COMPUTERS AND STUDENTS AND ADULTS WHO ARE IMPAIRED

Frank P. Belcastro (fbelcast@hotmail.com)

Instructor

Northeast Iowa Community College

285 North Grandview Avenue

Dubuque, IA 52001

563-588-1044

COMPUTERS AND IMPAIRED

Abstract

Assistive devices and assistive software make it possible for the impaired to use computers with all of its processing programs and to access the Internet. Assistive software and assistive devices are described that are specifically intended for students and adults who are blind or visually impaired, students and adults who are deaf or hard of hearing, and students and adults who are motor impaired. Recommendations and conclusions are drawn.

COMPUTERS AND STUDENTS AND ADULTS WHO ARE IMPAIRED

Out of every one hundred students and adults, ten are students and adults who are impaired. In the United States more than twenty million people have a disability that affects their daily lives (Cattoche, 1986). Several of these handicaps can be effectively dealt with by using conventional devices: a wheelchair to help someone that cannot walk, a hearing aid to help students and adults who are hard of hearing, or even something as simple as a magnifying glass to enlarge the fine print for someone who has vision problems.

Although students and adults who are impaired face a variety of barriers to providing computer input, interpreting output, and reading documentation, adaptive hardware and software have been developed to provide functional alternatives to standard operations (Burgstahler, 1999). Access to computers and the World Wide Web is increasingly required for education and employment as well as for many activities of daily living (Chiang, Cole, Gupta, Kaiser, & Starren. 2005).

Most important to students and adults who are impaired is the ability of the computer to immerse them into a world that might otherwise be off limits. By accessing the Internet, these students and adults have immediate access to a vast amount of information, can tap into practical impaired-related information, and can converse with other students and adults who are impaired.

For the first time in their lives, through the use of computers many students and adults who are impaired find themselves able to belong somewhere, a virtual community where they feel a relationship with events and other students and adults, as in any other community. Critically, computers help give students and adults who are impaired what they want more than anything else--independence in their daily lives. Along with independence comes the capability for even students and adults who are severely impaired to earn a living or get a diploma or a degree (Sussman, 1984). Not only that, computers are a powerful tool for learning new job skills. With

the help of these assistive computer devices and advanced assistive software, many adults who are impaired can be just as competitive as anyone else and enter the mainstream of society and be accepted as participating, contributing, and cherished members of the community. The future outlook for students and adults who are impaired is excellent.

Computers can benefit students and adults with low vision, blindness, speech and hearing impairments, learning disabilities, mobility, and health impairments. Each of these impairments poses challenges to accessing and using a standard computer and electronic resources. For example, a person who is blind is unable to read a computer screen display or standard printouts. A person with a spinal cord injury may not have the motor control and finger dexterity required to use a standard mouse and keyboard.

Students and Adults Who are Blind or Visually Impaired

Five hundred thousand blind people live in the United States; a million more are partially sighted. Most blindness occurs in people more than sixty years old, while fewer than ten percent of blind people are under twenty-one (Cattoche, 1986).

Obviously, students and adults who are blind or visually impaired are challenged in learning and communicating because they are blind or visually impaired. The use of computers would be of severely limited use to them unless some intervening products could convert the contents of the computer screen to speech. For students and adults who are blind or visually impaired, using computers and accessing the Internet have changed their lives forever, mainly because it provides independent access to information (Sreenivasan, 1996). The most common aid for students and adults who are visually impaired is a screen reader, a program that reads out a computer display for them. The screen reader may display information in Braille, use voice output, or use other audio signals to indicate graphics on the screen. These screen-reader products exist and the most accessible way for students and adults who are blind or visually

impaired to become computer functional is through screen-reading voice software.

Screen-Reading Voice Software

Realspeak One of these is RealSpeak software (Nuance, 2006a). This program can read the text on a computer screen aloud. Because many professors use Web sites to provide class updates, students who are blind or visually impaired can now use RealSpeak to access these updates.

JAWS Another is Job Access with Speech (JAWS) for Windows that uses an integrated voice synthesizer and the computer's sound card to output the content of a computer screen to speakers. Users can adjust voice rate, pitch, and amount of punctuation spoken. Because Braille is by far the most common tactile system used by the blind or visually impaired, JAWS helps them by providing line-by-line Braille on a specialized keyboard that changes or refreshes according to the text on the screen (Freedom Scientific, 2006c).

IBM Home Page Reader Not only does the IBM Home Page Reader (HPR) bring spoken access to the Internet for the blind or visually impaired user, it also converts to speech Web information text in columns, tables, date input fields, and graphic description. Support for low vision users permits customization of font size, background, color, and other display elements. System components such as large screen CRT Monitors, LCD Flat Panel Monitors and Large Print Keyboards also can be used to enhance accessibility (Technology Round-Up, 2002).

OpenBook and WYNN Wizard For printed information that is physically present, OpenBook and WYNN Wizard (Freedom Scientific, 2006a) convert written text to speech for students and adults who are blind or visually impaired. For the low vision user, the MAGic software magnifies the computer screen up to 16x (Freedom Scientific, 2006b).

BATS students and adults with low vision have been conducting geographic research for some time and tactile maps have allowed students and adults who are Braille readers to explore

geographic information. Now students and adults who are blind or severely visually impaired can access geographic maps using the map-navigation software, Blind Audio Tactile Mapping System (BATS). It takes digital map information and provides non-visual feedback as the user moves a cursor across the map. As the cursor passes over a name, a speech synthesizer pronounces the name; as it passes over land, one hears the sound of horses galloping; as it passes over water, one hears the sound of waves breaking (Tosczak, 2002).

Initial success with these software, as with all software, will depend on whether the user's visual impairment is congenital or adventitious and with the user's previous experience with computers. Using these screen-reading products, students and adults who are blind or visually impaired cannot access information that a screen-reader cannot describe nor can they learn concepts that would be accessible only through vision; these require the intervention of a sighted person.

Many visually impaired users are attracted to the idea of operating their computer by voice. The main problems are: (1) Hearing the words or phrases echoed back is often not enough for the user to be sure there are no errors in the recognition or formatting of the text. (2) It is very easy to become disoriented when a command has been misrecognized and one is suddenly taken somewhere unexpected. This can be frustrating, and at worst disastrous (Peissner, Heidmann, & Ziegler, 2001).

The inability of computer users who are visually impaired to access graphical user interfaces (GUIs) has led researchers to propose approaches for adapting GUIs to auditory interfaces, with the goal of providing access for students and adults who are visually impaired (Ratanasit & Moore, 2005).

Other screen-reader products and adaptive technology devices for the blind and visually impaired can be located at http://www.adaptivetech.net/php/products/screen_readers.php and Technology

Round-Up, 2002. Thus, being visually impaired is no longer as great a challenge in learning and communicating as it was before these products existed (Belcastro, 2005b).

Students and Adults Who are Deaf or Hearing Impaired

Of the sixteen million students and adults who are deaf or hearing-impaired in the United States, two million are deaf and unable to understand normal conversation even with the assistance of a hearing aid. Some deaf people can hear sounds, such as a bell ringing or a door slamming" (Cattoche, 1986).

A computer is an especially helpful device for students and adults who are deaf or hearing-impaired because computer hardware and software commonly produce visual output. Therefore students and adults who are deaf or hearing-impaired can utilize the same programs that everyone else uses. There are, of course, assistive hardware and software available for specific cases (Dolter, 1996).

Programs have been developed to offer training and practice for students and adults who are deaf in such things as sign language, finger spelling, and even lip-reading. All the user needs is a system with a microphone and the correct software. The person selects a word, and the correct pronunciation is displayed as a pattern on the screen. The word produced by the deaf individual speaking into the microphone is also displayed as a pattern on the screen. The deaf person compares both patterns and through practice improves the pronunciation of the word (Cattoche, 1986).

It is apparent that students and adults who are deaf or hard of hearing are challenged in learning and communicating because they are deaf or hard of hearing. Computers alone would be of severely limited use to them unless some intervening product could convert the spoken language provided by the computer into text (Belcastro, 2004). Such a product exists: it is the iCommunicator (Hearmore, 2006).

The iCommunicator is a fully integrated system that consists of a high-end laptop computer, iCommunicator software, and other peripherals. Among its many capabilities, the iCommunicator uses continuous speech recognition to translate speech to text and/or sign language in real time. Further, any Internet presentation can be burned onto a CD-Rom or DVD and that would permit pausing and instant replay of the material for review as it is processed through the iCommunicator.

Deaf children face considerably more difficulty than hearing children in learning to read. SigningAvatara puts virtual 3D technology, widely used in video games, to use for educational purposes. The virtual characters interpret English words, sentences and complicated concepts into sign language, combining signing, gestures and body language to simulate natural communication. The animations are based on in-depth research of how both hearing and deaf students and adults use the face and body to communicate. Besides translating printed text, they "tell" stories, ask follow-up questions and hold interactive conversations with viewers. SigningAvatara technology is available on an educational CD-ROM or can be licensed to provide signing interpretation of Internet websites, including spoken information. (National Science Foundation, 2001a).

Baldi, a 3D computerized tutor, helps profoundly deaf children to develop their conversational skills. This animated instructor converses via the latest technologies for speech recognition and generation, showing students how to understand and produce spoken language. Baldi's 3D animation (including articulated mouth, teeth and tongue) produces accurate facial movements that are synchronized to its audible speech, which can be either a recorded human voice or computer-generated sounds. Baldi is state-of-the-art in its integration of speech recognition, speech synthesis and facial animation technologies. Baldi is used by profoundly deaf children whose hearing is enhanced through amplification or electrical stimulation of the cochlea

(National Science Foundation, 2001b).

Students and Adults Who are Motor Impaired

About ten million people have impairments that affect movement. Most people with physical impairments use canes, crutches, or braces to aid in walking. More than 500,000 need wheelchairs to become mobile. There are many causes of movement impairments, including spinal cord injuries, nerve and muscle diseases or injury, cerebral palsy, strokes, accidents, amputation, repetitive strain injury, muscular dystrophy, and severe arthritis. (Cattoche, 1986; Dunn, 1997).

It is evident that students and adults who have a motor impairment are challenged in learning and communicating because they cannot use parts of their bodies. The use of computers would be of severely limited use to them unless some intervening products could permit computer control by voice (Belcastro, 2005a). These voice-controlling programs exist and the most accessible way for those who have a motor impairment to become computer functional is through voice-recognition software (Deming & Valeri-Gold, 1987; Lazzaro, 1993).

Voice XML and Speech Application Language Tags (SALT) are speech technologies that do not necesssitate the use of hands and are a reliable method of controlling menus: a means of moving and clicking the mouse using voice commands and a correction mechanism that works completely by voice. Users with spelling difficulties need predictive correction, a text to speech feature to help with proofreading, and a facility to "play back" what was dictated. Students and adults who wish to speed up typing are likely to be most interested in speed of recognition and easy correction (Curran, Crawford, & O'Hara, 2004).

Another application is QPointer Voice (EnableMart, 2006). This program allows the user to have complete computer control by voice in any application. With this voice recognition software, the person who has a motor impairment can created, format, edit and save documents; the person can write and send e-mail and surf the Internet, entirely by voice. It will also create a

database of the student's most commonly used words and will switch between applications on voice command.

Another is Dragon NaturallySpeaking 7, which also permits students to edit documents, control applications, and manage their desktop, all by speaking. Its Vocabulary Optimizer examines documents for sentence structure and word use frequency and then adjusts the recognition engine to match the person's writing pattern. By automatically inserting periods and commas when the student dictates, this feature is ideal for use with casual documents like e-mail and instant messaging (Nuance, 2006a).

Not only does IBM ViaVoice Advanced Edition permit access to websites by speaking the link name, it also will navigate to bookmarks with a simple voice command. It contains similar features as the two previously described software (Nuance, 2006b).

Other voice recognition software and a list of the companies that sell them can be located athttp://dir.yahoo.com/Business_and_Economy/Shopping_and_Services/Computers/Software/Voice_Recognition/

Technologically complex solutions exist for students and adults who have severe motor impairments. For example, the HeadMouse wireless pointing device (Origin Instruments Corporation, 2006) converts the movements of a user's head into corresponding movements of the mouse pointer by optically tracking the motion of a single point on the user's head. A standard keyboard may be completely replaced by using this system in conjunction with software that produces an on-screen keyboard.

HeadMouse Extreme is the solution for wireless head-pointing on PCs, the Apple Macintosh, and Alternative and Augmentative Communcation (AAC) devices. It replaces a standard computer mouse for people who cannot use their hands. It operates from the top of a computer monitor, laptop computer, or augmentative communication device, and measures the

user's head movements. The wireless sensing technology employs infrared light to track a small disposable target that is placed on the user's forehead or glasses. HeadMouse Extreme provides a wide field-of-view and superior precision, supporting even graphics-intensive applications like drawing and computer-aided design.

However, some assistive devices are designed specifically for cognitive impairments. Word prediction software is used by dyslexic individuals and those who type very slowly. This software predicts the completion of the word currently being typed and can predict the next word based on word context and frequency (Madentec, 2006).

Initial success with these software, as with all software, will depend on the user's previous experience with computers. It should also be noted that those students using voice recognition systems need considerable additional training over a period of several weeks beyond the basic training period. Trained tutors are recommended. Further, there are limitations to the currently available voice recognition software programs, especially as it relates to accuracy, program dependency, and compatibility with other assistive technologies. Nevertheless, having motor impairment of the hands is no longer as great a challenge in learning and communicating as it was before these products existed.

Other sources for helping the motor impaired use the computer can be located at: http://www.google.com/search?hl=en&q=motor+impaired+and+computers&btnG=Google+Search

Recommendations

It is recommended that both federal and state legislatures "make powerful new Internet resources, especially broadband access, widely and equitably available and affordable for all learners" (Grush, 2001); fund the purchase of high-speed phone lines (Knapczyk, Rodes, & Chung, 1998) and fund hardware and software for use with assistive devices in schools and

libraries. State administrators should take advantage of grants under the Assistive Technology Act of 2004. Title II of the Act authorizes funding for grants or other mechanisms to address the unique assistive technology needs of urban and rural areas; Title III of the Act provides for alternative financing mechanisms for students and adults who are impaired to purchase assistive technology devices and services (Bingue-Romano & Gold, 2005; Council for Exceptional Children, 2006).

An additional responsibility of state administrators is to inform those who are impaired of the assistive technologies available. The results of a survey of students and adults with different impairments indicate that many students and adults did not know about the types of computer technologies that could be helpful to them or about available subsidy programs (Fossey, Fichten, Barile, & Asuncion, 2001).

Both state and local school administrators, students and adults who are impaired, and employers can find further assistance at one of the Disability and Business Technical Assistance Centers (DBTAC). The National Institute on Disability and Rehabilitation Research has established ten of these regional centers to provide information, training, and technical assistance to employers, students and adults who are impaired, and other entities with responsibilities under the Americans with Disabilities Act (ADA). The center acts as a central, comprehensive resource on ADA issues. Of special interest to these school administrators and to those with involvement in educational settings will be materials and technical assistance developed to assist in efforts to make educational experiences accessible to all participants (ADA & IT Technical Assistance Centers, 2006).

Conclusions

The use of computers and assistive software and devices is an equalizer of the access to education. For as long as one has access, one's age or gender or socioeconomic, geographic or

population-density circumstances will not hinder one's access to information and thus greatly assist all students and adults impaired and non-impaired, in acquiring knowledge and taking advantage of educational opportunities.

All students and adults should be developed to their fullest potential; students and adults who are impaired because of their potential for making contributions to society should not be neglected. As part of the general population, the needs of students and adults who are impaired should not be overlooked and can uniquely be met by the use of computers and assistive technology in order to help them develop into strong, independent, individuals by providing these students and adults with the ability to compete as equals with their peers.

References

ADA & IT Technical Assistance Centers. (2006). Home page. Retrieved September 3, 2006, http://adata.org/centers.aspx

Belcastro, F. (2004). Rural gifted students who are deaf or hard of hearing: How electronic technology can help. American Annals of the Deaf, 149(4), 309-313.

Belcastro, F. (2005b). Applications of electronic technology to rural gifted students who are blind or visually impaired. Information Technology and Disabilities, 11, 1-6.

Belcastro, F. (2005a). Electronic technology: Hope for rural gifted students who have motor impairment of the hands. Journal of Developmental and Physical Disabilities, 17(3), 237-247.

Bingue-Romano, A., & Gold, M. (2005). Nuts and Bolts of assistive technology: What every educator must know. TheEdge 1(2), 1-2.

Burgstahler, S. (1999). Working together: People with disabilities and computer technology. Usability Interface, 6(2), 1-2.

Cattoche, R. (1986). Computers for the disabled. London: Franklin Watts.

Council for Exceptional Children. (2006). Legislation page. Retrieved September 3, 2006, http://www.cec.sped.org/AM/Template.cfm?Section=Search&Template=/search/searchdisplay.cfm

Chiang, M., Cole, R., Gupta, S., Kaiser, G., & Starren, J. (2005). Computer and World Wide Web accessibility by visually disabled patients: problems and solutions. Survey of Ophthalmology, 50(4), 394-405.

Curran, K., Crawford, I., & O'Hara, L. (2004). Catering for the disabled surfer: A case study in

web site navigation for disabled students. Technology and Disability, 16(1), 41-47.

Deming, M., & Valeri-Gold, M. (1987). Computers and the handicapped: A primer. Atlanta, GA: Annual meeting of the Conference on College Composition and Communication. (ERIC Document Reproduction Service No. ED 295 408)

Dolter, F. (1996). Computers for the deaf and hearing impaired. In J. Klaus, E. Auff, W. Kremser, & L. Wolfgang (Eds.), Interdisciplinary aspects on computers helping people with special needs (pp. 205-210. Wien/Munchen: Oldenbourg.

Dunn, J. (1997). Special physical education: Adapted, individualized, developmental (7th ed.) Madison, WI: Brown & Benchmark.

EnableMart. (2006). EnableMart products page. Retrieved September 3, 2006, http://www.enablemart.com/productGroupDetail.aspx?store=10&dept=20&group=46.

Fossey, M., Fichten, C., Barile, M., & Asuncion, J. (2001). Computer technologies for postsecondary students with disabilities. Dawson College: Montreal, Canada. (ERIC Document Reproduction Service No. 457 605)

Freedom Scientific. (2006a). Freedom Scientific home page. Retrieved September 3, 2006, http://www.freedomscientific.com/fs_products/software_open.asp

Freedom Scientific. (2006b). Freedom Scientific home page. Retrieved September 3, 2006, http://www.freedomscientific.com/fs_products/software_magic.asp

Freedom Scientific. (2006c). Freedom scientific home page. Retrieved September 3, 2006, http://freedomscientific.com/fs_products/JAWS_HQ.asp

Grush, M. (2001). Editor's note. Syllabus, 14(8), 4.

Hearmore. (2006). Hearmore product details. Retrieved September 3, 2006, http://www.hearmore.com/store/prodList.asp?idstore=2

Knapczyk, D., Rodes, R., & Chung, H. (1998). Collaborative learning program addresses demand for special education teachers. T H E Journal, 26(4), 57-60.

Lazzaro, J. (1993). Computers for the disabled. Byte, 17(7), 59, 61-62, 64.

Madentec (2006). Telepathic 2000 page. Retrieved September 3, 2006, www.madentec.com/products/comaccess/telepathic/telepathic.html

National Science Foundation. (2001a). Animated 3-D boosts deaf education: "Andy" the avatar interprets by signing. Retrieved September 3, 2006, http://www.sciencedaily.com/releases/2001/03/010307071110.htm

National Science Foundation. (2001b). "Baldi" the virtual tutor helps hearing-impaired children to learn speech. Retrieved September 3, 2006, http://www.sciencedaily.com/releases/2001/03/010307070929.htm

Nuance. (2006a). Nuance products page. Retrieved September 3, 2006, http://www.nuance.com/naturallyspeaking

Nuance. (2006b). Nuance products page. Retrieved September 3, 2006, http://www.nuance.com/viavoice/advanced

Origin Instruments Corporation. (2006). Origin Home page. Retrieved September 3, 2006, http://www.orin.com/access/headmouse/index.htm

Peissner, M., Heidmann, F., & Ziegler, J.(2001). Simulating recognition errors in speech user interface prototyping. In M. J. Smith, G. Salvendy, D. Harris, and R. J. Koubek (Eds), Usability evaluation and interface design (pp. 233-237). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Ratanasit, D., & Moore, M. (2005). Representing graphical user interfaces with sound: A review of approaches. Journal of Visual Impairment and Blindness, 99(2). 69-84.

Sreenivasan, S. (1996, December 2). Blind users add access on the Web. The New York Times, p. C7.

Sussman, V. (1994, September 12). Opening doors to an inaccessible world. U. S. News & World Report, p. 85.

Technology Round-Up. (2002). Adaptive technology comes of age. Syllabus, 16(2), 48-49.

Tosczak, M. (2002). A new way to read, not see, maps. Retrieved September 3, 2006, http://www.wired.com/news/technology/0,1282,54916,00.html .