Technology *in Action*

Assistive Technology Helps Students Compensate for Reading Difficulties

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Assistive technology can help students with reading disabilities access information. This Technology in Action directs you to tools and resources designed for this purpose.

Technology and Media Division

The ability to read and understand written and electronic text is critical for academic success. On a daily basis, students are required to read and comprehend a variety of written and electronic materials such as textbooks, workbooks, literary works, newspaper and journal articles, Internet information, and reference materials. Problems can occur when the reading level of these materials is beyond student skill (Boyle, Washburn, Rosenberg, Connelly, Brinckerhoff, & Banerjee, 2002). Students who struggle with reading comprehension have difficulty completing their assignments and often fall behind in their work. This can be frustrating and stressful, and it can hinder learning (Stahl, 2004).

Some high school students compensate for their reading disabilities by having their reading materials read to them (Dell, Newton, & Petroff, 2008). Some students confide that they rarely complete their reading assignments and "get by" by paying attention to class lectures. These same students often are unable to complete their reading assignments on their own when they attend college or hold a job.

Assistive technology (AT) can help students compensate for reading difficulties. Compensation differs from remediation—a topic in another *Technology in Action* (Newton & Dell, 2009)—in which tools are used to help students learn to read. With compensation, students are provided with tools that allow them to access information. This *Technology in Action* explores AT that compensates for reading disabilities. Topics include the following:

- **Scan/read systems.** A sampling of available systems is provided.

- **Text readers.** A sampling of software programs that read aloud electronic text is provided, along with online resources for obtaining e-text.
- **Other compensatory tools and resources.** Organizations that provide recorded books for use on portable reading devices are cited.

Scan/Read Systems

Scan/read systems combine the use of a computer, a scanner, optical character recognition software, and speech output to read printed text aloud while providing a visually-enhanced display on a computer monitor. Users of scan/read systems place the pages to be read on a scanner and click the "scan" icon. The information is converted into an electronic file, similar to a word processing file. As the words are spoken the corresponding text on the screen is highlighted, providing a synchronized auditory and visual presentation of the text (Hecker, Burns, Katz, Elkind, & Elkind, 2002). Highlighting helps users follow the text, while the speech output provides ongoing auditory feedback.

Scan/read software can have a positive impact on the reading performance of post-secondary students with attention disorders. Consider these examples:

- Hecker, Burns, Katz, Elkind, and Elkind (2002) reported that when 20 students were trained to use the *Kurzweil 3000* program to read assignments in English and take tests over the course of a semester,

scan/read software allowed the students to attend better to their reading, to reduce their distractibility, to read with less stress and fatigue, and to read for longer periods of time. It also helped them read faster and thereby complete reading assignments in less time.

- Results from the Iowa Text Reader Study (Iowa Assistive Technology Text Reader Project, 2008) showed that students were able to read two times more information when using a scan/read program. They also showed improved comprehension, even as the reading level increased. Improvements were noted on passage comprehension measures and on factual and inferential comprehension questions. This allowed them to work competitively in an inclusion setting.

Scan/read programs offer many features that are designed specifically to meet the needs of individuals who struggle with reading comprehension. In addition to highlighting and reading the text aloud, the programs offer options that can change the appearance of the visual display. With a few clicks of the mouse, users can transform single-spaced, cramped text into easier-to-read text that is double-spaced and large. Users also can choose the reading selection—the amount of text the program highlights and reads aloud (word, phrase, line or sentence)—as well as the reading voice and speed.

Embedding tools are another beneficial feature of scan/read programs (Anderson-Inman & Horney, 1997). These include a talking dictionary,

talking thesaurus, electronic highlighters to assist students in taking notes and preparing study guides, voice notes, and sticky notes for inserting hidden prompts and reminders.

The talking dictionary is an example of an embedding tool that helps students who have reading comprehension problems (Dell, Newton, & Petroff, 2008). Students click on unfamiliar words, then click on the dictionary icon, and the program immediately displays the dictionary entries, which can be read aloud when the "read" icon is clicked. A second click of the mouse will copy the definition to the computer clipboard so students can create customized vocabulary lists that they can study later.

The extracting notes feature is another useful embedding tool. Different colored electronic highlighters enable users to highlight portions of the text for future study. When reading a history text, a student might highlight battlefields in one color, important historical figures in another, and key dates in a third. The student can then choose to extract the highlighted text, and the program will create a new document that lists all the highlighted text, sorted by highlight color. The student has, in effect, created his or her own study guide.

The newest versions of scan/read systems offer the ability to create audio files for listening on por-

table devices, such as an MP3 player. [*Note*: Visit **http://www.tcnj. edu/~technj/2008/2008TECH-NJ.htm** for step-by-step instructions for converting electronic text into MP3 files.]

Two of the most widely used systems in K-12 and higher education settings are *Kurzweil 3000* (**http://www. kurzweiledu.com/**) and *WYNN* (**http:// www.freedomscientific.com/lsg**). Both offer two versions: one that includes the Optical Character Recognition (OCR) component for scanning, and one that is read-only. Both offer packages that include one full scanning program with four read-only versions. *Kurzweil 3000 Professional* and *WYNN Wizard* are the full scanning versions; *Kurzweil 3000* LearnStation and *WYNN Reader* are the read-only versions. The *Kurzweil 3000* programs are available for both *Windows* and *Macintosh* operating systems.

Other scan/read programs include *Read&Write Gold* from TextHelp (**http://www.texthelp.com**), and *Claro Read Plus*, from Claro Software (**http://www.claroread.com**), both of which are available for *Windows* and *Macintosh* platforms and on a USB flash drive.

Text Files in Electronic Formats

One of the obstacles standing in the way of wide scale implementation of scan/read technology is the time required for scanning documents.

Even with the establishment of the National Instructional Materials Access Center (NIMAC), schools still struggle to provide students with texts in alternate formats. [For more information, see the text box, "NIMAS/NIMAC."]

One means of meeting students' needs for alternative formats is to become knowledgeable about Internet sites that provide text files that are already in electronic format. Called e-text, these Internet sites include electronic versions of books or other printed material. Most literature that is in the public domain (i.e., not copyrighted), such as Shakespeare's plays, is available

for free download from Internet sites such as Project Gutenberg (**www. gutenberg.net**) or the Internet Public Library (**www.ipl.org**). For example, instead of scanning *Hamlet*, the file can be downloaded from the Project Gutenberg website and, after some simple formatting, can be read aloud using a scan/read system such as *WYNN* or *Kurzweil 3000*. The student benefits from the software features and embedding tools, and the need for time consuming scanning is eliminated.

Another site is **Bookshare.org** (see the text box, "Bookshare.org Sample Screen Shot"), which is designed specifically to provide accessible
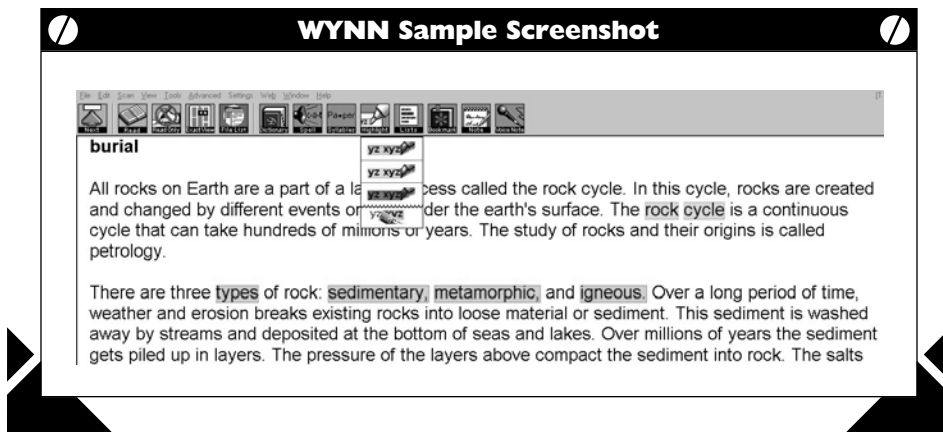

NIMAS/NIMAC

In the 2004 reauthorization of IDEA, a provision was added to ease the problems associated with procuring textbooks in alternative formats. This provision requires K-12 textbook publishers to use a technical standard called the National Instructional Materials Accessibility Standard (NIMAS) to produce source files (in XML) that can be converted to specialized formats such as Braille, audio, e-text, or large print for students with print disabilities (CAST, 2008). NIMAS applies to instructional materials published on or after July 19, 2006. When a state education agency (SEA) or local education agency (LEA) contracts with a publisher to purchase a textbook, the publisher must provide a NIMAS file set to the national repository of digital materials in the National Instructional Materials Access Center (NIMAC), which is located at the American Printing House for the Blind. On request, if the file is in their inventory, NIMAC will provide state and local education agencies with the textbook source files that follow the NIMAS standard.

Files in the NIMAC are *not* "student ready." They follow the NIMAS standard, but someone in the state or local school agency must convert the NIMAS file into the specific format each student needs. The NIMAS standard and the repository are for students in grades K-12 only; they do not apply to college students or adults. A NIMAS workflow graphic that provides details regarding the various steps involved in the whole NIMAS cycle can be downloaded from **http://nimas.cast.org/about/nimas**.

WYNN Sample Screenshot

burial

All rocks on Earth are a part of a la[rge pro]cess called the rock cycle. In this cycle, rocks are created and changed by different events on [or un]der the earth's surface. The rock cycle is a continuous cycle that can take hundreds of millions of years. The study of rocks and their origins is called petrology.

There are three types of rock: sedimentary, metamorphic, and igneous. Over a long period of time, weather and erosion breaks existing rocks into loose material or sediment. This sediment is washed away by streams and deposited at the bottom of seas and lakes. Over millions of years the sediment gets piled up in layers. The pressure of the layers above compact the sediment into rock. The salts

books in digital formats. These digital formats include the NISO/DAISY XML-based format for talking books, and the BRF format for Braille devices and printers. Access to copyrighted books from Bookshare.org is limited to people with documented print disabilities and the schools and nonprofit organizations serving them. An array of security protections and digital rights management solutions ensure that these books are available only to authorized users.

Bookshare.org was recently awarded a grant from the U.S. Department of Education to add more than 100,000 new books to its existing collection and to give all K-12, postsecondary, and graduate students with qualifying print disabilities in the United States access to its library without charge. Bookshare.org also offers a free copy of the text reader *Read Out:Loud* (Bookshare.org Edition published by Don Johnston) to all of its members. It is important for school district personnel to become familiar with multiple sources of

e-text. See the text box, "Internet Sites that Offer e-Text Files for Free or at Low Cost".
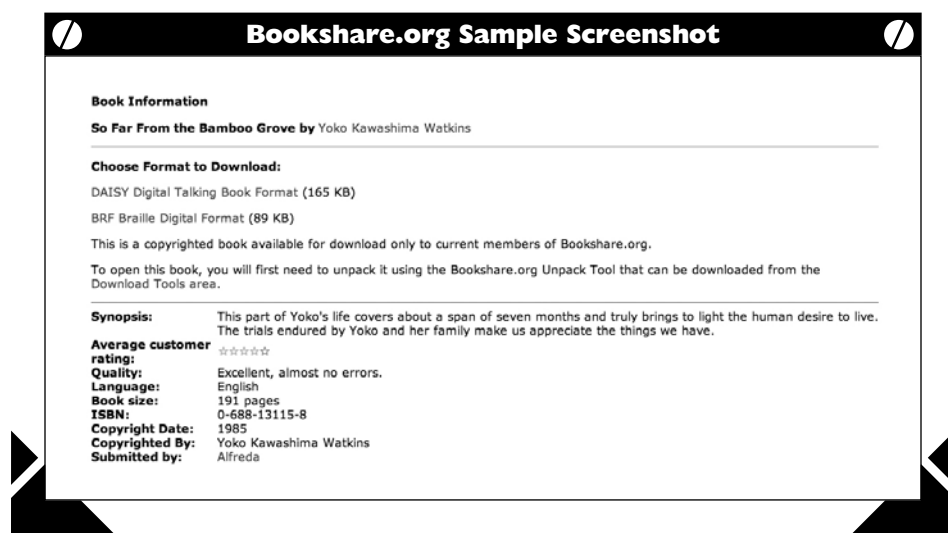
Text Readers

Text reader software provides an alternative to scan/read systems. It can be used when reading material is already available in an electronic format, such as a website or a *Microsoft Word* document. Text readers use text-to-speech technology to convert electronic text to audio. For example, if a teacher has

composed a test using *Microsoft Word*, a student with reading disabilities could complete the test on a computer using text reader software to read aloud the test questions (and to proofread his or her answers). There is no need to scan the paper test, since it is already available as an electronic file.

A wide variety of text readers are available that can be downloaded from the Internet. [See the text box, "Text Reader Resources" for program titles, platforms, and web addresses.] Some of these are freeware, while others are basic versions of more elaborate commercial products. Most text readers highlight the text while reading and offer the ability to adjust the reading speed. In general, text readers priced under $100 offer several refinements over the free versions, such as:

- Using higher quality voices and/or offer the user a choice of voices.
- Offering improved navigation,

Bookshare.org Sample Screenshot

Book Information

So Far From the Bamboo Grove by Yoko Kawashima Watkins

Choose Format to Download:

DAISY Digital Talking Book Format (165 KB)

BRF Braille Digital Format (89 KB)

This is a copyrighted book available for download only to current members of Bookshare.org.

To open this book, you will first need to unpack it using the Bookshare.org Unpack Tool that can be downloaded from the Download Tools area.

Synopsis:	This part of Yoko's life covers about a span of seven months and truly brings to light the human desire to live. The trials endured by Yoko and her family make us appreciate the things we have.
Average customer rating:	☆☆☆☆☆
Quality:	Excellent, almost no errors.
Language:	English
Book size:	191 pages
ISBN:	0-688-13115-8
Copyright Date:	1985
Copyrighted By:	Yoko Kawashima Watkins
Submitted by:	Alfreda

Internet Sites that Offer e-Text Files for Free or at Low Cost

- *Project Gutenberg* (**http://www.Gutenberg.org**). The first producer of free electronic books (e-books), Project Gutenberg offers 25,000 books in the public domain (that is, no longer under copyright). It includes classic literature, such as Shakespeare's plays, and public documents, such as the U.S. Constitution.

- *Bookshare.org* (**http://www.bookshare.org**). Bookshare.org is a membership-based online community that enables people with visual and other print disabilities to legally share scanned books that are copyrighted.

- *Accessible Book Collection* (**http://www.accessible-bookcollection.org**/). This organization provides high interest/low reading level digital text to students with disabilities. Books are appropriate for pre-K through 12th grade students and include books specially written for older struggling readers.

- *Tiflolibros* (**http://www.tiflolibros.com.ar**). This site provides e-text in Spanish and other languages.

- *The Internet Public Library* (**http://www.ipl.org**). The Internet Public Library is now maintained by a consortium of colleges and universities with programs in information science. It is a searchable database that includes books, stories, essays, poems, articles, dramas, letters, and speeches.

- *The Online Books Page* (**http://digital.library.upenn. edu/books**). This site is hosted by the University of Pennsylvania and contains an index of more than 30,000 online books freely readable on the Internet. It includes a helpful beginners' guide called *How To Put Books Online*.

- *Bartleby.com* (**http://www.bartleby.com**). This site provides free access to classical literature, reference works, nonfiction, and verse.

- *EServer* (**http://www.eserver.org**). This is an e-publishing co-op based at Iowa State University that provides an alternative niche for quality work, particularly writings in the arts and humanities. More than 35,000 works are available free of charge.

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including the ability to insert bookmarks.

- Allowing the toolbar and icons to be customized in some cases.

- Having a feature to convert text files to MP3 format.

Higher end programs combine writing tools with text reading technology. In addition to offering many of the features mentioned above, these programs include features such as spell checkers, talking dictionaries, word prediction, homonym finders, and electronic highlighting tools for note taking or developing outlines. Most of these programs read commonly used accessible formats such as NIMAS, PDF, TXT, HTML, XML, and Digital Accessible Information Systems (DAISY) (for more information on DAISY, see the text box "DAISY Format").

Other Compensatory Reading Tools

Recorded Books

In addition to scan/read programs, electronic text, and text readers, there are other forms of technology that can help students who struggle with reading comprehension. Books on Tape is a service that was available for many years. The books are read aloud by readers and recorded on four-track tapes that had to be played back on special four-track tape recorders. Today organizations like Recording for the Blind and Dyslexic (RFB&D) have moved from four-track tapes to digital books on CD, which use the DAISY format (for more information, see the text box, "DAISY Format"). The advantage to digital recordings is that, unlike tapes, they do not need to be navigated in sequential order from beginning to end. Users can start the book at any place, insert bookmarks at any point, and easily navigate from one page or chapter to another page or chapter very easily, or from one bookmark or heading

Text Reader Resources

Free Text Readers

Product Name	Vendor	Platform	Available from:
ReadPlease	ReadPlease	Win	**http://readplease.com**
NaturalReader	NaturalSoft, Ltd.	Win	**http://www.naturalreaders.com**
Balabolka	Freeware	Win	**http://cross-plus-a.com/balabolka.htm**
Help Read	Hawaii Education Literacy Project	Win	**http://www.dyslexia.com/helpread.htm**
Awesome Talkster	Awesome Talking Library	Win	**http://www.awesomelibrary.org/Awesome_Talking_Library.html**
Read:OutLoud Bookshare.org Edition (Free to Bookshare members)	Don Johnston/Bookshare	Win (Mac expected 2009)	**http://www.bookshare.org**
Macintosh OS 10.4–System Preferences: Speech	Apple, Inc.	Mac	Comes with system software on all *Macintosh* computers

Text Readers Available Commercially

Product Name	Vendor	Platform	Notes	Website
ReadPlease Plus	ReadPlease	Win	Uses AT&T Natural Voices	**http://readplease.com**
ReadingBar2	ReadPlease	Win	Designed specifically for Internet Explorer	**http://readplease.com**
NaturalReader Personal & Professional Versions	NaturalSoft, Ltd.	Win	Uses AT&T Natural Voices	**http://www.naturalreaders.com**
TextAloud	NextUp	Win	Offers AT&T Natural Voices, Neospeech, Nuance RealSpeak TTS, Acapela, or Cepstral voices for an additional fee	**http://www.nextup.com**
GhostReader	Convenience-Ware/ NextUp	Mac	Uses Acapela voices	**http://www.nextup.com**
EasyReader	Dolphin	Win	Reads all DAISY files, RFB&D audio books, & Bookshare text or HTML files	**http://www.yourdolphin.com**

Text Readers with Writing Tools

Product Name	Vendor	Platform	Website
AspireReader 4.0	CAST/ Aequus Technologies	Win (Mac under development)	**http://www.cast.org/products/**
Read Out:Loud	Don Johnston, Inc.	Win/Mac	**http://www.donjohnston.com**
Read&Write	TextHelp	Win	**http://www.texthelp.com**
ClaroRead Standard	Claro Software	Win/Mac	**http://www.claroread.com**

DAISY Format (Digital Accessible Information SYstem)

DAISY is an international consortium of libraries and organizations for people with print disabilities. Its mission is to ensure that all people have access to published material through the development of an international standard and implementation strategies for the production, exchange, and use of digital talking books. It features an accessible, feature-rich, easily navigable format. A DAISY book can contain several digital files including digital audio (WAV) files containing a human narration of the source text, a marked-up (HTML/XML) file containing text, a synchronization (SMIL) file to relate places in the text file with corresponding time points in the audio file, and a navigation control (NCC) file that enables the user to move smoothly around the book while synchronization between text and audio is maintained.

to the next. This ease of navigation is a significant improvement over the rewind-fast forward guesswork of Books on Tape.

To access RFB&D's library of digital audio books, students or their schools need to become members. Membership entails a small

annual fee, agreement to a copyright acknowledgement form, and documentation of a print disability. To listen to an RFB&D digital book, students need either a special portable CD player such as a *Victor Reader Wave* or a computer equipped with playback software such as *Victor ReaderSoft*, *EasyReader* or *eClipse Reader* (all available from RFB&D at **http://www.rfbd.org**).

Commercially Available Audio Books

Commercial bookstores and web-based businesses that are targeted to the general public are other sources of recorded books. With the popularity of portable CD players, car audio systems, and MP3 players such as the *iPod*, listening to audio books has become a popular activity in our society. People listen to books as they commute to work, exercise in gyms, jog, or just walk around. They borrow audio books from public libraries, buy them in bookstores, and download them from web-based services such as **Audible.com** and **iTunes.com**.

Commercially available audio books typically include bestsellers and popular fiction and nonfiction titles, not textbooks. Anecdotal evidence suggests that many teenagers, who do not want to look "different" from their peers, would prefer to listen to an audiobook on an iPod, rather than on a "special" device. For stu-

Classmate Reader

ClassMate Reader is an example of a text reader. Humanware and Don Johnston Inc. partnered to create and market this light-weight, portable device. This product, introduced in early 2008, weighs only 10.7 ounces and looks like a *Nintendo DS* or a *Play Station Portable (PSP)*. It has a 2 x 3 inch interactive color touch screen that displays and highlights text as the text-to-speech engine reads it aloud. A headphone jack enables students to listen to the text as they follow along on the screen. The text automatically scrolls as it reads, a helpful feature on a small screen. Text files are stored on a removable SD flash memory card and can be downloaded from websites like Bookshare.org. Like *Kurzweil 3000* and *WYNN*, the device provides a talking dictionary and study tools such as bookmarks, text notes, and voice notes. With this combination of portability, synchronous display of text and audio, and embedding tools, the *ClassMate Reader* could be widely used by students with reading disabilities.

dents who do not need to see modified or enhanced text on a computer monitor, these portable audiobook players are an inexpensive, convenient option for school and personal choice reading.

Audible.com recently introduced a new website called *AudibleKids* (**http://kids.audible.com**) that provides audio books in MP3 format. This site is geared specifically for children and families. It offers an interface and options to search by age, grade level, or category of children's literature (e.g., animal stories; biography and history; classics and poetry; fables, fairy tales and myths; fiction; mysteries; nonfiction; parenting and teaching; science fiction and fantasy; study guides; and foreign language).

AudibleKids is designed to be an interactive community and to promote the fun of storytelling through audiobooks. Users can listen to books, read and post reviews, and share their favorite books with others. In collaboration with Reading Is Fundamental, Inc. (RIF), AudibleKids offers several free downloads. A new promising feature being beta-tested at the time of this writing is "Audible Enhanced," which uses the video capabilities of *iPods* and similar players to show the original illustrations from picture books as it reads the text aloud.

Conclusion

Software and hardware can help students compensate for reading disabilities. However, simply providing students with the technology is not enough. Students need to be taught how to use the technology and how to use specific features to help overcome their learning problems. Schools need to provide training on the technology to students, staff, and family members, if appropriate. Implementation plans need to be developed that identify specific staff members who will be responsible for scanning texts and other reading materials, locating materials in alternative formats, preparing the files for student use, and arranging for the files to be installed or given to students. Training, preparing detailed implementation plans, and following through on these plans must be addressed if students with reading disabilities are to benefit from compensatory reading technology.

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