson, Inc.]

PCS Animations

Provides students an opportunity to understand verbs and prepositions through animation or movement. More than 500 animations are available. Animations can be used within programs such a *Clicker, PowerPoint, Buildability*, and *Intellipics Studio*. [Mayer-Johnson, Inc.]

Clicker 4

A talking word processor that integrates graphics and symbols that help students build vocabulary and writing skills. This program provides support for vocabulary and sentence building through a structured grid of word choices. Words can be read aloud, providing as-needed audio support. Students select familiar words in a sequence to make a sentence. The sentence can then be written and displayed with both picture symbol and text. Sentence building grids range from simple to complex. depending on the individual learner's needs. [Crick Software]

Clicker Animations

Provides students with 100 animations that can add interactivity and meaning into the writing process. [Crick Software]

Picture It

A productivity tool that consists of 6,000 symbols that can be used to make single or groups of symbol icons to create picture supported learning materials. Provides both colored and black and white formats. [Slater Software]

Pixwriter

A writing program containing pictures, text, and voice output. Button-type setups allow students to select words by just a click of a button. [Slater Software]

Writing with Symbols 2000 (Version 2.6)

A talking word processor that speaks the letter/word as it is typed, along with a talking symbol processor that automatically places a picture on the page. Grids for printing symbols and symbol groups along with grids for writing provide needed support for organizing letters, words, pictures, or phrases. [Widgit Software, Ltd.]

Adult Vocabulary Grid

Provides picture symbols for adult-suitable vocabulary situations. Onscreen grids are used with *Writing 2000*. [Widgit Software, Ltd.]

Publishers

Mayer-Johnson, Inc.
P.O. Box 1579
Solana Beach, CA 92075
800-588-4548
mayerj@mayer-johnson.com

Crick Software
50 116th Avenue SE
Suite 211,
Bellevue, WA 98004
866-33-CRICK
www.cricksoft.com

Slater Software
351 Badger Lane
Guffey, CO 80820
877-306-6968
http://www.slatersoftware.com/index.html

Widgit Software Ltd
124 Cambridge Science Park,
Milton Rd,
Cambridge, England CB4 0ZS
http://www.widgit.com/index.htm

such as mat, sat, and pat. Secondary students can use this same concept for understanding prefixes, suffixes, and word roots.

Practice of phonemes might be achieved through guided pronunciation. The text reader says each word and the student practices saying the word along with the computer. Fluency also can be increased through the use of text readers. The student can read along with the text readers during multiple reading sessions to gain confidence through word familiarity and speed.

Text readers have built in features that allow students to work independently with text through the use of automatic highlighting, text to speech feedback, built-in thesaurus, and study tools. As students begin to build vocabulary or research new topics, they can use highlighting tools to identify new vocabulary words. By highlighting the word in a specific color they can then come back to that word and perform a "Stop, Look and Listen" routine. This requires the student to stop, look up the word in the talking dictionary or thesaurus, and listen to the word—how it sounds and how it is used within the sentence or paragraph.

Examples of text readers include:

- *Texthelp: Read & Write* (v7). These comprehensive text-to-speech tools are transparent within any Windows application. In addition to reading text, the tools provide such features as word prediction, spell checker, and the capability to read the Internet. An added bonus is PDFaloud, which allows PDF files

to be read. [Contact the publisher at **http://www.texthelp.com**/, **info@texthelp.com**, or 888-333-9907.]

- *WYNN Wizard*. WYNN Wizard provides reading, writing, studying, productivity, and Internet features. The text is highlighted and read to the user. Onscreen dictionaries, word prediction, outliners, highlighters, voice notes, and writing notes are essential tools that support diverse learners. WYNN Wizard has scanning (OCR) capabilities and can read PDF files. [Contact the publisher at: Freedom Scientific, Learning Systems Group, 480 California Avenue, Suite 201, Palo Alto, CA 94306-1609, 888-223-3344.]

- *Kurzweil 3000*. In this reading, writing, and study program, text is highlighted and read to the student. Reading and reference tools provide the learner with dictionaries, word prediction, notes, test taking, and other powerful study skills tools. One feature—Picture Dictionary—allows students to look up picture definitions for words. In addition, text files can be converted easily into MP3 and wav files so students on the go can take a complete text file and listen to it. [Contact the publisher at: Kurzweil Educational Systems, Inc., 14 Crosby Drive, Bedford, MA 01730-1402, 800-894-5374.]

- *eReader*. This program uses the principles of universal design pioneered by CAST to create a versatile, advanced literacy tool that helps learners of various abilities gain access to electronic text while supporting and

enhancing literacy development. This program reads digitized text, HTML, and DAISY 2.02 formatted digital talking books. It highlights and reads text by word, sentence, or paragraph. It provides easy to use tools to read the web. [Contact the developer at: 40 Harvard Mills Square, Suite 3, Wakefield, MA 01880-3233, 781-245-2212, **cast@cast.org**, 781-245-9320 (TTY), **http://www.cast.org**.]

Internet Resources

It is important to provide the student with different opportunities to read and re-read text. This can be accomplished by integrating reading and writing tasks. Students write a story or passage and then read what is written. Since information on the Internet is already in electronic format, text readers can highlight words and read back selected text.

The Internet is a viable tool that can provide students with high-interest materials that can be used to allow students to "drill and practice" newly acquired skills. For example, **StuartStories** web site [www.stuartstories.com] offers stories that students can use to practice reading. The web site features an activities section that includes:

- "Finish me" section where students add an ending to the story.

- "Frankenstein" section where students bring parts of a story together and watch the story come to life.

- "Machine" activity where students describe what they would do with a variety of machines.

> Technology holds great potential for promoting student participation and progress by providing access to the general education curriculum. Technology scaffolds have the potential to deliver educational content paired with graphics, video, audio, hypertext, virtual reality, and animation to support instructional strategies.

Other creative writing ideas to implement can be found at **http://www.teachingideas.co.uk/english/creative.htm**. A sample activity has the students read Roald Dahl's popular book, *Charlie and the Chocolate Factory*. After reading the book, students are encouraged to design a new room for the chocolate factory. Building on students' strengths, each student decides what and how he or she would contribute to the room. Some students may prefer to draw the room while others may describe it orally. Others may prefer to write out special recipes for the goodies in the room. This activity provides endless of opportunities to practice reading and writing skills at all levels.

Additional sources of electronic text include:

- **The Internet Public Library** [**http://www.ipl.org**] offers electronic books and resources. One feature is "kidspace," which provides students with resources and activities to build literacy skills. In addition, this site links resources and web site on particular topics. For example, if students are researching a United States president, the site will direct them to a variety of online resources.

- **BAB Books online** [**http://www.sundhagen.com/babbooks**/] has a feature entitled, "Stories and Resources" that provides delightful children's stories. The resource page includes hundreds of stories and activities students can use to practice reading and writing skills.

- **Between The Lions** [**http://pbskids.org/lions/**] shares stories and activities for students to enjoy. The stories include underlined words. When a student clicks on the underlined word, the word is spoken and a simple definition pops up.

- **Kidpub** [**http://www.kidpub.com/kidpub/**] encourages students to write. It provides more than 40,000 student-written stories. Students can read other student stories and their own story may be selected as the reader's pick or publisher's pick of the month. Teachers also can set up their own class page to showcase students' writing.

- **Secrets at Sea** [**http://www.secretsatsea.org/**] is a web site that provides a mystery for students to solve. Students are provided with resources such as a field guide and notes to learn new facts. This site is a great vehicle for teaching students inductive and deductive reading clues and strategies, explicit problem solving approaches and, if working in a group, collaborative skills. There also is a teacher's guide.

Diversified Materials

Use this strategy for students who:

- Miss information, often need things repeated, or need someone to write notes for them.

- Have difficulty identifying main ideas or important points.

- Can understand the information when someone else reads it.

- See little value in reading.
- Acquire new information by hands-on trial and error.

Overview of Diversified Materials: What We Know

Students engage in and express learning outcomes in various ways. Therefore, teachers should offer students multiple means of expression and control while providing instructional content through multiple means of engagement (Castellani, 2000; Stainback & Stainback, 1992). Providing text in multiple formats allows learners to build their strengths and previously acquired skills. It also provides teachers with many different strategies for differentiating learning materials from early childhood to high school settings (Castellani, 2000).

Technology Scaffolds

Teachers can develop instructional materials that allow learners to access support through assistive technologies such as a text reader. Technology can be used to modify the readability of classroom materials. They also can use software programs that build in media other than traditional written products. Examples of techniques follow.

Hypermedia Tools

Hypermedia tools help students attain a high degree of control and success in attaining learning objectives. Students can execute control over certain aspects of the teaching environment (e.g., the speed at which the information is accessed), which subsequently meets their needs in a

more individualized fashion. Learner control not only allows individuals to access information at their own pace, but it enables the learner to master important concepts within their individually developed schemas and thought repertoires.

Hypermedia programs provide teachers with an adaptable tool to use across the curriculum that allows students to have ownership of individual projects. In addition, hypermedia tools can create electronic learning activities such as study guides, stories, and review games within the classroom that allow for interactive customization of learning tasks.

Here's an example: The use of action buttons and hyperlinks within ***MS PowerPoint*** or similar presentation software can provide learners with opportunities to select multiple paths of learning and apply higher order thinking skills and problem solving strategies. The first step is to break the reading or learning task into different categories or avenues thus providing task options at various levels. Next, each of these options is placed onto a separate presentation slide. Slides are linked slide-to-slide in a nonlinear fashion. For example, when reading a story about hockey, students can use action buttons to select to read the story, play a hockey trivia game related to the story, or learn more about the individual hockey players within the story. Each option provides them with new and exciting information about the learning theme of hockey as well as brief opportunities for comprehension and vocabulary checks. As a result, the reading task, which is typically individual and pas-

sive, becomes alive and interactive with activities that provide immediate feedback.

Here's another example: Hypermedia activities and programs are typically used to increase reading and writing across the curriculum. Teachers and students mutually choose a topic that is based on the current curriculum. After researching their topic, students create slides or stacks for each topic. In the popular software program Hyperstudio, students create stacks. These stacks become a mental expression of their research and exploration of a topic in visual (use of graphics and animation), auditory (use of pre-recorded sound and student recordings), and/or tactile (being able to manipulate a stack with a keyboard and mouse and pass through the cards interactively) form. Because create their own reading and learning activities, these tasks are meaningful and enjoyable to use and share with others.

Other examples of Hypermedia tools are found in Figure 2, "Hypermedia Tools for Modifying Readability of Materials."

Universal Design of Learning

Curriculum also can be adapted using the tenets of universal design for learning, which is defined as design of instructional materials and activities that allows learning goals to be attained by individuals with wide differences in their abilities (CAST, 1996). Textbooks and curriculum materials such as graphics, sound clips, and videos are becoming available on

CD-Rom or through online resources. Such technology provides resources for academic support.

For up-to-date information, a general all-purpose web site is the Universal Learning Center (**http://ulc.cast.org**). It offers access to digital learning materials and suggests strategies for implementation. Other web sites that provide digital alternatives for reading and writing skill practice include:

- *Learning Resources* (**http://literacynet.org/cnnsf**/) offers real-life news stories supported with action video, vocabulary, and comprehension activities for adolescent/ adult readers.

- *Literacy Access Online* (**http://www.literacyaccessonline.com**) allows user to read or create stories. Pre-reading, reading, and post reading activities for stories are available.

- *Storybook Online* (**http://www.storybookonline.net/Default.aspx**) offers both online

and interactive stories.

- *Amazing Adventures* (**http://www.amazingadventure.com/**) provide stories and activities with video.

- *Writing Den* (**http://www2.actden.com/writ_den/**) focuses on interactive activities to build writing skills.

- *Game Goo* (**http://www.earobics.com/gamegoo/games/alien/ashlo.html**)provides interactive games for practicing literacy skills in fun and creative ways.

Summarizing Big Ideas

Use this strategy for students who:

- Have difficulty organizing knowledge about a broad content area.

- Get bogged down with grammar and spelling rather than focus on

the main ideas to be learned.

- Have limited expressive language skills and difficulty expressing the main ideas of a story.

Overview of Summarizing Big Ideas: What We Know

Summarizing big ideas simply means taking larger, table of contents type information from blocks of instruction and highlighting it before presenting students with more specific information about a topic. This helps students answer broad comprehension questions, recall prior knowledge about the topic being studied, and use these ideas to serve as placeholders as new information is introduced.

Strategies that include summarizing big ideas as an instructional support can be applied to general education materials through multiple representations of content or situated to promote student control and expression (CAST, 1996; Castellani, 2000; Castellani and

---

Figure 2: Hypermedia Tools for Modifying Readability of Materials

WebQuests

(**http://theclassroomconnection.freewebspace.com/webquests.htm**). This Internet resource allows learners to choose their paths of learning. WebQuests provides students with a learning task, tools needed to accomplish the task, and information about how they will be evaluated.

Writers WebQuest

(**http://webquest.sdsu.edu/** and **http://coe.west.asu.edu/students/lcastiglione/WQ/#top**). These WebQuests use the Internet to provide exploration and question/answer activities. They also provide places for students to work with available media on a topic, from single source documents to video and animation. Examples of links include "Do you want to be a president?"—a social studies WebQuest (**http://coe.west.asu.edu/students/shorgeshimer/WebPage/preswebquest.html**).

PowerPoint

(**http://www.actden.com/pp/**). PowerPoint is readily available on many school-based machines. It has simple and easy-to-use hypermedia features, including animation and sound.

Jeffs, 2001). Applying strategies that allow students to organize broader ideas about the content to be taught assists in knowledge transfer. This means individuals can access their prior knowledge about a topic and organize it in such a way that allows them to use this knowledge to solve problems. It allows them to increase their prior knowledge base and facilitating their assimilation of new knowledge. This transfer of knowledge also anticipates that when encountering similar situations in the future, the learner will be able to access the knowledge needed to solve conflicts within the learning situation.

Technology Scaffolds

Since many children with disabilities have difficulty organizing thoughts, getting through difficult words, working with difficult text selections, reading and re-reading text, and summarizing and writing about what they have read, it is important to use the technology tools that are available to help them become independent and provide opportunities for success. Examples of techniques follow.

Mind Mapping and Graphic Organizers

With the increase in instructional and assistive technology tools, it is now possible to augment instruction through the use of graphic organizers or concept mapping software. Graphic organizers, structured overviews, and concept maps provide students with a conceptual framework, in terms they understand, to help them organize newly acquired information.

Software programs such as ***Microsoft Word***, ***Microsoft Visio***, and ***Inspiration*** provide students with the ability to graphically display information in a variety of visual formats. For example, let's say that the topic is "wildlife." The teacher starts by having students brainstorm a list of all possible wildlife. Then they create graphic organizers for each of the identified species. Information about each animal is attached visually to the main idea through a box or other creative graphic. The graphics are then used to help students organize their main ideas and accompanying information into sentences.

Graphic-based Word Processors

If a student has difficulty with a text-based approach to writing after they have worked with a specific reading passage, it is helpful to use graphic-based writing software. In most of these programs, users can work with pictures, video, audio, and voice recordings to get ideas down on paper. The key to successful post-writing activities in such software programs is the high degree of motivation these programs provide. In addition, the programs allow students to work with media and text, rather than text alone. Students can organize pictures into storyboards, or within their graphic organizer, and retell the story in their own words, using voice recording or by writing key ideas under each main story scene. Pictures can be taken (downloaded/saved) off the Internet site where a reading passage was found.

References

Biemiller, A., & Siegel, L. (1997). A longitudinal study of the effects of the Bridge reading program for children at risk for reading failure. ***Learning Disability Quarterly***, ***20***(2), 83-92.

Center for Applied Special Technology (CAST) (1996*).* ***The role of online communication in schools: A national study***. Boston, MA: CAST. [Available at **http://www.cast.org**.]

Castellani, J. D., & Jeffs, T. (2001). Reading and writing: Teaching strategies, technology tools, and the Internet. ***Teaching Exceptional Children, 33***(5), 60-67.

Castellani, J. D. (2000). Teachers' perspectives on integrating the Internet into the classroom for high school students with emotional and learning disabilities. ***Intervention in School and Clinic***, ***35***(5), 297-305.

Hall, T. (2004). ***Explicit instruction***. Boston, MA: CAST. [Available at **http://www.cast.org/ncac/ index.cfm?i=2875**.]

Scanlon, D.J., Deshler, D.D., & Schumaker, J.B. (1996). Can a strategy be taught and learned in secondary inclusive classrooms? ***Learning Disabilities Research and Practice***, ***11***(1) 41-57.

Stainback, S., & Stainback, W. (1992). Including students with severe disabilities in the regular classroom curriculum. ***Preventing School Failure, 37***(1), 26-30.