



DO-IT

Working Together: People with Disabilities and Computer Technology

Providing access to technology
By Sheryl Burgstahler, Ph.D.

People with disabilities meet barriers of all types. However, technology is helping to lower many of these barriers. By using computing technology for tasks such as reading and writing documents, communicating with others, and searching for information on the Internet, students and employees with disabilities are capable of handling a wider range of activities independently. Still, people with disabilities face a variety of barriers to computer use. These barriers can be grouped into three functional categories: barriers to providing computer input, interpreting output, and reading supporting documentation. Hardware and software tools (known as adaptive or assistive technologies) have been developed to provide functional alternatives to these standard operations. Specific products, and approaches to using them, are described below.

Mobility Impairments

Some wheelchairs may not fit under standard height computer tables and some computer users do not have enough use of their hands and arms to operate a standard keyboard or mouse.

Input

Equipment which provides flexibility in the positioning of monitors, keyboards, documentation, and tabletops is useful for many individuals with disabilities. Plugging all computer components into power outlet strips with accessible on and off switches makes it possible for some individuals to turn equipment on and off independently.

Some technology assists individuals with little or no use of their hands in using a standard keyboard. Individuals who have use of one finger, or have access to a mouth- or head-stick or some other pointing device, can control the computer by pressing keys with the pointing device. Software utilities can create "sticky keys" that electronically latch the SHIFT, CONTROL, and other keys to allow sequential keystrokes to input commands

that normally require two or more keys to be pressed simultaneously. The key repeat function can be disabled for those who cannot release a key quickly enough to avoid multiple selections. Keyboard guards (solid templates with holes over each key to assist precise selection) can be used by those with limited fine motor control.

Sometimes repositioning the keyboard and monitor can enhance accessibility. For example, mounting keyboards perpendicular to tables or wheelchair trays at head-height can assist individuals with limited mobility who use pointing devices to press keys. Other simple hardware modifications can assist individuals with mobility impairments. For instance, disk guides can assist with inserting and removing diskettes; a dedicated hard disk or computer network access can eliminate or reduce the necessity to do so.

For individuals who need to operate the computer with one hand, left- and right-handed keyboards are available. They provide more efficient key arrangements than standard keyboards designed for two-handed users.

Some hardware modifications completely replace the keyboard or mouse for individuals who cannot operate these standard devices. Expanded keyboards (larger keys spaced far apart) can replace standard keyboards for those with limited fine motor control. Mini-keyboards provide access to those who have fine motor control but lack a range of motion great enough to use a standard keyboard. Track balls and specialized input devices can replace a mouse.

For those with more severe mobility impairments keyboard emulation is available, including scanning and Morse code input. In each case, special switches make use of at least one muscle over which the individual has voluntary control (e.g., head, finger, knee, mouth). In scanning input, lights or cursors scan letters and symbols



displayed on computer screens or external devices. To make selections, individuals use switches activated by movement of the head, finger, foot, breath, etc. Hundreds of switches tailor input devices to individual needs. In Morse code input, users input Morse code by activating switches (e.g., a sip-and-puff switch registers dot with a sip and dash with a puff). Special adaptive hardware and software translate Morse code into a form that computers understand so that standard software can be used.

Speech input provides another option for individuals with disabilities. Speech recognition systems allow users to control computers by speaking words and letters. A particular system is “trained” to recognize specific voices.

Special software can further aid those with mobility impairments. Abbreviation expansion (macro) and word prediction software can reduce input demands for commonly used text and keyboard commands. For example, word prediction software anticipates entire words after several keystrokes and increases input speed.

Output

Screen output does not present a challenge, but individuals with mobility impairments who have difficulty obtaining output from printers may need assistance from others.

Documentation

On-screen help provides efficient access to user guides for individuals who are unable to turn pages in books.

Blindness

Individuals who are blind cannot access visual material presented on the computer screen or in printed materials.

Input

Most individuals who are blind use standard keyboards, however, Braille input devices are available. Braille key labels can assist with keyboard use.

Output

Speech output systems can be used to read screen text to computer users who are blind. Special software programs (called screen readers) “read” computer screens and speech synthesizers “speak” the text. The availability of earphones for individuals using speech output systems can reduce the distractions for others nearby.

Refreshable Braille displays allow line-by-line translation of screen text into Braille on a display area where vertical pins move into Braille configurations as screen text is scanned. Braille displays can be read quickly by those with advanced Braille skills, are good for detailed editing (e.g., programming and final editing of papers), and do not disrupt others in work areas because they are quiet. Braille printers provide “hard copy” output for users who are blind.

Documentation

Scanners with optical character recognition can read printed material and store it electronically on computers, where it can be read using speech synthesis or printed using Braille translation software and Braille printers. Such systems provide independent access to journals, syllabi, and homework assignments for students who are blind. Electronic versions of documentation can support computer users who are blind if it is delivered in an accessible format.

Low Vision

For some people with visual impairments the standard size of letters on the screen or printed in documents are too small for them to read. Some people cannot distinguish one color from another.

Input

Most individuals who have visual impairments can use standard keyboards, but large print keyboard labels are sometimes useful.

Output

Special equipment for individuals who are visually impaired can modify display or printer output. Computer-generated symbols, both text and graphics, can be enlarged on the monitor



or printer, thereby allowing individuals with low vision to use standard word processing, spreadsheet, electronic mail, and other software applications. For individuals with some visual impairments, the ability to adjust the color of the monitor or change the foreground and background colors is also of value. For example, special software can reverse the screen from black on white to white on black for people who are light sensitive. Anti-glare screens can make screens easier to read. Voice output systems are also used by people with low vision.

Documentation

Scanners with optical character recognition can read printed material and store it electronically on computers, where it can be read using speech synthesis or printed in large print.

Hearing or Speech Impairments

Speech and hearing disorders alone do not generally interfere with computer use. However, advanced speech synthesizers are close enough to human quality to act as substitute voices and thus provide a compensatory tool for students who cannot communicate verbally. Students with portable systems can participate in class discussions once adapted computers provide them with intelligible speaking voices. Word processing and educational software may also help students who are hearing impaired develop writing skills.

Input

Students with hearing or speech impairments typically use a standard keyboard and mouse.

Output

Alternatives to audio output can assist the computer user who is hearing impaired. For example, if the sound volume is turned to zero, a computer may flash the menu bar when audio output is normally used.

Documentation

Individuals with hearing or speech impairments typically do not have difficulty using standard written or on-screen documentation.

Specific Learning Disabilities

Educational software where the computer provides multi-sensory experiences, interaction, positive reinforcement, individualized instruction, and repetition can be useful in skill building. Some students with learning disabilities who have difficulty processing written information can also benefit from completing writing assignments, tutorial lessons, and drill-and-practice work with the aid of computers. For example, a standard word processor can be a valuable tool for individuals with dysgraphia, an inability to produce handwriting reliably.

Input

Quiet work areas and ear protectors may make computer input easier for individuals with learning disabilities who are hyper-sensitive to background noise.

Software that aids in efficient and accurate input can also assist. Some people can compensate for high rates of input errors by using spell checkers, thesauruses, and grammar checkers. In addition, word prediction programs (software that predicts whole words from fragments) have been used successfully by students with learning disabilities. Similarly, macro software which expands abbreviations can reduce the necessity to memorize keyboard commands and can ease the entry of commonly used text.

Output

Some individuals with learning disabilities find adaptive devices designed for those with visual impairments useful. In particular, large-print displays, alternative colors on the computer screen, and voice output can compensate for some reading problems. People who have difficulty interpreting visual material can improve comprehension and the ability to identify and correct errors when words are spoken or printed in large fonts.

Documentation

Some individuals with learning disabilities find it difficult to read. Computer documentation provided in electronic forms can be enlarged



on the screen and/or read aloud with speech synthesis systems to make it accessible to those with reading difficulties.

Next Steps

Continue your exploration of computer technology for people with disabilities by:

- Buying the directory and attending the conference of *Closing the Gap*. To request information, write to P.O. Box 68, Henderson, MN 56044 or call 507-248-3294. Visit their website at www.closingthegap.com/.
- Contacting technology assistance centers in your state (www.resna.org/taproject/at/statecontacts.html).
- Joining electronic discussion lists and accessing resources on the Internet. A good place to start is DO-IT's *Technology and Universal Design* website at www.uw.edu/doit/Resources/technology.html.

Video

A 14-minute video, *Working Together: People with Disabilities and Computer Technology* may be freely viewed online at www.uw.edu/doit/Video/wt_dis.html or purchased in DVD format. Permission is granted to reproduce DO-IT videos for educational, noncommercial purposes as long as the source is acknowledged.

About DO-IT

DO-IT (Disabilities, Opportunities, Internetworking, and Technology) serves to increase the successful participation of individuals with disabilities in challenging academic programs and careers, such as those in science, engineering, mathematics, and technology. Primary funding for DO-IT is provided by the National Science Foundation, the State of Washington, and the U.S. Department of Education.

For further information, to be placed on the DO-IT mailing list, request materials in an alternate format, or to make comments or suggestions about DO-IT publications or web pages, contact:

DO-IT
University of Washington
Box 354842
Seattle, WA 98195-4842
doit@uw.edu
www.uw.edu/doit/
206-685-DOIT (3648) (voice / TTY)
888-972-DOIT (3648) (toll free voice / TTY)
509-328-9331 (voice / TTY) Spokane
206-221-4171 (fax)
Founder and Director: Sheryl Burgstahler, Ph.D.

Acknowledgment

Content of this publication was developed from the 1992 Ph.D. Dissertation of Sheryl Burgstahler titled *Computing Services for Disabled Students in Institutions of Higher Education*, University of Washington.

Copyright © 2012, 2010, 2008, 2006, 2002, 2001, 1998, 1994, Sheryl Burgstahler. Permission is granted to copy these materials for noncommercial purposes provided the source is acknowledged.

Grants and gifts fund DO-IT publications, videos, and programs to support the academic and career success of people with disabilities. Contribute today by sending a check to DO-IT, Box 354842, University of Washington, Seattle, WA 98195-4842.

Your gift is tax deductible as specified in IRS regulations. Pursuant to RCW 19.09, the University of Washington is registered as a charitable organization with the Secretary of State, State of Washington. For more information, call the Office of the Secretary of State, 800-322-4483.



University of Washington
College of Engineering
UW Information Technology
College of Education