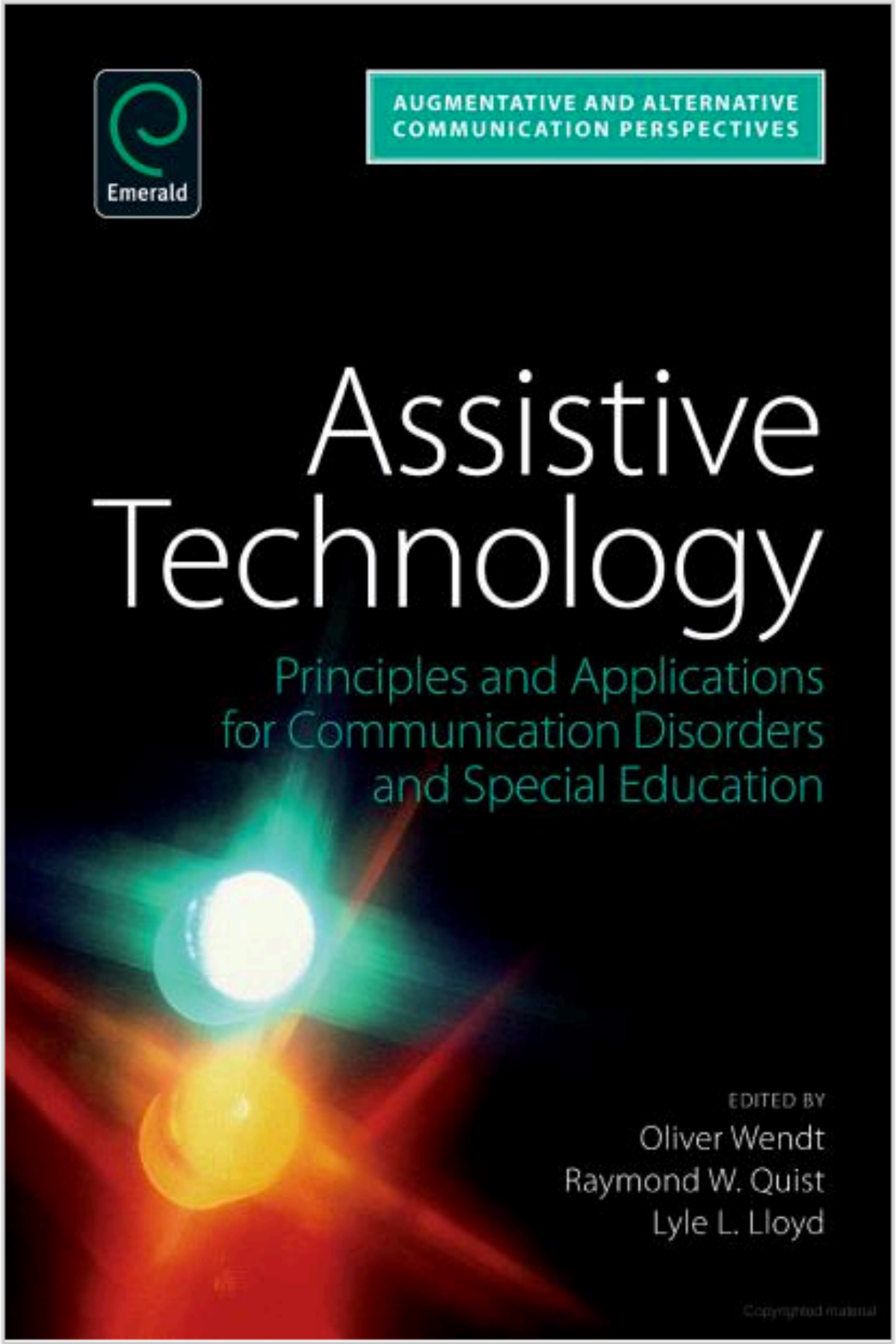
Emerald
AUGMENTATIVE AND ALTERNATIVE COMMUNICATION PERSPECTIVES
Assistive Technology
Principles and Applications for Communication Disorders and Special Education
EDITED BY
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CHAPTER 7

HIGH TECHNOLOGY

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INTRODUCTION

Interacting with people today includes talking, listening, reading, writing, texting, blogging, e-mailing, and gaming, among other forms of communication. High-technology (high-tech) devices make these options much more accessible to individuals with special needs and allow them to blend in with the crowd. Smaller batteries, smaller computer chips, wireless technology, and other high-tech components enable individuals to obtain portable devices that allow them to interact without being conspicuous. In fact, when individuals use newer mainstream devices to interact (such as an Apple iPad®), others are more accepting of them and want to see how their technology works. This ability of high technology to make individuals with special needs more included in the mainstream population is quite a benefit. The idea is to improve both their educational experience and their social experience.

It is important to understand the principles behind the technology being used (Quist & Lloyd, 1997). For example, understanding how a device helps an individual to communicate allows one to look beyond the specific piece of hardware or software. This is significant because with the rapid advancement of technology, the tools one learns about today are easily replaced with more advanced tools tomorrow. By understanding the principles behind a device and why and how to choose it for an individual

Assistive Technology: Principles and Applications for Communication Disorders and Special Education
Augmentative and Alternative Communication Perspectives, Volume 4, 221–264

ISSN: 2047-0991/doi:10.1108/S2047-0991(2011)0000004011

with special needs, one will be able to find other devices that might do the same thing, but for lower cost and/or with newer technology. Some tools and devices can be used for individuals without disabilities who are in situations that make communication more difficult. As example, trying to talk in a loud room or needing to communicate with someone on the other side of a large room. High-tech devices are not limited to individuals with special needs. Keep in mind that although a device may be used by one individual as an assistive technology (AT) device, another individual may not use it as such. For example, non-dedicated devices such as Tablet PCs or the Apple iPad® can be used by anyone, disability or not. If, however, the device "is used to increase, maintain, or improve functional capabilities of an [individual] with a disability," it is considered AT (Individuals with Disabilities Act, 2004, p. 2652).

This chapter discusses a wide variety of *high-tech devices* that assist with *alternative access*. Both *dedicated devices* that assist with *communication* and *cognitive abilities* and *non-dedicated devices* that can be used to assist users with special needs will be discussed. Although brand name examples of assistive devices are presented, keep in mind that with the rapid advancement of technology development, it is a considerable task to keep up-to-date. Therefore, understanding the principles behind the use of the technology is critical to stay current (Quist & Lloyd, 1997).

BASIC PRINCIPLES OF HIGH-TECHNOLOGY ASSISTIVE DEVICES

High Technology versus Low Technology

To address the difference between high-tech and low-technology (low-tech) devices, think of the technology as running along a continuum. The AT device continuum includes no technology (no-tech) and low-tech through high-tech (Beard, Carpenter, & Johnston, 2011). No-tech devices typically do not need batteries, electricity, or other types of power to enable the device. They can be simple aids such as pictures on a board or a pencil grip. Low-tech devices are typically inexpensive devices that do not operate on computer chips, are easy to use, and include devices such as calculators, tape recorders, and CD players (Behrmann & Jerome, 2002). High-tech devices (e.g., computers) are more sophisticated than low-tech, are electronic, and have computer chips that typically permit storage, retrieval, input, and/or

output usage. High-tech devices may also require some training depending on their complexity (Cennamo, Ross, & Ertmer, 2010).

Dedicated versus Non-Dedicated Devices

Dedicated AT devices are devices or programs that are specifically designed to aid individuals with a certain disability; whereas non-dedicated devices are everyday items that happen to have a function that is useful to someone with a disability, but were not built for that specific purpose (Quist & Lloyd, 1997). The dedicated device is more limited in its capabilities. For example, a dedicated communication device was specifically built to aid an individual who has little to no functional speech. Its primary use is to enable the individual to communicate. A non-dedicated device (such as a Tablet PC) can be used by individuals with or without AT needs. However, if a non-dedicated device has features that assist an individual with special needs, then it is considered AT (Quist & Lloyd, 1997).

A non-dedicated device can be manipulated to only perform certain functions, at which point it becomes a dedicated device. For example, putting special software on a computer and locking out all of the other features of the computer would turn it into a dedicated device (Quist & Lloyd, 1997).

ALTERNATIVE ACCESS

Alternative access is an alterative means by which individuals with special needs can access technology (e.g., mainstream computers). Alternative access may involve the use of an alternative keyboard, an adapted mouse, or be achieved by changing functionality settings within a computer, to name a few examples. This section discusses the following: the adapted mouse, the smartpen, alternative keyboards, and software.

Adapted Mouse

Did you know the computer mouse was first known as a *turtle* and then a *rodent* before the name *mouse* stuck (Barrett & Mingo, 2005)? However, it is also thought that MOUSE is an acronym for Manually Operated User Selection Equipment. Either way, people use the mouse to access computers. Although there are low-tech modifications that can be made to a mouse to

assist individuals such as placing a reminder sticker on the left button, this chapter discusses the high-tech alternatives. There are a large number of mouse alternatives for individuals with special needs. The following mouse alternatives will be discussed: switch-adapted mouse, vertical mouse, foot-controlled mouse, trackballs, joysticks, touch pads, trackpads, touch screens, MouseKeys, eye-controlled input, head-tracking input, light and optical direct selection pointers, and sip and puff mouse. Each of these types of mouse provides a different approach to access a computer.

Switch-Adapted Mouse

A switch-adapted mouse is a device that allows a switch to be attached to the mouse and acts as the input for the corresponding button (right click, left click). This allows individuals without finger dexterity to use a one-button input device.

Vertical Mouse

A vertical mouse is like a traditional mouse that has been turned on its side (Fig. 1). The vertical mouse was designed as an ergonomic device. If an individual's hand typically sits in a handshake position, this mouse would rest perfectly in his/her palm.

Fig. 1. Evoluent™ VerticalMouse™ 4. Photo courtesy of Kinesis Corporation

Foot-Controlled Mouse

A foot-controlled mouse is available for individuals who either do not have hands or cannot use their hands. An individual uses a foot to do what the hand would normally do with a mouse. The two-piece foot mouse allows the user to use one foot for button pushing and the other foot to control the cursor. There are other versions of the foot-controlled mouse that have more buttons for individuals with additional needs. The Footime™ foot-controlled mouse (Maxi-Aids, Inc.) has programmable buttons that an individual can connect to any computer input method that is required. The foot mouse is typically compatible with both Mac® and PC.

Trackballs

Trackballs (a.k.a. rollerballs) are input devices similar to the mouse that typically have a big ball in the center that the user can manipulate with fingers or a hand. Some trackball devices have other buttons that can be programmed to perform functions needed by the individual. The movement of the ball moves the cursor around on the screen. Trackball devices come in many different sizes and shapes. Fig. 2 illustrates one example.

Trackballs allow individuals who might not have the dexterity to use a standard mouse to use an adapted mouse as an input device. One of the bigger trackballs is Infogrip's BIGtrack™. The BIGtrack™ has a 3-inch yellow ball and oversized blue buttons for visibility and easy use.

Joysticks

Joysticks are alternatives to a mouse or trackball. The joystick is a *stick* that protrudes up from the device and is used to control cursor movements and mouse clicks (Fig. 3). Typically, the user provides force to the stick to move the cursor. Some individuals find the joystick easier to grasp than a traditional mouse. Many think joysticks are for playing computer games; however, they can assist individuals who do not have the flexibility to hold a mouse.

Touch Pads

Touch pads allow individuals to move a finger across the pad to move the cursor on the screen (Fig. 4). Typically, the pad needs to sense the touch of the finger to work; a stylus will not work on a touch pad. Buttons on the touch pad can be programmed by the individual.

In addition, a device can contain what is known as a touch-sensitive pad such as the Click Wheel™ on Apple's iPod®. The Click Wheel™ allows the

Fig. 2. BIGtrack™ Trackball. Photo courtesy of Greystone Digital Inc.

user to navigate through songs by touching the round screen. The Click Wheel™ is not actually a *wheel* in the sense that it does not move. There are actually four buttons under the circle at the 12 o'clock, 3 o'clock, 6 o'clock, and 9 o'clock points. The back of the wheel has a connective membrane that allows the user to swipe a finger around the circle; the microprocessor behind the wheel identifies the speed at which the finger is moving. This allows for tasks such as scrolling through lists, changing volume, or fast-forwarding through a song. The interesting thing about the iPod® Click Wheel™ is that it typically will not work using a tool other than a finger. It has to do with pressure, surface area, and possibly conducting electricity. This means that a user who cannot use a finger will probably not be able to activate functions by touching the wheel.

Trackpads

Apple® makes a trackpad called the Apple® Magic Trackpad™ similar to the tiny trackpads on laptops that allows the user a trackpad surface next to

Fig. 3. SAM-Joystick™. Photo courtesy of Enabled Devices

Fig. 4. Smart Cat Pro Touchpad™. Photo courtesy of Cirque Corporation

Fig. 5. Apple® Magic Trackpad™. Photo courtesy of Apple Inc.

the keyboard. Users can tap or double tap on the trackpad to simulate clicking a mouse (Fig. 5).

Touch Screens

A touch screen (touch window) is an input device that allows an individual to navigate and interact with a computer by touching the screen, rather than using a mouse or keyboard. A touch screen can come in two different varieties. One is a clear plastic sheet with sensors that attaches to a monitor. The other is built in to the monitor. The screen detects a fingertip or a pointing device (e.g., soft-tipped pen) when it is touched. This allows the sensors to send a signal to move the cursor on the monitor. This input device is advantageous for users who cannot or do not understand the concept of the detached mouse moving the cursor on the screen.

Many mainstream technologies now incorporate touch screens, (e.g., a Tablet PC screen and an Apple iPad® screen). Most smart phones also have touch screens, which can be manipulated either by finger or by stylus. A stylus looks like a pen, but contains no ink and simply applies pressure to communicate with the device.

MouseKeys

MouseKeys is an alternative access option that allows keyboard keys (typically the numeric pad) to be changed into a directional mouse. Typically, the operating system of the computer has a function that allows users to simply make this change. The modification would mean the 6 key would move the cursor to the right, the 9 key to the upper right, and so on. Other keys would indicate a click or double click. If individuals cannot easily move their hands off the keyboard to use a mouse, or no mouse is available, this feature can be enabled.

Eye-Controlled Input

There are various types of eye-controlled input devices that can be used instead of a mouse. These are especially useful for individuals who have no mobility other than eye movement. One type of eye-controlled input device includes a camera mounted on a monitor that is focused on the user's eye. The camera can recognize if the user makes a controlled blink, or if the user stares at one spot, which can then be set to be a mouse click. Another type allows for a head strap to be put on the user with the input camera pointed directly at the eye. The cursor on the screen moves as the user's eye moves around the screen. Including an on-screen keyboard allows an individual to *type* by staring at the keys. Typically, these systems need an initial calibration by the user. Eye-controlled input devices are typically used by individuals with quadriplegia, cerebral palsy, multiple sclerosis, muscular dystrophy, amyotrophic lateral sclerosis (ALS), carpal tunnel syndrome, or any other disability in which users have little or no control of their hands or feet to use a mouse or adapted foot mouse.

Head-Tracking Input

Head-tracking input devices are similar to eye-controlled input devices in that the user's control over the movement of the on-screen mouse is not done through a typical mouse but instead by using movement of the head. Again, the device comes in different formats such as a camera mounted on the monitor that tracks the user's head movements. For example, if the user turns the head to the left, the cursor moves to the left. The system can be set so that if the cursor does not move for a certain number of seconds, a *click* occurs. For the camera to track the user's head movements, a small tracking reflector *dot* is placed on the user's forehead, glasses, or hat rim. One example of this is Origin Instruments' HeadMouse Extreme™ (Fig. 6).

Fig. 6. HeadMouse Extreme™ (Attached to a Laptop Computer). Photo courtesy of Origin Instruments

Light and Optical Direct Selection Pointers

Light and optical sensors are generally mounted on the user's head at midline, but sometimes on one side. The sensors are often mounted on headbands, hats, or glasses, or they can be held in the user's hands. This method of communication is great for persons who have good fine motor control, but limited range of motion with the hands. The use of light and optical pointers requires good motor and coordination skills. The user must be able to master small movements of the head to hold the beam steady on the board. Although there are many kinds of direct selection devices using light or optical pointer systems, the most basic uses a laser light pointer that shines a small red beam of light onto the screen of a communication device. The common laser light pointers used by presenters at conferences can be used to activate on-screen icons and keyboards.

Fig. 7. Sip and Puff Mouse. Photo courtesy of Origin Instruments

Sip and Puff Mouse

The sip and puff mouse is an input device controlled by the user's mouth and breath. The user can sip and puff air to click and move a cursor. Origin's Sip/Puff™ headset slips over the user's ears to hold it in place; the bendable mouth tube can be adapted to fit any individual (Fig. 7).

SmartPen

The smartpen (such as the Livescribe™) can be used as an input device (Fig. 8). The user writes with the pen on a special type of paper, and then the text is input into a computer, Apple's iPad® or iPhone® and displayed on the screen. The pen captures audio that can be played back. This device would be well suited to an individual with auditory processing deficits because it allows precise playback.

Fig. 8. Livescribe Echo Smartpen™. Photo courtesy of Livescribe Inc.

Single-Word Scanners/Reading Pens

Although reading pens have been in use for a number of years, new technology has significantly changed the options and opened many more applications for use by individuals with a wide range of disabilities. Simply swipe the pen across the material to be scanned, and it will scan, store, and transfer the text or small images to a computer. The accuracy is very precise and added features include dictionaries, color scanning, language translations, text-to-speech modes, and LCD screens for word definitions. There are some cautions to consider when recommending pens for individuals with moderate to severe disabilities. Fine motor control is essential, because the pen must be swiped over the specific words to be scanned. Because the pen is not a large piece of technology, the user needs to be responsible enough to keep track of it. Auditory discretion is necessary as many of the pens read the text aloud in a synthesized voice, which can be distracting to some users. In some models, headphones are available so that the user need not distract others in the room. For most, however, the benefits outweigh the disadvantages, because the pen can be used for test taking, note taking, accessing materials of all kinds, and also auditory support.

One example of a reading pen is the EC-Pen Handheld Scanner™ (ECTACO, Inc.), which includes multiple dictionaries for instant definitions

or language translations and is capable of copying text into a computer in an editable format. It also contains a flashcard application to help the user learn words. Other pens with similar capabilities are the Wizcom family of smartpens and the IRISPen (I.R.I.S.).

The ReadingPen2™ by Franklin Electronic retains a history of the last 80 words scanned for easy review and, like the others, will scan text and read aloud a single word or a line of text at a time. It shows the scanned words divided into syllables as an additional aid to understanding. It contains over 240,000 definitions from the Concise Oxford Dictionary.

Keyboards

Keyboards can be modified using low-tech devices such as colorful stickers or rubber pads. Some traditional keyboards can also be modified using a computer's built-in software for both PC and Mac®. However, there are high-tech alternative keyboards also. These keyboards are specifically developed for various physical and/or sensory needs. For example, the portable word processor is a keyboard and small screen in one lightweight device. Portable word processors will be examined later on. Other alternative keyboards allow individuals who have difficulties with traditional keyboards to use a keyboard better suited to their needs.

The following types of alternative keyboards are discussed: large keys keyboard, ergonomic keyboard, mini keyboard, one-handed keyboard, on-screen keyboard, keyguard, StickyKeys, membrane keyboard, and IntelliKeys™. These keyboards come in different sizes, styles, layouts, and assist individuals in different capacities.

Large Keys Keyboard

Some keyboards have been modified to allow for bigger keys. BigKeys Keyboard™ (Greystone Digital Inc.) is an alternative keyboard that was designed for young children or individuals with mobility issues (Fig. 9). Typically, the keyboard is the same size as a traditional keyboard, but the keys are very large: 1-inch square. Some versions have the various keys color coded to help individuals easily find specific keys (i.e., vowels are one color and consonants are a different color). The keyboard also has a version with the keys arranged in alphabetical order for individuals with that need.

Ergonomic Keyboard

There are different styles of ergonomic keyboards. Some are angled with a split keyboard design and a raised middle. Some have a front extension or

Fig. 9. BigKeys Keyboard™. Photo courtesy of Greystone Digital Inc.

cushioned wrist rest to allow for resting the hand or wrist on the keyboard. These keyboards are typically wider and larger than traditional keyboards; they can also cost more. Some individuals have found that because of the size of the keyboard, the mouse is out of reach. Thus, some ergonomic keyboards now incorporate a touchpad on the wrist rest.

Some ergonomic keyboards (e.g., Kinesis Maxim) have a split keyboard design that allows the individual to put the two halves at the appropriate angle for their needs (Fig. 10). The two halves can be moved both vertically and horizontally and locked in place. It is also possible to mount the two keyboard halves on a wheelchair.

Mini Keyboard

A mini keyboard is typically about one-third the size of a traditional keyboard. Mini keyboards are lighter weight and can more easily be placed on a user's lap or wheelchair. They have smaller keys, and the keys are placed closer together, and so, these are not for users without good fine motor skills.

One-Handed Keyboard

There are a number of one-handed keyboards for individuals who can use only one hand to access the keyboard. They come in several varieties (Fig. 11). The BAT™ (Infogrip) uses a chordic keyboard. The chordic keyboard looks nothing like a traditional keyboard. It allows the hand to

Fig. 10. Maxim™ Split Adjustable Keyboard. Photo courtesy of Kinesis

Fig. 11. Infogrip's BAT One-Handed Keyboard™. Photo courtesy of InfoGrip

remain stable on the keyboard and press the buttons in different patterns to simulate the traditional keyboard keys. Maltron manufactures a one-handed keyboard that was designed based on frequency of use keys. The most frequently used letters and functions are placed where they can be most

Fig. 12. FrogPad One-Handed Keyboard™. Photo courtesy of FrogPad, Inc.

easily accessed. Their one-handed keyboard allows for easy key access for either hand and is based on ergonomic studies and is useful for individuals who experience any number of nerve or muscle deficiencies.

The FrogPad™ has 20 full-sized keys (Fig. 12). The letters are laid out based on frequency of use. There are two layouts: one for the left hand and one for the right hand. There is also a downloadable version of the FrogPad™ called SoftFrog™ for use on the Apple iPhone®, touch screen computers, and so on.

On-Screen Keyboard

An on-screen keyboard can be either a traditional keyboard or a one-handed keyboard displayed on a computer's screen. An individual can use a finger, switch, mouse, or a pointing device to press a key on the on-screen keyboard (Fig. 13). One example of this is the OnScreen Keyboard™ (formerly known as the My-T-Soft™ Product Family).

Keyguard

A keyguard helps an individual press only one key at a time. This is actually a low-tech option. However, for a complete understanding of keyboard possibilities, it is mentioned here. Individuals who have mobility issues such as tremors or who need to rest their hands on the keyboard will hit unwanted keys less often if using a keyguard.

Fig. 13. On-Screen Keyboard. Photo courtesy of Innovation Management Group, Inc.

StickyKeys

StickyKeys is a feature provided by both Mac® and PC operating systems that allows an individual to change the settings of the traditional keyboard to prevent the user from having to hold down two or more keys at a time to access a feature of the computer. This feature allows the user to lock a key such as Shift or Ctrl and keep it active and then hit the other needed key. To access StickyKeys, tap the Shift key five times and the computer will chirp and a pop-up message will ask if the user wants to activate StickyKeys.

Membrane Keyboard

The membrane keyboard does not have the individual key parts of a traditional keyboard. Instead, it is a flat, flexible surface in which the keys are pressure pads. These are extremely portable, and some versions can be rolled up and washed.

IntelliKeys™

IntelliKeys™ (IntelliTools Inc.) is a commonly used alternative keyboard that connects to a computer. It provides ports for four switches so that individuals with limited motor control can access through a switch. Overlays for the membrane keyboard can be changed to accommodate the needs of the user.

Software

Voice-Recognition Software

Although discussed briefly in Chapter 2, voice-recognition software counts as high technology and deserves mention in this chapter. Voice recognition (or speech recognition) is an alternative access option for individuals who need to use their voice as an input device to a computer. The software can be *trained* to the individual user and is much easier to use today than older versions. Voice recognition is suitable for individuals with mobility issues who have good verbal articulation. In addition, if the individual has poor spelling or writing skills, the software can be beneficial. One example is the Dragon™ family of products. Dragon™ software can currently be used with a Mac®, PC, iPhone®, and Blackberry®.

Word-Prediction Software

Word prediction can be part of a word processing program or a separate product. It helps individuals write by predicting what their next word(s) might be. After the first letter of the word is typed, the program begins to anticipate the remaining portion and then narrows down the choices as more letters are typed (a common feature on today's cell phones). Predictions can be based on sentence context and spelling and can be very helpful to any individual who is compromised in the use of grammar, spelling, and/or written text. Word prediction helps individuals express their thoughts with less frustration, a big plus for individuals with severe cognitive or learning disabilities, as it reduces the time and effort needed to produce desired text.

Word-prediction software goes hand-in-hand with talking word processors as it can help coach writers in learning grammar and spelling skills. It predicts what word the writer may wish to use next and offers multiple options. As in speech-recognition software, the word-prediction software learns the speaking (writing) habits of the user and bases predictions on the most likely sequence of words. The following examples are indicators of the features available in word-prediction software.

EZ Keys™ (Words+, Inc.) is Window's-based software designed specifically for literate individuals who cannot speak. It allows an individual to perform a range of activities from typing a single letter or talking to a friend to accessing the World Wide Web. It also includes dual-word prediction and abbreviation expansion. When an individual begins to type a word, it suggests words the individual has already used. It contains a database of words that can be modified to include new words. Co:Writer™ (Don Johnston, Inc.) works in conjunction with any application that is a word-processing program including Microsoft Word™, web sites, blogs, e-mail, and so on. It is available for Mac® and PC. Aurora Suite 2005™ (Aurora Systems, Inc.) will read aloud text from a magazine, document, or web page that the user has scanned. It has the added feature of highlighting each word as it is read aloud if the user prefers. Aurora's word prediction is designed to help with spelling, word choice, and grammar. It will even sort out which homonym is appropriate.

COMMUNICATION DEVICES

There is a wide variety of communication devices on the market today that serve individuals with a range of communication disorders. Both the quality and the availability options have greatly improved, and many devices can provide both speech-generating output and printed output. Communication devices are designed primarily for communication purposes, but often can be used for other purposes as well. "A device that is made specifically for communication is called a *dedicated communication device*, because it is primarily limited to communication functions, although it may interface with a computer and perform limited environmental control functions" (Quist & Lloyd, 1997, p. 151, emphasis added).

Dedicated versus Non-Dedicated Devices

As noted earlier, today's communication devices are often multipurpose. However, a device designed for a specific purpose is considered to be a dedicated device and cannot be used for any other purpose than the particular communication for which it was designed. A non-dedicated device (e.g., a regular off-the-shelf computer) can be used for specific communication purposes, but can also be used for various other purposes by many other users.

Dedicated Devices

This section describes some of the dedicated speech-generating devices (SGDs) now available for use in augmentative and alternative communication (AAC).

Speech-Generating Devices

SGDs (formerly known as voice-output-communication aids, or VOCAs) are electronic communication aids that generate synthetic speech that can take the place of natural speech. The device becomes the individual's voice. There are literally hundreds of SGDs on the market to assist individuals with severe disabilities to communicate. These devices can be the link to the world for individuals who cannot speak. There are different types of SGDs, which serve various purposes. Synthesized speech uses a typical computerized voice and turns symbols and text into speech using the common rules of grammar. Because it is generated on the spot, it can sound very machine-like and lack intonation and emotion. Digitized speech, on the contrary, is prerecorded by a speaking person and contains all of the natural inflections and tone that would be expected to accompany a message (Quist & Lloyd, 1997). One disadvantage is that a prerecorded message may not say exactly what the person using the device wishes to say at that moment. Many of these devices are created for both children and adults. They are useful for individuals who have autism, postoperative voice loss due to laryngectomy or tracheotomy, brain injury, dysphasia, and degenerative voice disorders such as dysarthria, aphasia, or stroke.

There are dozens of SGDs that use icons or pictures with prerecorded messages (i.e., digitized speech). The following are just a few examples of the available digital devices on the market.

Big Talk™ (Enabling Devices) is a big button-shaped device used for recording a message (Fig. 14). It features a large area to provide easy access for individuals who have limited mobility. The Big Talk™ has 300 seconds of recording time. There is also a Small Talk™ (Enabling Devices), which can contain a recording up to 20 seconds in length. These are typically used for beginning communicators and are often a first step to starting more high-tech AAC interventions before moving on to more sophisticated devices. Button devices can be used to teach cause and effect; press the button and something happens. These are also used in many preschool settings to facilitate speech and language development in children at risk for delayed acquisition of speech and or language abilities.

Super Wrist Talker™ (Enabling Devices) is a personal SGD that is worn on the wrist (Fig. 15). It can hold up to 12 levels with four 5-second

Fig. 14. Big Talk™. Photo courtesy of Enabling Devices

Fig. 15. Super Wrist Talker™. Photo courtesy of Enabling Devices

messages of recorded speech per level. The example shows four different buttons the user can enable by pressing.

The Comboard™ (AbleNet Inc.) is a picture symbol board that holds a motor-driven pointer (Fig. 16). The pointer can be rotated like a dial until it

Fig. 16. Comboard™. Photo courtesy of AbleNet Inc.

reaches the preferred symbol. Pressing on one of two switches activates voice output. Such a device is particularly suitable for beginning communicators who are learning to distinguish between a few choices and who may need to operate the device with a single switch due to motor limitations.

SuperTalker™ (AbleNet, Inc.) and Cheap Talk™ (Enabling Devices) are devices that use icons or pictures arranged in rows (Fig. 17). Each picture can be touched, and a prerecorded message will play. One version of this device holds up to 48 5-second messages.

Fig. 17. Cheap Talk™ 4 & 8 Direct and Scan. Photo courtesy of Enabling Devices

The MACAW™ (Zygo Industries, Inc.) and the Smart/128™ (Advanced Multimedia Devices, Inc.) communication devices contain interchangeable inserts with icons, pictures, or words that allow the user to touch and hear prerecorded messages (Fig. 18).

ChatBox™ (Saltillo Corp.) is designed to hold up to four customizable vocabulary overlays and can be programmed with up to 10 minutes of speech (Fig. 19).

Hip Talk™ (Enabling Devices) is a device that hangs on the side of the hip (Fig. 20). An individual simply reaches down to the waist and pushes a button to activate a message. It can contain from 3 to 60 messages. Hip Talk™ comes with 2–12 buttons. The Hip Talk™ has the feature of hands-free portability. Many users prefer to stay highly mobile, want to continue

Fig. 18. Smart/128™ Communication Device. Photo courtesy of Advanced Multimedia Devices, Inc.

Fig. 19. ChatBox™ Communication Device. Photo courtesy of Saltillo Corp.

Fig. 20. Hip Talk™ 12 with Levels. Photo courtesy of Enabling Devices

their regular jobs, live daily routines, and still be able to communicate quickly. In this case, a highly portable device is the option of choice.

More sophisticated SGDs typically include synthetic speech output. ChatPC-4™ (Saltillo Corp.) and the ChatPC-Silk™ (Saltillo Corp.) both have dynamic displays and look like a Pocket PC™ (Fig. 21). They offer symbol-based screen communication in a rugged case. These devices are much higher technology than the picture and icon boards described earlier. They both have a carrying case, strap, or wheelchair mounting device for easy access. The advantage to the ChatPC-4™ and the ChatPC-Silk™ are the hundreds of pages of symbols they contain. The software contains numerous voices and languages from which the individual can choose. It allows modifications as well as additions to its vocabulary list. The number of buttons on the screen, the sizes, and other features can be modified to meet the needs of the individual.

Synthetic speech generated by SGDs offers simple and flexible speech options. This section discusses some of the more well-known devices. The TextSpeak TS Series™ (Digital Acoustics Corp.) uses a talking keyboard to generate speech directly from typed text. It works over speaker phones, is portable, and has an unlimited vocabulary. The user can select either male or female voices in either English or Spanish. There are several keyboard options depending on the user's unique needs. TextSpeak™ offers both

Fig. 21. ChatPC-Silk™. Photo courtesy of Saltillo Corp.

wireless portable and large keyboards. There are many such devices, some of which allow users to record their own voices in preset messages. Some are more simple and portable than others. The Lightwriter SL40™ (Tobii Technology) features an ergonomic design, easy to clean keyboard, scratch resistant screen cover, and an impact resistant case allowing it to handle everyday wear and tear with ease. In addition to converting text to synthesized speech, the Lightwriter™ has software that bases word prediction on the writer's own vocabulary. The predicted words appear in tabs at the bottom of the screen.

The Lightwriter™ has dual display so that the text faces both the person typing and the person sitting across from the typist (speaker). This allows

Fig. 22. ECO2™. Photo courtesy of Prentke Romich Company

listeners to also read messages from the user. The audio can be turned off and just the message read, if necessary. The keyboard can either be the traditional QWERTY keyboard or an ABC format.

The ECO2™ (Prentke Romich Company) is an advanced AAC device that has a Windows™ XP-based computer processor with enough speed and capability for superior communications (Fig. 22). It features *one-touch* transition from computing to speech output. A version without computer capabilities that meets Medicare/Medicaid requirements is also available. The ECO2™ has a 14-inch display with larger keys to provide easier access for individuals with limited mobility or visual impairments. The audio players support both MP3 and WAV files and also have auditory prompts for individuals with visual impairments.

SpringBoard Lite™ (Prentke Romich Company) is a portable device that includes various display settings from 4 to 36 items (Fig. 23). This device allows communication capacity to grow as the user's ability grows. The SpringBoard Lite™ has a built-in media player that includes MP3, WMA, and WAV file formats.

Fig. 23. SpringBoard Lite™. Photo courtesy of Prentke Romich Company

DynaVox Mayer-Johnson has a number of SGDs such as the DynaVox Maestro™, DynaVox V+™, DynaVox Vmax+™, EyeMax System™, DynaVox Express™, and Tango™. These dynamic devices can be used for individuals with various disabilities such as autism, developmental delay, and ALS. Children with little or no functional speech can use the devices at a young age to generate oral communication. For individuals who are echolalic and show repetitive speech, these SGDs can provide consistent speech and meaningful communication. For individuals who have aphasia and deficits in reading, writing, and receptive and expressive language, a dynamic device that uses icons can aid communication. Users can interact with the device using a touch screen, switch, head, or eye-tracking system.

The DynaVox Xpress™ is a handheld device small enough to fit into a pocket. Not only does this device allow personal communication, it also provides web access with Wi-Fi capabilities. The device has a touch screen similar to the Apple iPhone®.

The DynaVox Maestro™ is larger than the Xpress™ and includes a carrying case. The Maestro™ has a built-in digital camera, Wi-Fi access, and Bluetooth wireless capabilities. The Maestro™ also has a spell-checker, phrase prediction software, and customizable page templates. It can be connected to any device that uses a remote control, such as a television, light switch, or DVD player. One can also operate a telephone using the Maestro™.

The DynaVox EyeMax System™ combines the Vmax+™ with the EyeMax™ accessory. It allows a user to access the Vmax+™ communicator by blinking or by staring at a particular area of the screen. This is extremely helpful for users with limited mobility but who have vision in at least one eye.

Dynamic communication displays provide users flexibility by allowing them to easily change the frames shown on the device. For example, if a user is at home, they can indicate that on their device, and a different display is shown than if they are at work. This allows for greater communication ability than a static communication device that only shows, for example, eight symbols from which to choose. Dynamic displays can contain multiple pages that can be selected allowing a user more control over various communication contexts.

Switch Access

Many SGDs can be accessed using a switch or multiple switches. A switch provides alternative access to the SGD as was discussed earlier. Some switches are still connected to a device using cables; however, newer switches can be connected wirelessly, some of which can access up to 30 feet away from the device. Switches come in many different forms depending on an individual's physical capabilities. For example, some switches are activated by being pressed, squeezed, bent, sipped and puffed (described earlier), and/or tilted. Switches come multicolored to stimulate visual senses. Some switches have pictures or symbols added to them to indicate their function. Typically, for early learners, switches teach cause and effect. For more advanced learners, switches provide alternate access to technology.

Non-Dedicated Devices

As previously mentioned, non-dedicated devices are not specifically made to be assistive devices but can be used as is or modified to allow individuals with special needs to use them as an assistive device. Consider the type of application the individual needs, the size of the device, and the cost when determining which of the following could be AT for a particular individual.

Keep in mind that accessories may need to be purchased to make a device more functional for a particular user.

Portable Word Processor

Portable word processors (a.k.a. stand-alone word processors) are not connected to a computer or monitor. They have a small screen and typically contain only word processing software. They are smaller and lighter than laptop computers. With new technology like Tablet PCs and the Apple iPad®, which may also contain word-processing software, however, devices are becoming multiuse. Some individuals might prefer having the stand-alone word-processor device to reduce distraction and sensory overload. A portable word processor is typically less expensive than an iPad® or Tablet PC. The word processor allows individuals to enter text, check spelling, and so on. Portable word processors serve various functions such as note taking, keyboard practice, and writing compositions. The devices will typically connect to a computer and/or printer to allow the user further editing and/or printing. Some examples of portable word processors are the Fusion™ (Writer Learning Systems), Dana™ (Renaissance Learning), and Neo2™ (Renaissance Learning). Readers may be familiar with the AlphaSmart™ (Renaissance Learning). AlphaSmart's™ name was changed to Neo™ in 2005 (Fig. 24). With advancements in technology, some of the portable keyboards

Fig. 24. NEO™ Portable Word Processor.Photo courtesy of Renaissance Learning

now contain additional software such as presentation software, and spreadsheet. The Dana™, in particular, has a Palm™ (Hewlett-Packard) operating system that allows it to run many Palm™ applications.

Talking Word Processors

Talking word processors are a fairly recent innovation in AT pioneered by Meyers, Rosegrant and Peet (1995). The talking word processor "allows learners to construct words from scratch, so to speak. The learner types a letter and the computer not only places the letter on the computer screen, but says the letter out loud" (Peet, 1995, p. 4). Ultimately, the letters are turned into words and the words into a sentence. Meyers invented the first talking word processor to use as part of her research into technology to assist children with Down syndrome (Meyers, 1994). Rosegrant invented a talking word processor to help in her work with children with learning disabilities (Peet, 1995). Both found success helping children learn writing skills.

A talking word processor typically contains word-processing software with built-in text-to-speech capability that provides auditory feedback. These systems help students with their writing skills through features that notice omissions, dropped endings, incorrect subject–verb agreement, and so on. Other features include spell-checking, dictionary, and grammar checking. Some programs provide ways to reread and edit text, so that individuals can listen to their text as often as they wish.

An example of a talking word processor is Write:OutLoud™ (Don Johnston, Inc.), which features several options that help individuals with moderate intellectual disabilities. It can be used as an SGD and uses the latest voice-output technology to read words aloud. The spell-checker is more precise than those found in standard word-processing programs. The text-to-speech reads the word choices, helping users decide which word to choose. The dictionary displays and speaks the definition of almost any word with clear and concise meanings. The homophone checker quickly checks the user's work for mistakes and offers definitions for all the alternatives. The bibliographer guides students through creating references using dozens of sources types and formats in both American Psychological Association (APA) and Modern Language Association (MLA).

The following are some other examples of current talking word processors. Read&Write™ (Texthelp Systems Ltd.) software will read aloud what is on the screen and can be used with either Mac® or PC. It shows menus, boxes, and lists on the screen and can use optional friendly animated characters. The CAST eReader™ (CAST, Inc.) is text-to-speech software for both Mac® and PC that features spoken digitized text, flexible voice settings

for speed and pitch, and highlighting tools. The highlighting tool allows an individual to highlight a single word, sentence, or paragraph to be read aloud by the software.

Electronic Dictionaries

Electronic dictionaries and other word meaning programs are useful for individuals who need easy methods for looking up words. Although most word processing programs contain spelling- and grammar-checking features, many electronic dictionaries contain advanced features that could be used by a person with limited motor skills and impaired speech or cognition. Programs loaded onto an SGD can be an enormous help in providing independence for people struggling with text generation and speech production. Matching an individual's needs with available features has become a much easier process with many products on the market. Features include spell-checkers (text and read aloud), homonym checkers, thesaurus help, and pronunciation aids.

Many electronic dictionaries define words at the click of a mouse. Some can also correct spelling based on the phonetic spelling of the word input by the user. Word variations can be read aloud by the dictionary if the user does not know the exact word needed. There are sometimes simplified versions of synonyms and antonyms in the thesaurus. Some devices include a rhyme-finder software program that will display words that rhyme with a selected word. The Children's Talking Dictionary™ by Franklin Electronics contains easy-to-understand definitions that are pronounced for the user (Fig. 25). The dictionary also detects phonetically spelled words and features an animated handwriting guide showing print and cursive handwriting.

Portable Audio Players

Portable audio players such as MP3 players or Apple's iPod® are being used for more than music only. Some of these devices now play videos, games, and connect to the Internet wirelessly. However, one chooses to use their portable audio player, individuals with special needs are now being considered during the manufacturing of some of these products. For example, Apple® has now made all Mac OS® devices more accessible with the VoiceOver™ feature. The iPod® nano has both the VoiceOver™ feature and a white on black contrast display option (Fig. 26). Apple®'s VoiceOver™ uses speech to tell the user what is happening on the screen and allows the user to control the tool without seeing the screen.

Fig. 25. Children's Talking Dictionary™. Photo courtesy of Franklin Electronics

Because of the unique buttons located on the Apple® In-Ear Headphones, users do not even have to look at the device to navigate. They navigate by feel.

Much research is currently under way on using the iPod® for individuals with special needs, particularly autism, and this research is moving into the iPad® realm as well. The iPod Touch® looks more like a smartphone than the classic iPod® (Fig. 27). It still not only plays music but also connects to the Internet and plays videos, has an e-book reader, does e-mail, and so much more. Closed captioning for videos is available for the iPod®. Many applications created for the iPod Touch® and the iPad® have versions for the family of devices including the iPhone®. These devices can now hold AAC applications and make the communication devices much more portable and fun to use. The individual's dexterity must be good to use the iPod Touch® or iPhone®, but the bigger screen of the iPad® means their dexterity does not have to be quite as good. In addition, mounts for these devices have been created to allow attachment to a wheelchair, bed, and other equipment. This

Fig. 26. Apple iPod nano® with VoiceOver. Photo courtesy of Apple Inc.

allows for one-handed use as the user does not have to hold the device. The affordability of these devices is sometimes better than dedicated devices. They are multifunction tools that allow users to talk, read, text, e-mail, photograph, play games, listen to music, watch movies, and so on. Research is urgently needed on who is using these tools, for what purposes, as well as on the effectiveness of these devices in accomplishing different tasks and training specific skills in natural environments.

Tablets/Handheld Computers/Notebooks

Apple® introduced the iPad® in 2010. The iPad® is a type of touch screen tablet, a computer in a portable one-piece design that weighs 1.5 pounds (Fig. 28). The iPad® works through various software applications that are downloaded and installed on it. It contains an on-screen keyboard for text input. The iPad® and smartphones are replacing personal digital assistants (PDAs) in that they allow more productivity, more flexibility, and accomplish more tasks. For example, using photos to remind a child with

Fig. 27. Apple iPod Touch®. Photo courtesy of Apple Inc.

autism how to wash hands can be done easily on the iPad®. However, the iPad® is a fragile piece of equipment, and a tantrum can destroy the device. Another use for the iPad® is to create a list of schedule or behavior reminders. One popular application is the Proloquo2Go® (AssistiveWare) AAC software that can be used on multiple platforms including the iPad®, iPhone®, and iPod® (Fig. 28). There are many other applications for individuals with special needs created for the iPad®, and these are continuously added to by developers. But keep in mind that an application created for another reason might also be beneficial to an individual with special needs. For example, an application for art or fun might keep an individual with special needs engaged and entertained.

Fig. 28. Apple iPad® with Proloquo2Go® Software by AssistiveWare. Photo courtesy of AssistiveWare and Apple Inc.

There are a number of different types of Tablet PCs, handheld computers, and notebook computers. All of these have a touch screen that can be written on with a stylus. Although the iPad® was discussed separately, it could still be considered a handheld computer. Some of these devices look like a laptop but the monitor rotates and folds down onto the keyboard.

One of the advantageous features of the Tablet PC is the ability to *read* the handwriting of the user (writing with a stylus) and translate it to typed text.

Because these all have the same capabilities as a desktop or laptop computer, they can handle the same types of software applications.

Smartphones

Cellular telephones (cell phones) are another non-dedicated device that can be used by individuals with special needs. Some phones come with larger buttons, larger print, fewer buttons, hearing aid compatibility, Braille buttons, and so on to accommodate various needs. Some of these phones are special simplified versions of smartphones made for specialized populations (e.g., senior citizens, people with visual impairment, and lack of fine motor control) with clearly visible and extra large buttons and/or larger screens (Fig. 29). Features are kept fairly simple to increase ease of accessibility.

Fig. 29. Jitterbug™ Cell Phone. Photo courtesy of Jitterbug.com

There is a difference between a regular cell phone and a smartphone. The cell phone has call-making abilities and, depending on the service plan, typically has text messaging abilities. Cell phones do not have full Qwerty keyboards, cameras, Internet access, music-playing capabilities, and so on. Smartphones, on the contrary, have all of those capabilities. Smartphones allow for voice input, text messaging, picture capturing and messaging, e-mailing, Internet access, gaming, and more. Most smartphones have the same capabilities as a handheld computer.

Cell phones have advanced rapidly over the last few years. Smartphones are now using operating systems similar to computers and can have software applications loaded onto individual phones. Some of that software is specifically designed for people with disabilities or special needs. Other software and features exist that were not designed for a specific group of people, but can be used to make the phone more accessible for people with special needs. Some of the same software applications used on computers have versions for smartphones.

Interactive Whiteboard

Two of the more commonly seen interactive whiteboards are SMART Boards™ and Promethean™ boards (Fig. 30). They are mounted to a wall or stand and connected to a computer. They can either have a built-in projector or stand-alone projector that displays the computer image on the screen. The screen can then be touched, either by finger or by stylus, and the image can be manipulated by the user. The whiteboard can have an on-screen keyboard, buttons, and handwriting recognition. Using an interactive whiteboard gives all students access to interact with the technology. SMART™ has not only an interactive whiteboard but also an interactive table made for multiple users. The table's surface is an interactive touch screen that multiple users can interact with simultaneously.

Both SMART Boards™ and SMART Tables™ support various learning styles (i.e., visual, auditory, and kinesthetic). A touch of the finger can produce a new web site or open a video clip, complete with sounds. For students who struggle with written text, seeing the lesson unfold and hearing it simultaneously can facilitate comprehension.

For example, a special needs class at an alternative high school is studying economics, and the topic of the day is bond ratings and how they work. A tedious lesson in the textbook comes alive with the use of a SMART Board™. The teacher brings up some Wall Street corporations and shows the students how the companies are listed. The students can choose their own favorites (shoe manufacturers, clothing lines, race cars, etc.) and touch the screen to

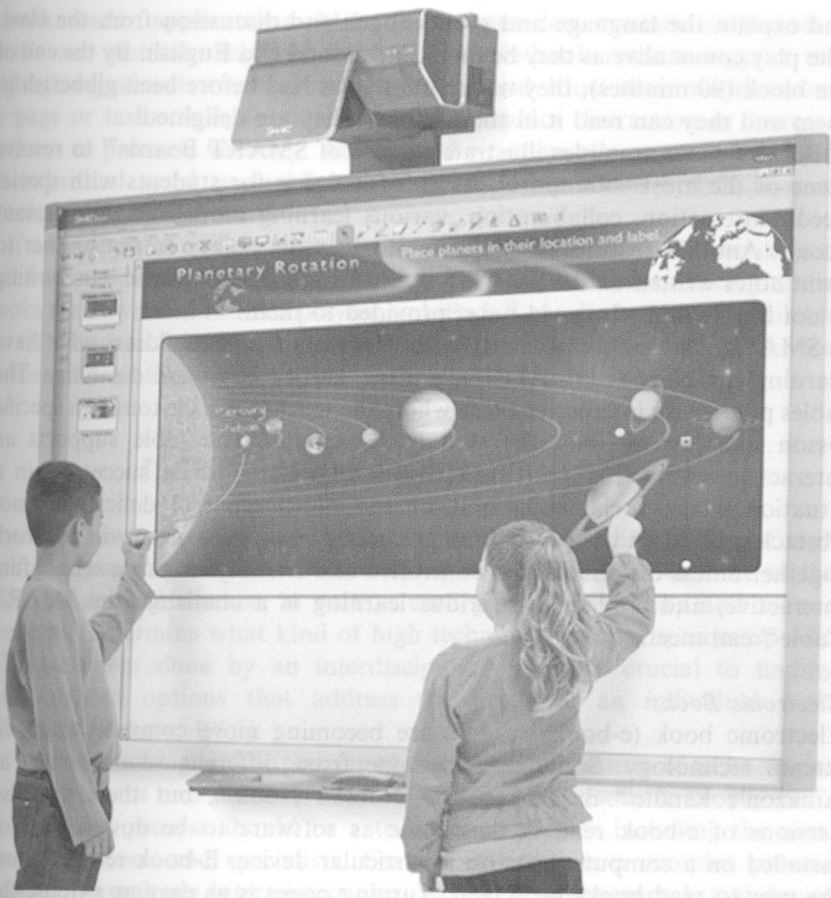

Fig. 30. SMART Board™ Interactive Whiteboard. Photo courtesy of SMARTTech

activate their company's bond rating and how and why it is rated as it is. The result is an instant and relevant lesson on a complicated topic. Another reason the lesson is understood is the ability of the SMART Board™ to provide a very focused example of the lesson with little extraneous information to interfere, something that is often the downfall of students with learning disabilities and attention deficit and/or hyperactivity disorders (ADHD).

Another example presents a middle school teacher using a SMART Board™ to show his students Romeo and Juliet in the modern version with the Old English language. As the movie unfolds, he is able to stop the film

and explain the language and get feedback and discussion from the class. The play comes alive as they begin to understand Old English. By the end of the block (90 minutes), they understand what had before been gibberish to them and they can read it in their books. They are delighted!

Both of these examples illustrate the use of SMART Boards™ to resolve some of the most common obstacles to learning for students with special needs: interaction, collaboration, various learning modalities, and instant access. Another feature of this technology is the ability of the teacher to print notes written on the SMART Board™ for students whose handwriting is not legible and who need notes provided to them.

SMART Tables™ work well with elementary age children who have learning disability (LD), ADHD, autism, and/or cognitive disability. The tables provide an interactive place where the teacher can customize a specific lesson focusing on only the skill to be taught. The table supports an interactive setting for students to work together and be successful in a situation where social collaboration and motor control deficits are not obstacles. Children with any of the preceding disabilities often will not work together unless the situation is controlled and friendly. Making school fun, interactive, and a place for serious learning is a challenge the SMART Table™ can meet.

Electronic Books

Electronic book (e-book) readers are becoming more common as mainstream technology. Some devices come from different vendors such as Amazon's Kindle™ or Barnes and Noble's Nook™, but there are also versions of e-book readers that come as software to be downloaded or installed on a computer, not on a particular device. E-book readers allow the user to read books on screen. Turning pages is as easy as swiping the hand or finger across the *page* (screen). This is advantageous to individuals with mobility impairment who still have the ability to move their hand somewhat. E-readers allow individuals to interact with books, move at their own pace, and ultimately have more control over the process of reading a book. This can increase motivation to read as it provides independence. Users can download e-books from a number of different sites. The aforementioned e-book readers are non-dedicated devices that can be used by individuals with special needs. There are also e-readers created specifically for special needs users. For example, DynaVox provides SGDs called Maestro™ and Vmax+™ that now include an e-book reader. This software has the capability to read the book aloud to the user if warranted. Other devices such as Apple®'s iPad®, smartphones, and tablets can also support

e-book reader applications. Many e-book readers contain multimedia, which can motivate students to read. Some e-book readers support the highlighting of each word as it is being read aloud. Most allow modifications to page or text colors, fonts, and so on to reduce distraction or increase contrast to promote visibility. And several e-readers allow users to click on an individual word to highlight the word and produce a definition or pronunciation of the word.

If an individual cannot read a book using an e-reader, audio books can still be considered. Many libraries and web sites are now offering audio books for download to MP3 players and iPods®. Audio books are available on CDs and in various other electronic formats (refer to Chapter 11 for further information).

ISSUES AND CONSIDERATIONS

There are many issues and consideration to study regarding the use of high technology as augmentative assistance. This section discusses some of the more common. However, in reality, each person's disability and unique needs will determine what kind of high technology is appropriate. Specific AT assessment done by an interdisciplinary team is crucial to finding individualized options that address the needs of an individual most effectively (Zabala, 1995).

Feature matching is "the process of matching the features of technologies to the strengths and needs of users" (Wasson, Arvidson, & Lloyd, 1997, p. 226). This process should be a team-based process including the user, family members, and specialists. Feature matching is a complex process "shaped by multiple interrelated user, partner, environmental, and device variables" (Wasson et al., 1997, p. 227).

Specific needs are first on this list of considerations because the kind of technology needed should first be considered, followed perhaps by the individual and specific features that would be most appropriate. For example, one individual may need a device with speech output, whereas another may need only a scanning pen to help compensate for dyslexia.

The technology chosen should be focused on increasing the person's strengths. In the case of a person who is a talented writer, who lacks the capacity to hand write, a device that records words or a device as high tech as a HeadMouse™ (Origin Instruments) might be the solution that leads to success. This means understanding the technology is crucial in terms of necessary programming or training.

A further consideration is the individual's capacity and inclination to use technology. Success is unlikely if a person is not willing to use the device(s).Where the technology will be used is another concern. Should it be portable so that it can travel to school or the office or is the person homebound and only needs it in one place? At the present time, small portable devices are as powerful as the large awkward devices were in the past. Consider whether it is easy to use or not. Is there a big learning curve? If the person is technologically sophisticated, it may not be a problem, but someone with an intellectual disability will not achieve any freedom if the assistive device is too complicated. Reflect on reliability of the high-tech option you are considering. Researching online reviews and asking clinical support personnel about their experiences with devices can be very informative. Will it work in connection with any technology the person currently uses? Can it be mounted on a wheelchair or bed? Consider if there is technical support available. Online and 24/7 technical support can save much frustration and wasted time. A personal support network is also important for anyone with even mild disabilities. Having someone close to help with and explain the technology or device can be indispensible.

Another component of this discussion should take into account the cost of the product desired. If it is prohibitive and not covered by insurance, it may not be realistically available for those who could use it. However, mainstream technology (e.g., laptops and computers) is now reasonably priced and often can be modified to fit many of the specific needs of a person with disabilities. Thus, much of the enhanced mainstream technology is now less expensive than the dedicated assistive devices and serves the same purpose with the same results. Further principles for applying AT can be found in Chapter 4 of this book.

An additional consideration is the *digital divide*. One component of the digital divide is socioeconomic status. More sophisticated technology is easily within the reach of those who are a higher socioeconomic status. Although Medicare and Medicaid, as well as general health insurance companies level the playing field to some extent, too often, the same technology is not available to all individuals that need it on an equal basis. In this respect, the modified mainstream technology may help many individuals achieve a measure of independence who otherwise would not have been able to afford it.

The attitudes of nonusers toward AAC and AT should also be considered. Younger children seem more at ease with the use of AAC or AT devices by their friends. Some training and adjustments may also be necessary on the part of regular education classroom teachers and employers and coworkers (Cook & Polgar, 2008).

Finally, the value of an AAC or AT device is only as good as its usefulness to the user. It is important to continuously monitor the progress and desirable outcomes of any AAC or AT device in terms of its user's goals and needs.

SUMMARY

This chapter is meant to serve as an introduction and update (Quist & Lloyd, 1997) to the availability of both established and emerging assistive high-technology devices. There have been many advances in AT in terms of portability, weight, and convenience, making it even more capable of producing meaningful communication for individuals with disabilities. Computers and handheld devices are becoming more important to AAC users as both dedicated and non-dedicated devices are increasingly permitting easier communication than the technology of the past. However, it should be kept in mind that some users need the simpler, low-technology assistive devices and that the type of AT needed should be determined on a case-by-case basis. Even though high technology exists, it is not always the best choice for an individual. The advancement of technology in today's world means an increase in the number and types of devices on the market. AAC and AT specialists should be consulted for recommendations for individuals based on their individual needs. The resources listed throughout this chapter are by no means a complete description of all of the devices on the market today, but rather serve as a representative sample of the general types of technology available and the opportunities these can offer.

ACKNOWLEDGMENT

The authors would like to thank Ms. Erin Kenney, a graduate student in the Learning Design and Technology program at Purdue University for her help with attaining the reprint permissions for the figures in this chapter.

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