North Central Regional Educational Laboratory

USING TECHNOLOGY TO IMPROVE THE LITERACY SKILLS OF STUDENTS WITH DISABILITIES

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ABSTRACT

This is a summary of best practices in using technology to improve the literacy skills of students receiving special education services. Topics under discussion and review include: common literacy problems experienced by students with disabilities; legal requirements of technology consideration and acquisition in relation to a school district's special education assessment and planning process; leading approaches to assessing students' technological needs; suggestions for incorporating assessment information into the development of individualized education programs (IEPs); and a variety of low- and high-tech tools that can be used to enhance the literacy skills of students with disabilities.

INTRODUCTION

Using technologies to help persons with disabilities learn and experience an enhanced quality of life has been an important area of research and practice in special education for many years. Even Alexander Graham Bell's invention of the telephone grew out of his efforts to assist people with hearing disabilities (Grosvenor, 1997). Although there is a long history of efforts to help persons with disabilities by using technologies available to the general population as well as technologies designed solely for use by people with disabilities (Blackhurst & Edyburn, 2000), the past 20 years have seen an unparalleled interest in the use of instructional and assistive technologies. ABLEDATA (2004) maintains a database that includes descriptions of more than 30,000 technologies intended to enhance the learning and/or life functioning of persons with disabilities.

Along with an unprecedented growth in the development of high-tech devices over the past two decades, there has been a renewed appreciation for low-tech aids and considerable refinement in procedures to assess students for technological needs. A significant focus of the recent technology boom has been on developing tools that enhance student literacy skills. This article summarizes the best practices in using technology to improve the literacy skills of students with disabilities. Topics under discussion and review include: the legal responsibilities of schools, common literacy problems experienced by children with disabilities, procedures to assess the technological needs of students with disabilities, and information on how to use assessment information when developing goals and objectives for an IEP. In addition, several popular assistive and instructional technologies are described in relationship to the functions they serve.

RESPONSIBILITIES OF EDUCATORS

Education teams must consider the need for assistive technology in the development of every student's IEP. The Individuals with Disabilities Education Act (IDEA) of 1990 stated that assistive technology should be considered; the IDEA Amendments (IDEA, 1997) state that assistive technology must be considered. Today, all students requiring special education services must be considered for assistive technology; there are no exceptions or prerequisites, and the determination must be made on an individual basis (Chambers, 1997).

Golden (1999) projected that assistive technology could be used with up to 35 percent of students with a health impairment or a learning or cognitive disability; up to 75 percent of students with autism or traumatic brain injury; and up to 100 percent of students with physical or multiple disabilities, students who are deaf or hearing impaired, and students who are blind or visually impaired. An *assistive-technology device* is "any item, piece of equipment, or product system, whether acquired commercially, off-the-shelf, modified, or customized, that is used to increase, maintain, or improve functional capabilities of individuals with disabilities" (IDEA, 1997). An *assistive-technology service* is "any service that directly assists an individual with a disability in the selection, acquisition, or use of an assistive-technology device" (IDEA, 1997). This includes but is not limited to evaluation, training, technical assistance, maintenance, or repair. In addition to the consideration requirement for assistive technologies, the IDEA Amendments of 1997 require that any instruction, adaptation, accommodation, or related service—including assistive-technology devices and services—must be provided at no cost to the student or family if such devices or services are needed to provide a free appropriate public education in the least restrictive environment.

COMMON LITERACY PROBLEMS EXPERIENCED BY STUDENTS RECEIVING SPECIAL EDUCATION

Literacy skills consist of the ability to think, listen, speak, and read and write effectively. Although many questions remain about the complex processes in the acquisition of language and literacy skills, few question that oral language, reading, and writing are parts of an integrated language system (Lerner, 1997). Due to the interrelationship of literacy skills, students who exhibit difficulties with one element of the language system often exhibit related problems in other areas of literacy.

A common characteristic of students with disabilities is language deficiency, which may present itself as problems with letters and sounds, limited vocabulary (both receptive and expressive), and numerous weaknesses in oral and written expression. Another difficulty area for students with disabilities are perceptual problems—recognizing, discriminating, and interpreting visual and auditory stimuli (Salend, 2001)—and problems with large- and small-motor tasks (Silvia, McGee, & Williams, 1985). Clearly these areas of difficulty can jeopardize effective reading and writing skills, which combine auditory, visual, motor, and conceptual processes. In addition, many students with IEPs have problems with attention, memory, and organization (Bay & Bryan, 1992), all of which affect both reading and writing.

Reading is often considered the most complex element of literacy. It is problematic for 10 percent to 15 percent of the general K–12 population (Harris & Sipay, 1990) and the majority of students with IEPs (Ysseldyke, Algozine, & Thurlow, 2000). Early literacy development includes several phases of learning—emergent literacy, early literacy, and early fluency/fluency (Clay, 1991; Pinnell & Matlin, 1989)—through which children progress in different ways and at different speeds toward the more complex skills needed for written composition and oral expression. As in most other areas of development, all children do not follow one clear, sequential path. Rather, individual children may take a variety of routes toward mastering reading and writing because literacy learning is circular or recursive. Learners may move forward in some areas and seem to step back in others as they consolidate their understanding. Thus, reading and writing may not develop evenly; a child may be fluent in one area and only emergent in another.

Emergent Literacy

During the emergent literacy stage, students must obtain an awareness of print, including both visual and auditory elements, as well as a basic understanding of the purpose and process of reading. Typically, learners at the emergent literacy stage can identify parts of a book (e.g., front, back, and page) and can distinguish between letters, words, and punctuation marks. They understand that words convey meaning and can pretend to read stories familiar to them (Clay, 1991; Mercer & Mercer, 1998; Pinnell & Matlin, 1989). Phonological awareness—the recognition that words are made up of sound elements or phonemes—also develops within the emergent literacy stage. Students who lack phonological awareness may have difficulty naming rhyming words, counting sounds or syllables, or segmenting words into sounds. Lyon (1995) stated that the best predictor of reading ability for kindergarten and first-grade students is the phoneme segmentation skill, breaking words into separate sounds (e.g., cat becomes k-æ-t).

Early Literacy

Within the early literacy stage, learners begin to utilize letter-sound relationships to decode printed words not recognized by rote or sight. Problems occur when students cannot discriminate between similarly shaped letters, such as "b" and "d," or cannot recall the sounds belonging to the letters. Memory problems often slow the symbol-to-sound translation process and leave little working memory for constructing meaning from print. Finally, in this stage, students begin to utilize a variety of context, syllabication, and structural-analysis cues to assist them in word identification (Clay, 1991; Mercer & Mercer, 1998; Pinnell & Matlin, 1989).

Early Fluency/Fluency

Fluency can be defined as the reading of grade-level material at a minimum of 100 words per minute with few errors (Deno, Fuchs, Marston, & Shin, 2001). Good readers at this stage often recognize a large bank of irregular sight words (e.g., was, sight) automatically. Students with disabilities, as well as other poor readers, continue to struggle with the decoding process at this stage. The process of reading may become so painful for poor readers that they begin to avoid reading whenever possible, which increases the gap between skilled and unskilled readers (Stanovich, 1986). The development of increased comprehension is also part of this stage. Typically, students at this stage can comprehend a wide variety of reading materials independently to gain knowledge and facilitate abstract thinking (Clay, 1991; Pinnell & Matlin, 1989). However, poor readers often exhibit difficulties with metacognitive skills, failing to monitor their comprehension during reading and failing to employ repair strategies when comprehension problems occur (Lerner, 1997).

Written Composition

Written composition is considered by many to be one of the highest forms of communication; it depends on complex thinking, comprehension, concept development, and abstraction. Successful writing requires organizing ideas to convey a message in addition to the lower order tasks of spelling, handwriting, and punctuation (Mercer & Mercer, 1998). The writing of students with disabilities is different from that of their nondisabled peers, both in quantity and quality. Their writing is frequently disorganized with fewer ideas, poorly developed themes, and more spelling and handwriting errors. Poor writers often have fewer planning and revising strategies in their repertoire, which results in a poor product at completion (Englert & Raphael, 1988).

Oral Expression

As mentioned previously, oral expression is also a key aspect of being literate. Although the focus of this paper is limited to technologies that address reading and writing difficulties, interested readers are encouraged to investigate information on technologies that promote oral expression and verbal communication. Excellent resources can be found at the following Web sites:

- The American Speech-Language-Hearing Association—**www.asha.org/public/speech/disorders/Augmentative-and-Alternative.htm**
- The Augmentative and Alternative Communication Institute—**www.aacinstitute.org**

ASSESSING TECHNOLOGY NEEDS FOR DEVELOPING IEPS

Difficulty acquiring literacy skills puts children at risk for referral for special education services (Bay & Brian, 1992), and the vast majority of children with disabilities perform poorly on standardized tests that measure literacy achievement (Ysseldyke, Algozine, & Thurlow, 2000). Therefore, enhancing literacy skills has traditionally been a major focus of many students' IEP goals and objectives. Within the development and delivery of a student's special education services, there are four distinct points at which the educational team needs to consider a student's need for assistive technology: (1) the initial evaluation for eligibility—it supports completion of an effective evaluation, (2) the development of the initial IEP, (3) the annual review, and (4) the three-year reevaluation (Bowser & Reed, 1995).

Although the 1997 IDEA Amendments require that assistive technology be considered during the development of every student's IEP, there is a lack of clarity as to how consideration translates into assessment. Reed and Bowser (1999) suggest consideration constitutes a brief discussion, lasting at least a minute or two but no more than 15–20 minutes with the IEP team. They recommend, "If understanding and agreement cannot be reached in 20 minutes, then it is possible that there are questions that need to be addressed in another forum, such as an assistive-technology evaluation." Thus, consideration can be accomplished by an educational team that is knowledgeable of assistive-technology devices and services and has sufficient information to engage in a problem-solving process in a reasonable or limited span of time.

The consideration of assistive technology is more akin to collaborative problem solving (Friend & Cook, 2003), invoking a process that begins with problem identification, proceeds to formulating solutions—often through a brainstorming process—and ends with selecting and implementing a solution. This is most often an ongoing process that can involve as few participants as the special education and general education teachers collaborating together or as many participants as the multidisciplinary educational team working with the parents to address a problem. Such collaborative problem solving should result in selecting assistive technologies to be used. For example, it may be determined that specific devices, software, or other materials (e.g., handheld spell checkers, software to support first-draft writing, or portable keyboarding devices) are indeed needed by the student as compensatory technology. If identifying and selecting technology requires more time, information, or expertise—or if it is too complex for the team to consider using a problem-solving process—then a more in-depth technology assessment is needed.

The need for a more structured approach has led to the emergence of assistive-technology consideration models (Watts & O'Brian, 2001). These models have either delineated a series of questions for the team to address (Chambers, 1997) or have provided a framework for the process of data gathering, analysis, selection of assistive technology, and trial implementation (Zabala, 1996).

One example of a more in-depth approach is Zabala's (1996) Students, Environments, Tasks, and Tools (SETT) framework. SETT users examine the student's strengths, abilities, and needs; the requirements of the environments in which the student must function (e.g., the classroom, the community, or work); and the requirements of the tasks the student must perform. Information

from the student, the environments, and the tasks are used to develop a set of features that the assistive-technology tools must provide to enable the student to learn and function. These features are then used to identify possible assistive technologies for use by the student.

The process continues with the identification of one or more tools to be used during a trial evaluation period. The educational team develops an implementation plan for the trial period that includes both training of the student, teacher, and family in the operation and application of the assistive technology and the collection of performance data. On the basis of the trial implementation, final decisions regarding selection and long-term implementation of the assistive technology are made by the educational team.

It is important to remember that the SETT framework is not a protocol for assessment but rather an organizational tool intended to be an integral, ongoing part of all phases of assistive technology. It is meant to support and encourage broad communication and participation by students, their family members, and education professionals—all of the people on IEP teams and other collaborative groups—as they work together to determine the possible need for assistive-technology devices and services (Zabala, n.d.).

Using Assistive-Technology Assessment Information When Developing IEPs

Whether developed through collaborative problem solving or the use of an assessment framework, the information concerning the assistive-technology devices or services, training supports, or the integration-into-instruction needed must be included in the student's IEP. The student's educational progress, data-based needs for the assistive technology, and the effectiveness of any prior assistive-technology use are documented under the *Present Levels of Performance* section of the student's IEP. On the basis of this information, the student's annual goals and objectives are developed.

The *Goals and Objectives* section of the IEP should specifically reference how assistive technology is used (Chambers, 1997). For example, "Using a portable keyboarding device, student will complete three two-paragraph journaling assignments per week." Or "Using a text-to-speech digital output, student will read weekly social studies assignments and answer written questions using a speech output word-processing program."

The assistive technology needed by the student is incorporated into the *Adaptations and Accommodations* section of the IEP, as is the assistive technology to be used to support state and district testing. And any devices or services needed to support the student in the general education classroom or to support parents or teachers in the use of the assistive technology must be referenced on the IEP in the *Supplemental Supports or Services* section (Chambers, 1997; Etscheidt & Bartlett, 1999).

The frequency and duration of necessary instruction or training in both the operational and functional use of the assistive technology is specified on the IEP in the *Special Education or Related Services* section (Chambers, 1997). Finally, an assistive-technology implementation plan that includes a specific date for reviewing the progress of the implementation efforts, as well as the student's educational progress, can be attached to the IEP as additional documentation, similar to the inclusion of reports of special medical or behavioral needs.

TECHNOLOGIES TO IMPROVE LITERACY

The remainder of this article focuses on describing an array of assistive and instructional technologies. The descriptions are intended to enable readers to acquire a sense of the types of technology available to assist students with disabilities who are experiencing academic difficulties due to poor literacy skills. Some technologies serve primarily to enhance teaching and learning (e.g., software programs for drilling and practicing academic concepts). Other technologies (e.g., screen readers that "read aloud" text on a computer) are primarily used to compensate for literacy problems—enabling individuals with disabilities to complete tasks more effectively, efficiently, and independently.

No pretense is made that the technologies described here provide a comprehensive or complete list. Such a list is beyond the scope of this article, and space requirements enable only a limited listing. Interested readers are encouraged to consult the additional resources listed at the conclusion of the article to find more information on assistive-technology products and services.

Technologies for Reading Problems

Many of the first assistive devices were developed for individuals with visual impairments, but these tools have been found to be very effective for people with reading problems as well and have since been adapted for these persons.

- **ReadPlease and outSPOKEN.** These programs read any text shown on a computer screen to the user.
- **Kurzweil 3000 LearnStation and OmniPage® Pro 14.** These programs scan and convert printed text from a paper or book into editable text so a screen reader (noted above) can read aloud the words on a computer.
- **Read&Write (v7) Gold and TextAloud.** These programs convert printed text to an audio file for use in an MP3 player or similar portable device.
- **Other Auditory Technology.** Tapes, CD-ROMs, DVDs, portable readers and players, and special Internet services all can provide auditory access to printed materials.
- **Format Features in Microsoft® Word and Write:OutLoud SOLO™.** These programs format text to be easier for a user to see by increasing font size, pairing graphics with text, changing background and font color, changing text to a more readable font, or using highlighting to emphasize certain text.
- **Franklin Speaking Homework Wiz® and Quicktionary Reading Pen.** Students can access pronunciations and definitions for words on the computer using portable spell checkers and auditory dictionaries and thesauruses; or on paper using reading pens.
- **Writing With Symbols 2000™.** This program pairs text with graphics, such as Widgit Rebus symbols or picture-communication symbols, for users who can interpret pictures but not the printed word.
- **Visual Tracking Magnifier.** This product can assist users in keeping their place on the page through transparent overlays that change the background color of a page or magnify a line of text for easier reading.

Additional examples of technologies that help students experiencing problems developing reading skills are provided in the following pages. Common problems experienced by many students are presented, and examples of technologies that may provide solutions to the problems are briefly described. Many technologies can be used to solve more than one type of problem. Therefore, it should not be assumed that each of the technologies listed below is only useful in regard to the corresponding problem presented.

Problem: Student cannot read assigned printed material for a content area.
Solution: Obtain materials in alternative formats.

- **Recording for the Blind and Dyslexic® (RFB&D).** This Web site, **www.rfbd.org**, provides educational books (academic textbooks) on audiocassette and CD and has materials in all subject areas from Grade 4 to the postgraduate level. An RFB&D application requires a signature either by a medical or psychological professional or an education specialist.
- **Talking Books at the National Library Service (NLS).** This free service from the Library of Congress is commonly referred to as Talking Books. The NLS offers leisure materials and magazines on audiocassette or CD. The collection includes popular novels, classic literature, poetry, biographies, and magazines. The Talking Books program is maintained at **www.loc.gov/nls/** by the NLS for the Blind and Physically Handicapped at the Library of Congress. The service has thousands of titles available or will order what an applicant requests. Talking Books requires signed applications by a medical doctor, not a psychologist.
- **Bookshare.** This subscription-based online service at **www.bookshare.org** provides digital books to persons with disabilities. A user must complete an application and have proof of disability to subscribe and download books. Thousands of books are available. Also, public-domain books in TXT and HTML formats are available to any subscriber who wishes to use text-to-speech software.

Problem: Student cannot read material from a computer screen or from a printed page.
Solution: Scan printed material into a computer, and use technology that reads text aloud on the computer screen.

- **Optical Character Recognition (OCR) and Text-to-Speech Software.** For a computer to "read" material from a hard copy (e.g., books or magazines), one needs a scanner, scanning software, OCR software, text-to-speech software, and a compatible computer. Users scan the material into the computer as an image, much like a photocopy. The OCR software then converts the image of the page into text that can then be read aloud using text-to-speech software (e.g., OmniPage® Pro 14 and Kurzweil 3000 LearnStation for Windows).
- **Web Resources.** If a student has OCR and scanning software, many Web sites have public-domain books, stories, and articles for downloading and "reading" by computers.
  - **Project Gutenberg.** As the largest e-text site, available at **promo.net/pg/**, the Project Gutenberg Web site has a wealth of materials divided into light literature, heavy literature, and references.
  - **Caveat Lector**. This site, **www.hicom.net/~oedipus/etext.html**, has resources on many topics useful to high school and adult populations.
  - **The Children's Literature Web Guide.** The University of Calgary maintains this excellent site for children's literature at **www.acs.ucalgary.ca/~dkbrown/**.
  - **The Internet Public Library Youth Division.** This site, **www.ipl.org/youth/**, has many stories and poems for young readers.

Problem: Student has difficulty following the lines of text, perceiving that the words jump or move on a page of standard black-on-white print.
Solution: Use colored transparent sheets or bar magnifiers.

- **Color Overlays.** Often persons with visual-processing difficulties complain text "jumps or moves" on the page. Sometimes a color filter can prevent or lessen this distortion and discomfort by "calming" the page. The color of the overlay is an individual preference. Example overlays can be found on the Cerium Vision Technologies Web site at **www.ceriumvistech.co.uk**.
- **Bar Magnifiers.** These 6- to 9-inch bars feature a yellow line down the center. A bar magnifier (e.g., BUGZ-EYE® Slider, BUGZ-EYE® Mega Slider, and BUGZ-EYE® Micro Slider) can be run down the text one line at a time to magnify and highlight lines of text. This is very helpful for readers who tend to read words in different lines.

Problem: Student has difficulty decoding some text, understanding more complex words, and skimming text for important information to study.
Solution: Use reading pens, portable spell checkers, and highlighters.

- **Reading Pens.** These are most helpful to readers who can decode most text but need help with limited words. A reading pen (e.g., Quicktionary Reading Pen) is designed so users run the scanning pen over a word and the punctuation, and a definition is read aloud. Good fine-motor control is required since the user must run the pen tip over the desired word.
- **Portable Spell Checkers.** These are good for readers who can decode most text but need help with limited words. A user can enter a word into a portable spell checker or dictionary (e.g., Franklin Speaking Homework Wiz® and the American Heritage Talking Dictionary) to obtain a spelling or definition.
- **Highlighters.** These low-tech tools can help readers differentiate important from unimportant text. Using a system of various colors for different types of information can help cue users to where to look for text to review. For example, use yellow for topic sentences, blue for new vocabulary, pink for dates, and green for supporting sentences.

The assistive technologies discussed above help compensate for reading problems. There are also numerous software applications and other programs that work on increasing reading skills. Deciding when to use compensation strategies as opposed to remediation techniques is up to the individual and the "team," depending on the age of the user. Some software programs designed to teach reading include Phonics Talking Learning System (Model 2600), StudyWiz™, and Leaps and Bounds 2.

Technologies for Writing Problems

Individuals with written-language problems may have difficulty with one or more of its aspects, such as spelling, proper use of grammar and syntax, organizational skills, punctuation, and initiating writing. Assistive technologies can help with the physical act of putting words onto paper as well as written expression.

The physical act of putting pen or pencil to paper can be a daunting task for a person with writing problems. Legibility can be difficult, as is the need to know the relationships between the symbols and the sounds of letters and words. Misspellings can come not only from lack of word knowledge, but also from replacing one letter with another, such as a "p" for a "q." Persons who have to work hard to put words to paper often lose comprehension, fluency, and their ideas when writing (McLaughlin & Lewis, 2001).

Practice is the number one tool that makes a person a better writer. Allowing a user access to word processing can help alleviate hesitancy in writing caused by poor spelling, lack of grammar skills, poor handwriting, and an inability to proofread and edit handwritten work. When the goal of the activity or task is written expression and not handwriting or grammar, access to word processing on a computer or stand-alone keyboard (e.g., AlphaSmart®) could be beneficial for a person with handwriting or grammar difficulties that may impede written expression.

Built-in supports in most word-processing applications can make writing less difficult. Editing techniques can be helpful in correcting writing errors. "Cut-and-paste" and "click-and-drag" features allow the writer to move words, sentences, and paragraphs within the text with ease. Spell checkers and grammar checkers help users make fewer errors in finished products. However, spell and grammar checkers are not foolproof methods; spell checkers only capture misspelled words—not misplaced but correctly spelled words, words used improperly (such as homonyms), or the use of a wrong word. Users must still be able to proofread their work using text-to-speech software or other methods to ensure error-free documents. Word-processing software can also facilitate a sequential approach to writing when used with accompanying outlining software.

Idea-organization software, such as Inspiration, and idea-organization and draft-writing software, such as DraftBuilder®, allow users to input data in smaller segments, organize and reorganize ideas, and slowly build segments into a finished document. Speech-recognition software is also a viable option for those individuals whose keyboarding skills are too slow for efficient writing.

Individuals with writing problems may have problems with:

- **Copying or completing work on a printed page.** The writer has difficulty copying words from a blackboard, book, or other printed material.
- **Taking notes from oral presentations.** The student has difficulty writing down homework assignments correctly, or the writing process is too slow to get lecture points on paper.
- **Spelling skills.** The writer spells phonetically and cannot remember patterns or spells words differently in the same document.
- **Handwriting or writing illegibility.** The writer does not follow lines on paper, writes too small or too large, writes too lightly or too firmly, or pencil grip is incorrect.
- **Grammar, syntax, and organization.** The writer demonstrates inconsistent memory for sentence mechanics and persistent problems with sentence structure.
- **Writing skills inconsistent with verbal abilities.** The writer produces short or simple essays despite the ability to verbalize more complex thought, or the student can verbalize answers to tests, but written answers are wrong.

Specific examples of technologies that help students experiencing problems developing writing skills follow. As in the reading section, common problems experienced by many students are presented along with examples of technologies that may provide solutions. Additionally, it is important to restate that many technologies can be used to solve more than one type of problem, and it should not be assumed the technologies presented are only applicable to a single circumstance.

Problem: Student has difficulty with some physical aspect of the writing process.
Solution: Pencil grips, incline boards, alternative paper options, writing guides, or portable keyboards.

- **Pencil Grips.** They help to build up the shaft of a pencil or pen and can help the user control the implement for easier writing.
- **Incline Boards.** This allows the user to write on a 15- to 30-degree surface that especially can help young writers get better control on the paper.
- **Alternative Papers.** Paper with bolder or raised lines helps writers stay on the lines while writing.
- **Writing Guides.** These plastic guides are available for one to multiple lines and provide more of a guide than raised lines.
- **Portable Keyboard.** This device (e.g., AlphaSmart® 3000) can be used to reduce the requirements of fine-motor control and coordination in cursive writing.

Problem: Student has difficulty spelling words when writing.
Solution: Employ word lists or spell checkers.

- **Word Lists.** Either made for the individual or commercially made (e.g., Quick Word Book), these provide models for correct spelling.
- **Spell Checkers.** Electronic or handheld spell checkers (e.g., Franklin Speaking Homework Wiz® and the American Heritage Talking Dictionary) are easier to use than print dictionaries because a user can make a guess at spelling and get a list of possibilities.

Problem: Student has handwriting difficulties.
Solution: Word processors, recorders, computers, and word-prediction software.

- **Portable Word Processors.** These products (e.g., AlphaSmart® 3000) allow writers to use keyboarding to create documents. Most word processors have features that can help poor writers with some writing problems. The features include autocorrect, autotext, spelling and grammar checks, a dictionary and thesaurus, highlighting tools, autosummarize, changing background and text color, changing font style and size, and the tracking of editing changes.
- **Auditory Word Processors.** These devices (e.g., Write:OutLoud® SOLO) give auditory feedback after the user types a letter, word, sentence, or paragraph. Aspects include the ability to change auditory feedback for any letter, word, sentence, or paragraph; to import text from other sources; to add graphics; and to change visual features.
- **Graphical Word Processors.** These products (e.g., Writing With Symbols 2000) allow graphics to be used with or without text to aid users who are unable to use or read normal text.
- **Recorders.** Both analog and digital, these are used to take lecture notes or record short passages instead of handwriting, dictating, or brainstorming. Digital recorders also can capture lectures for speech-to-text conversion.

- **Computers.** Computers change the writing process by eliminating handwriting problems, making proofreading easier because text is more legible, and including software-editing tools that help writers experience fewer difficulties with spelling and grammar.
- **Word-Prediction and Word-Completion Programs.** These programs display a list of words after a user types several letters; such software is typically used in conjunction with a word-processing program (e.g., Write:OutLoud®) or a portable keyboarding device (e.g., AlphaSmart® 3000). Possible features of prediction programs include: a number of possible words in a list, phonetic spelling, multiple user profiles, auditory feedback, switching of scanning capabilities, topic dictionaries, changeable visual features, a prediction box that either follows the cursor or stays in place, the ability to change the size of the predictive dictionary, and abbreviation expansion (e.g., CoWriter®, WriteAway 2000). Word-prediction software also can provide support to students who have problems with vocabulary and word-finding.

Problem: Student has difficulty organizing written information.
Solution: Use outlining or brainstorming software.

- **Outlining and Brainstorming Software.** These products can help students who have difficulty getting started and organizing written projects. Some applications, such as Inspiration and Kidspiration, allow graphics. Others, such as DraftBuilder®, provide more cueing and support for outlining and first-draft preparation.

Problem: Traditional input into the computer is not efficient.
Solution: Speech-recognition software, alternative input, and scanning and form-typing software.

- **Speech-Recognition Software.** This software (e.g., Dragon Naturally Speaking) allows the individual to speak into a microphone and have the text be transferred to the computer.
- **Alternative Input or Keyboards.** These products (e.g., AFC Access: TouchWindow, mouse-driven keyboards) can be programmed to change keyboard layouts for easier use. Other options include trackballs, joysticks, track pads, touch screens, and a head mouse.
- **Scanning and Form-Typing Software.** These help writers who have difficulty completing forms, worksheets, or other work on printed material. With this, writers can scan the hard copy and complete the work in an electronic format through drawing and writing on the scanned sheet with program tools such as paint, pen, eraser, and fill.

The assistive technologies discussed above help compensate for writing problems. There are also numerous software applications and other programs that work on increasing writing skills. Hyperstudio/Sunburst Write On! Plus: Writing With Picture Books is among the most popular programs.

KNOWLEDGE OF TECHNOLOGY IS POWER

As mentioned earlier, the U.S. Congress acknowledged the critical role that technologies play in the lives and education of students with disabilities by passing the Individuals with Disabilities Education Act Amendments of 1997 into law. This law clearly indicates that a determination of whether an assistive-technology device or service is required must be made on an individual basis for each child served through the IDEA. Although there are many factors to consider when making decisions regarding the use of technology (e.g., age of user, use of compensation, or remediation techniques), educators cannot truly consider a child's need for assistive technology unless they are familiar with what technologies are available. If they have not done so already, regular and special educators need to wake up to the fact that matching students with the right technologies and teaching students how to use technologies is an integral component of modern special education services. The technology to improve literacy skills of students receiving special education is here; we just have to use it.

REFERENCES

ABLEDATA (2004). *What is ABLEDATA?* Retrieved November 23, 2004, from http://www.abledata.com/

Bay, M., & Bryan, T. (1992). Differentiating children who are at risk for referral from others on crucial classroom factors. *Remedial and Special Education, 13*(4), 27–33.

Blackhurst, A. E., & Edyburn, D. L. (2000). A brief history of special education technology. *Special Education Technology Practice, 2*(1), 21–36. Retrieved November 23, 2004, from http://www.setp.net/pdf/SEThistory.pdf

Bowser, G., & Reed, P. (1998). Education tech points: A framework for assistive technology planning. *Journal of Special Education Technology, 12*(4), 325–338.

Chambers, A. C. (1998). *Has technology been considered? A guide for IEP teams*. Reston, VA: Council for Exceptional Children.

Clay, M. M. (1991). *Becoming literate: The construction of inner control*. Portsmouth, NH: Heinemann.

Deno, S. L., Fuchs, L. S., Marston, D. B., & Shin, J. (2001). Using curriculum-based measurement to establish growth standards for students with learning disabilities. *School Psychology Review, 30*(4), 507–524.

Englert, C. S., & Raphael, T. E. (1988). Constructing well-formed prose: Process, structure, and metacognitive knowledge. *Exceptional Children, 54*(6), 513–520.

Etscheidt, S. K., & Bartlett, L. (1999). The IDEA amendments: A four-step approach for determining supplementary aids and services. *Exceptional Children, 65*(2), 163–174.

Friend, M., & Cook, L. (2002). *Interactions: Collaboration skills for school professionals* (4th ed.). Boston: Allyn & Bacon.

Golden, D. (1999). Assistive technology policy and practice. What is the right thing to do? What is the reasonable thing to do? What is required and must be done? *Special Education Technology Practice, 1*(1), 12–14.

Grosvenor, E. S., & Wesson, M. (1997). *Alexander Graham Bell: The life and times of the man who invented the telephone*. New York: Harry N. Abrams.

Harris, A. J., & Sipay, E. R. (1990). *How to increase reading ability: A guide to developmental and remedial methods* (9th ed.). New York: Longman.

Individuals with Disabilities Education Act of 1990, Pub. L. No. 101-476 (1990). Retrieved November 23, 2004, from http://www.usdoj.gov/crt/ada/statute.html

Individuals with Disabilities Education Act Amendments of 1997, Pub. L. No. 105-17 (1997). Retrieved November 23, 2004, from http://www.ed.gov/policy/speced/leg/idea/idea.pdf

Lerner, J. (1997). *Learning disabilities: Theories, diagnosis, and teaching strategies* (7th ed.). Boston: Houghton Mifflin.

Lewis, R. B. (1993). *Special education technology: Classroom applications*. Florence, KY: Wadsworth Publishing Company.

Lyon, G. R. (1995). Research initiatives in learning disabilities: Contributions from scientists supported by the National Institute of Child Health and Human Development. *Journal of Child Neurology, 10*(1), 120–126.

McLoughlin, J. A., & Lewis, R. B. (2000). *Assessing students with special needs* (5th ed.). Upper Saddle River, NJ: Prentice Hall.

Mercer, C. D., & Mercer, A. R. (2000). *Teaching students with learning problems* (6th ed.). Upper Saddle River, NJ: Prentice Hall.

Pinnell, G. S., & Matlin, M. L. (1990). *Teachers and research: Language learning in the classroom*. Newark, DE: International Reading Association.

Reed, P., & Bowser, G. (1999). Assistive technology and the IDEA. *Exceptional Parent, 29*(11), 54–57.

Salend, S. J. (2000). *Creating inclusive classrooms: Effective and reflective practices* (4th ed.). Upper Saddle River, NJ: Prentice Hall.

Silvia, P. A., McGee, R., & Williams, S. (1985). Some characteristics of nine-year-old boys with general reading backwardness or specific reading retardation. *Journal of Child Psychology & Psychiatry & Allied Disciplines, 26*(3), 407–421.

Stanovich, K. E. (1986). Matthew effects in reading: Some consequences of individual differences in the acquisition of literacy. *Reading Research Quarterly, 21*(4), 360–407.

Watts, E. H., & O'Brian, M. (2002). It's your choice: Four procedural models for considering assistive technology. *Special Education Technology Practice, 4*(2), 25–28.

Ysseldyke, J. E., Algozine, R., & Thurlow, M. L. (2000). *Critical issues in special education* (3rd ed.). Boston: Houghton Mifflin Company.

Zabala, J. (n.d.). *About the SETT framework*. Retieved November 15, 2004, from http://sweb.uky.edu/~jszaba0/JoySETT.html

Zabala, J. (1996). *Setting the stage for success: Building success through effective selection and use of assistive technology systems*. Retrieved November 7, 2004, from http://www.ldonline.org/ld_indepth/technology/zabalaSETT2.html

ADDITIONAL RESOURCES ON ASSISTIVE TECHNOLOGIES

Journals

Journal of Special Education Technology (jset.unlv.edu)—A peer-reviewed journal published by the Council for Exceptional Children's Technology and Media Division.

Special Education Technology Practice (www.setp.net)—A practitioner-based journal focusing on providing practical information for teachers.

Assistive Technology Outcomes and Benefits (www.atia.org/call_for_papers.html)—An online, peer-reviewed journal published by the Assistive Technology Industry Association.

Web Sites

ABLEDATA (www.abledata.com)—Largest searchable database of assistive-technology equipment and materials.

Assistive-Technology Training Online Project (atto.buffalo.edu)—Information on assistive-technology applications to help students with disabilities learn in elementary classrooms.

Closing the Gap (www.closingthegap.com)—Information on the leading assistive-technology conference, online articles, an annual resource directory, and active discussion forums.

Council for Exceptional Children (www.cec.sped.org)—Information about improving educational outcomes for individuals with disabilities.

Infinitec (www.infinitec.org)—Information on using technologies to enhance the learning, daily living, and community participation of persons with disabilities.

Learning Disabilities Association of Georgia (www.gatfl.org/ldguide/read.htm)—Information on learning disabilities and assistive technologies.

Special Education Assistive Technology (SEAT) Center (www.coe.ilstu.edu/seat/)—A university-affiliated center focusing on the use of instructional and assistive technologies.

Yes I Can! With Technology: Students With Disabilities and Technology (yesican.cec.sped.org/xybernaut/QandA.html)—Information on technology that helps students with disabilities.

Association of Specialized and Cooperative Library Agencies (www.ala.org/ala/ascla/asclapubs/interface/archives/contentlistingby/volume23/accessibilityint/accessibility.htm)—Internet resources for accessible technology, Web-site accessibility, disabilities and accessibility, and discussion lists related to accessibility issues.

Wisconsin Assistive Technology Initiative (www.wati.org/athandbook.htm)—A state project that provides comprehensive information useful for people with disabilities as well as industry professionals.

Books

Assistive Technology for People With Disabilities, by Dianne Pedrotty Bryant & Brian R. Bryant. Published by Allyn & Bacon (2002).

Technology for Inclusion: Meeting the Special Needs of All Students (4th ed.), by Mary Male. Published by Allyn & Bacon (2002).

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