Assistive technologies that support specific disorders

The following sections describe some of the disabilities or special needs your students may exhibit as well as examples of assistive technologies available to support them. This is not a detailed explanation of how to use each of these technologies but is intended to provide an introduction to assistive technology possibilities so you can be better prepared to match the needs of your students with available technologies. The categories are drawn from the list of categories reported annually by the U.S. Office of Special Education Programs.

Learning and Behavioral Disorders

The U.S. Department of Education (2005) reports that a major consideration for determining whether a person has a **specific learning disability** is the discrepancy between that person's intellectual potential and their academic success. Students with learning disabilities may also exhibit developmental delays in language, problems with gross motor coordination, and difficulties with cognitive processing, such as visual perception, language development, reasoning, attention, and memory. Non-academic characteristics may include deficits in communication, social competency, and emotional maturity. In 2006, more than 54 percent of students between the ages of 6 and 21 who received special education and related services in the regular classroom at least 80% of the day were were reported as having a specific learning disorder or emotional disturbance (OSEP, 2008). Hasselbring (2000) reports that technology, when used to deliver well-designed and well-managed instruction, can help students increase skills and content knowledge. This finding is true of students with disabilities as well as those without. Several technologies exist that can support students with a variety of learning and behavioral disorders.

Hardware that can support students with special needs includes **portable writing devices,** from personal digital assistants (PDAs) or handheld computers, to word-processing devices such as the AlphaSmart keyboard. Laptop and tablet computers, too, provide a great deal of support when common software tools such as calendars, task lists, e-mail, web browsers, and other common productivity applications are used to help students organize their work as well as provide an environment for completing academic tasks and generating finished assignments. For a list of assistive technologies that may benefit students with mild learning disabilities and behavioral disorders, refer to figure 1.

Assistive technologies that may benefit students with mild learning disabilities and behavioral disorders include

- Word processing
  - Keyboard shortcuts
  - Auto-correct features
  - Autotext
  - Repeat keys
  - Filter keys
  - Toggle keys
- Word prediction software
- Prewriting and organization software
  - Concept-mapping software
- Networked communication technologies
- Multimedia environments with embedded hyperlinks
- Electronic reference tools
- Portable hardware
  - PDAs and handheld computers
  - Word processors
  - Laptop and tablet computers

Figure 1. Assistive technologies to support students with learning and behavioral disabilities.

Speech or Language Disorders

How have you communicated with others today? Have you spoken, written a note, used gestures, or body language? What if you didn't have these capabilities? What type of barriers would that create for you? Teachers and students rely heavily on communication for instruction, so students with disorders that prevent them from communicating effectively with their peers and teachers are at a significant disadvantage. A speech disorder can manifest itself as a difficulty or inability to control the rate of speech or vocal quality, or to form sounds properly. Students with a language disorder have difficulties in

understanding or using words in context, both verbally and nonverbally. Students in this case may use incorrect words or meanings, have limited vocabularies, and poor or incorrect grammar. They may not be able to express themselves clearly or to follow directions. More than 940,000 students between the ages of 6 and 21 served by IDEA were reported as having speech or language disorders in 2006 (OSEP, 2008).

Stories from Practice: Finding One's "Voice"

Michelle is a first grade student, of average cognitive ability, who uses a variety of augmentative communication tools throughout her day. At her desk Michelle has a picture symbol communication book that she uses to communicate her basic needs. These pictures include symbols representing lunch, taking a break, being tired, and asking what's next. Michelle gives the symbol to her teacher to indicate what she needs. She is learning to use a voice output device for asking questions and making choices. At lunch this device is programmed with the lunch choices.

When Michelle presses the symbol on her device it speaks and she is able to "verbalize" her lunch selection. A single message device is mounted on the shelf in the book area where Michelle can easily access it. The recorded message provides Michelle with a way of asking that a book be read to her. At home Michelle uses gestures to communicate most of her needs. Just like all of us, Michelle uses a variety of forms of communication through out her day.

Source: Glenna Gustafson

Students with speech or language disorders can use a form of assistive technology called **augmentative** or **alternative communication (AAC) devices** (Hasselbring, 2000). AAC devices are tools that aid, supplement, or replace conventional communication methods. As the names imply, *augmentative* communication devices support or enhance the communication skills of students while *alternative* communication devices replace the natural speaking functions for a student. Any student whose speech is not developing within the normal range or timeframe or is not likely to develop speech due to a pre-existing condition is a potential candidate for AAC (Burkhart, 1993). These devices may be stand-alone tools or may work in conjunction with other software and hardware, such as text-to-speech software that reads documents. **Synthesized speech** can be generated by a computing device (synthetic) or may consist of pre-

recorded words, letters, or sounds (digital speech output). Devices utilized for augmentative communication are most effective when integrated into a system of tools that includes facial expressions, gestures, symbols, picture boards, pencil/paper, and voice output devices that are both low and high-tech.

The methods that students use to control their AAC devices depend on their mobility, dexterity, and cognitive level. A variety of keyboard devices can be used to input information into an AAC device, but students can also input information using a number of input devices, such as a trackball, mouse stick, eye-tracking technology, or a variety of switches that can be controlled by hands, feet, an elbow, jaw, or head depending on the student's mobility. Some switches can compound problems when fatigue comes into play. **Abbreviation expansion software** (Brodwin, et al., 2004) allows students to enter a series of letters that prompts a longer response. These abbreviations can be assigned to keyboard shortcuts to further expedite communication. Students who have language problems such as a limited vocabulary may also be able to use graphic interfaces that allow them to generate synthesized words that are paired with pictures or icons. See Figure 2 for a list of assistive technologies that may benefit students with speech or language disorders.

Assistive Technologies that may benefit students with speech or language disorders

- Augmentative and alternative communication (AAC) devices that may include
- Synthesized speech
- Keyboards and alternative keyboards
- Touch-sensitive pads
- Alternative input devices
    - Trackball
    - Mouse stick
    - Eye-tracking technology
    - Switches
- Abbreviation expansion

Figure 2. Assistive technologies to support students with speech or language disorders.

Hearing Impairments

Students with hearing impairments comprise about 49% of all students between the ages of 6 and 21 who receive special education and related services in the regular classroom at least 80% of the day under IDEA. These students may use an **assistive listening device (ALD)** to enhance their residual hearing or may rely on technologies that represent text visually. ALDs include a variety of specialized hearing aids including **frequency-modulated (FM) amplification systems** that include a microphone for the teacher that transmits to a student's hearing aid. A variation on the FM amplification system is an **audio loop,** which consists of an insulated wire installed in a room, such as in a wall or ceiling, that receives the transmission from the teacher's microphone and converts the sound to magnetic waves. Students wearing a specialized hearing aid and sitting within the magnetic field of the wire can hear the transmission from the teacher's microphone. The audio loop is helpful for reducing ambient noise in the classroom and can help those wearing the specialized aids focus more completely on the teacher's instructions.

Cochlear implants require surgery and consist of small electronic devices placed behind a student's ear and under the skin. Unlike a hearing aid that is designed to amplify sounds, cochlear implants actually stimulate the auditory nerve directly through electrical impulses, thereby bypassing damaged or non-working parts of the ear. Cochlear implants greatly improve hearing sensitivity and speech perception abilities in deaf children. Although what they hear may sound slightly different than normal hearing, cochlear implants effectively allow thousands of adults and children as young as 12 months old hear, sometimes for the first time. More than 10,000 American children had cochlear implants by 2002 (NICHD, 2002). It should be noted that a this time, IDEA (2004) excludes cochlear implants as an assistive technology that school systems are responsible for providing for students.

Students with hearing impairments may also use **Telecommunication Devices for the Deaf (TDDs)** that allow them to use a small keyboard to type a message that is transmitted through a telephone. While not often used in classroom, TDDs can allow students to communicate with teachers, school officials, and other students outside of class time. The ability to send and receive text messages over mobile devices represents the next step in evolution from TDDs. Due to the ubiquity of mobile phones, pagers, and other portable devices, students with hearing impairments may be able to build socialization skills more easily as they join in with other students to communicate in and out of school.

Captioning refers to the addition of text to a visual presentation and may be familiar to you through the closed captioning available on all televisions built since 1993. *Closed captioning* refers to the ability to toggle the captioning on and off while the rarely used method of *open captioning* cannot be turned off. Live speech can be captioned by trained individuals who capture live speech on a device similar to a court stenographer that can be transmitted to a screen or monitor. Live speech captioning is more cost effective in large lecture classes or for speakers or programs to large audiences. On the high-tech end of the spectrum, software is available that uses avatars, human-like computer animations, that communicate in American Sign Language. Assistive technologies that may support students with hearing impairments are listed in Figure 3.

Assistive Technologies that may benefit students with hearing impairments

- Assistive listening devices (ALDs)
  - Hearing aids
  - Frequency modulated (FM) amplification systems
  - Audio loops
  - Cochlear implants
- Telecommunication Devices for the Device (TDD)
- Text-messaging
- Captioning
  - Closed captioned television and video
  - Live speech captioning
  - American Sign Language software

Figure 3. Assistive technologies to support students with hearing impairments.

Visual Impairments

While all of the learning and physical disabilities discussed so far can impede participation in a classroom, and subsequently negatively impact student achievement, consider the extent to which visual information dominates the traditional classroom and its instructional materials, such as print-based textbooks, instructional videos, or lecture notes taken from a chalkboard, whiteboard, or screen. Consider the limitations of the phrase, "go to the board and solve the next problem" to a student who is visually

impaired. Over 57% of students between the ages of 6 and 21 who received special education and related services in the regular class at least 80% of the time were designated as visually impaired in 2006 (OSEP, 2008); however, untold others have some form of visual impairment that may simply require the use of glasses or contacts that, while not qualifying for special education or related services, still can benefit from the use of assistive technologies.

Large-print materials come in both low- and high-tech versions and can be used by students with a range of visual impairments. Besides print-based materials, large-print word processors and computer magnification software can enlarge the information displayed on a computer monitor as much as 16 times. Large-print word processors may also be paired with or come installed with a variety of other helpful features already mentioned related to word processors, such as text-to-speech, word prediction, and others. Without special software, the settings of most computer monitors can be adjusted for individuals with visual impairments, and many text- and graphics-based programs allow for quick enlargement of the material on the screen, often through a menu item, shortcut key, or icon. Standard web browsers also take advantage of the flexibility of web-based resources developed in hyper-text markup language (HTML) and can quickly be adjusted to enlarge or reduce text-based elements. In this case, word processors and web browsers are an ideal illustration of how a software application can be a helpful technology for most students while also being legally designated as assistive technology for others who require them for reaching their intellectual potential for academic success.

Text and graphics also can be enlarged for easier readability through the use of **closed-circuit television magnification (CCTV),** which can be used to examine text on a monitor as it is being entered via the keyboard or other input device. CCTV uses a small camera that captures and displays text and graphic information on a monitor that can be adjusted for size, clarity, contrast, and brightness. Some CCTV devices also allow the background to be displayed in white or black, as students with different visual impairments may find one more helpful than the other. Newer CCTV units are portable.

Also mentioned previously, **text-to-speech synthesizers** can support students with visual impairments by reading documents or web pages on their computers. These devices are often referred to as *screen readers* and can be essential when students with visual impairments use the Internet. When used in your classroom, careful consideration must be given to the digital resources you use and make available to

your students. As mentioned earlier, public schools that receive federal funds must ensure that their instructional materials are compliant with section 508 of the Rehabilitation Act of 1973. The preponderance of information available on the Internet can be a boon to educators but a barrier to students dependent upon screen readers. In order to be compliant with section 508, web designers must follow design guidelines that make their pages accessible and incorporate specific codes that are not normally visible to the sighted user. Web pages that are not compliant with section 508 can be frustrating and confusing to students using a screen reader and can negatively impact their motivation, engagement, and academic success.

An **optical character recognition (OCR) scanner** creates a digital image of print materials, such as a textbook, that can then be displayed electronically, allowing it to be altered in size, manipulated by special software, or read by text-to-speech software. Scanning print textbooks takes some time and preparation (spines may have to be sliced off the book!) so it is best to plan ahead for students who require this service so as not to delay their learning. Of greater advantage are textbooks that already come in a digital format that can be accessed immediately either via CD-ROM or online. The OCR reader technology, first introduced by Ray Kurzweil in 1976, has evolved to include many reading and writing supports that provide greater functionality than just text-to-speech. For example, students can view visual cues during reading, such as highlighting of sentences being read, with the individual words highlighted in contrasting color to guide the student. Students can also use these tools to indicate main ideas, automatically generate outlines, and develop study guides—many learning strategies that would be useful to most students, not just students with disabilities.

Students who can read Braille can benefit from **Braille notetakers, embossers,** and **refreshable Braille displays.** The notetakers use the same keys for print-based Braille writers but the text can be read by text-to-speech software or converted into text. Documents can be printed on a standard printer for text or a Braille printer for Braille output. Refreshable Braille displays generate a line of Braille on a keypad device on which a series of 6 or 8 pins are raised or lowered in combination, similar to reading a line of printed Braille. Documents are stored electronically and can be refreshed by the user at the end of each line.

Video can also be made more accessible to students with visual impairments through the use of **Descriptive Video Services (DVS®)** (Cronin & King, 1998). Developed by WGBH-TV in Boston, a member of the Public Broadcasting System, and premiered in 1990, DVS is a verbal description of key

elements in a visual program, such as costuming, character descriptions, and facial expressions that occur in pauses in the program's dialogue. DVS is available through a separate channel, called the Separate Audio Channel (SAP) that is common on most current televisions and video players. Students with visual impairments may benefit from the technologies listed in Figure 4.

Assistive Technologies that may benefit students with visual impairments

- Large-print materials
  - Large-print word processors
  - Computer magnification software
  - Web browser and software applications with adjustable views
- Closed-circuit television magnification
- Synthetic and digital speech synthesizers
  - Text-to-speech
  - Screen readers
- Optical character recognition (OCR) software
- Braille devices
  - Braille notetakers
  - Braille embossers
  - Refreshable Braille displays
- Descriptive video services

Figure 4. Assistive technologies to support students with visual impairments.

Orthopedic Impairments

In 2006, more than 28,000 students between the ages of 6 and 21 who received special education and related services in the regular class at least 80% of the time were designated with physical disabilities, as reported by the Office of Special Education Programs (2008). These students face diverse barriers in terms of mobility, communication, and access to learning. Few students with orthopedic impairments will have similar needs because their impairments most likely will vary. Mobility is a big concern for some students and technology, with its collection of wires, cords, and cables can severely limit mobility for any

student, with or without orthopedic impairments. The safe and healthy use of technology is considered in Chapter 9, but special considerations should be made for students with limitations in mobility. You should carefully consider the layout of your classroom, including the placement of and access to computers and their peripherals as well as other technologies. In rooms with structural limitations, such as limited or poorly accessible outlets or communication jacks, you may need to consult with your building principal or district facility manager to provide a safe and healthy environment in your classroom. This includes providing a classroom that is free from extension cords that can trip students or block wheelchairs, furniture that is ergonomically appropriate for technology use, and equal access to technology and other resources for all students.

Several technologies exist to support students with orthopedic impairments. Several types of **alternative keyboards** are described in chapter 6, but the list continues. Keyboards can be expanded for students who have difficulties with fine motor skills or contracted for students with limited mobility who may rely on one or a few fingers, or a device such as a pointer, to operate the keyboard. The keys on some keyboards are rearranged so that the most common keys are clustered together while others, such as a chording keyboard, have a small number of keys that are pressed at the same time in combination. Programmable and virtual keyboards can be operated by a touch-screen monitor or overlay or a variety of input devices. Keyboards can also be paired with keyguards and moisture guards or overlays. Keyguards and moisture guards protect the keyboard from dirt and fluids while an overlay can be used to identify common keys, hotkeys or shortcut keys, or alternative responses programmed into a keyboard.

You are undoubtedly familiar with a computer mouse and perhaps even joysticks and trackballs, but these are just a few examples of a variety of input devices that are readily available to help students overcome limited mobility or problems with fine motor coordination. **Mouse sticks** are small levers built into a keyboard that require very little motion to be fully operational. If students do not have the ability to operate an input device with their hands or arms, they may be able to use a **foot mouse** or a **hands-free mouse** that is controlled by a device worn on the student's head that tracks changes in motion via infrared that interacts with a monitor. **Eye-tracking technology** is also an option that interacts with an emulated keyboard similarly to the hands-free mouse device. Head devices require control and coordination of the head and may need to be introduced gradually and monitored as students may become fatigued quickly.

There are also low-tech pointers, such as mouth sticks and head wands that can be used to interact with a variety of alternative keyboards—both physical and emulated.

Switches can help students operate a variety of technologies, including wheelchairs, computers, and other technologies. A switch can operate as a single-input device, basically either turning something on or off, or a multiple-input interface depending on the student's access to and ability to control the switch (Brodwin et al., 2004). Switches can be activated by almost any part of the body, such as an arm, hand, finger, leg, foot, head, or chin (Hasselbring, 2000), and come in a variety of types, such as paddles, lever, light beam, pillow, and "sip and puff." **Sip-and-puff switches** operate in reaction to a student's breath. Students must be able to control their responses to any type of switch device and training is required for the student to become proficient in their operation.

Voice-recognition technology (VRT) allows students with extremely limited or no mobility to interact with a computer or computer-controlled device. Voice recognition software can either require continuous speech or discrete speech, which requires a pause between words. Microphones can be used in order to block out unwanted ambient noise during operation. A student who uses voice recognition software must be able to control their verbalizations and voice recognition software often has to be "trained" to recognize an individual's speech patterns. Review the technologies that can support students with orthopedic impairments in Figure 5.

Assistive Technologies that may benefit students with orthopedic impairments

- Alternative keyboards
  - Expanded or contracted
  - Chording
  - Programmable
  - Virtual
  - Keyguards and moisture guards
  - Label overlays
- Alternate input devices
  - Trackball

- Joystick
- Mouse stick
- Foot mouse
- Hands-free mouse
- Eye-tracking technology
- Mouth sticks and head wands

- Switches
  - Paddle
  - Lever
  - Light beam
  - Pillow
  - Sip and puff
- Voice recognition technology (VRT)

Figure 5. Assistive technologies to support students with orthopedic impairments.

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