

DOCUMENT RESUME

ED 401 686

EC 305 177

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 TITLE Assistive Technology: Meeting the Needs of Adults with Learning Disabilities.
 INSTITUTION Academy for Educational Development, Inc., Washington, D.C.; National Adult Literacy and Learning Disabilities Center, Washington, DC.
 SPONS AGENCY National Inst. for Literacy, Washington, DC.
 PUB DATE 96
 CONTRACT X257B30002
 NOTE 13p.
 PUB TYPE Guides - Non-Classroom Use (055) -- Reference Materials - Directories/Catalogs (132)

EDRS PRICE MF01/PC01 Plus Postage.
 DESCRIPTORS Adults; *Assistive Devices (for Disabled); *Communication Aids (for Disabled); *Computer Oriented Programs; Input Output Devices; *Learning Disabilities; Listening Skills; Mathematics; Memory; Organization; Reading; Self Management; Tape Recordings; Technological Advancement; Time Management; Visual Perception; Written Language

ABSTRACT

This monograph briefly describes a sampling of tools and technologies that can be used by adults with learning disabilities to improve their functional capabilities in employment, educational, or personal settings. Stressed is the importance of evaluating each technology in terms of the individual's unique profile, the function to be performed, and the particular context in which the technology will be applied. The assistive technologies are grouped according to the following functional areas: (1) organizational skills, memory, managing personal information, time management, and staying on task, through use of such devices as beepers/buzzers, tape recorders, and index cards; (2) auditory/listening management through use of pressure-sensitive paper for classroom note-taking, a laptop computer for notetaking, and books on disc; (3) visual processing through use of tape recordings, large print materials, and computers with voice output capabilities; (4) math assistance through use of color coding of columns, hand-held talking calculators, and special-feature calculators; (5) reading assistance through use of optical character recognition systems with speech synthesis, books on tape, and online services; and (6) written language assistance through use of spell checkers, grammar checking and proofreading programs, and speech-to-text programs. Also briefly covered is use of technology to foster independence, the multimedia approach, use of telecommunications for distance learning, and sources of various services and resources. (DB)

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National Adult Literacy and Learning Disabilities Center
A Program of the National Institute for Literacy

ED 401 686

ASSISTIVE TECHNOLOGY

Meeting the Needs of Adults with Learning Disabilities

Adrienne Riviere

Assistive technology, sometimes referred to as adaptive or access technology, includes a whole realm of high and low technology devices designed to increase the independence of individuals with learning disabilities by enabling them to compensate for deficits, enhance self-confidence, and participate more fully in all settings - work, school, home, and leisure. While not exclusively so, these technologies tend to be electronically sophisticated and largely computer-based. Assistive technology can enhance the quality of life for a person with a learning disability by enabling the individual to circumvent specific deficits, while capitalizing on given strengths.

“Assistive technology” is defined by the Technology-Related Assistance Act of 1988 (Tech Act), P.L.100-407, and the Individuals with Disabilities Act of 1990, (IDEA), P.L.101-476, as “any item, piece of equipment, or product system, whether acquired commercially off-the-shelf, modified, or customized, that is used to increase, maintain or improve the functional capabilities of individuals with disabilities.” For the purpose of this discussion, the definition of assistive technology is narrowed to define any technology or product that offers an adult with a learning disability compensatory techniques. Equally important in the process of identifying and selecting appropriate assistive technology is the element of “assistive technology service,” defined in the above-referenced legislation as “any service that directly assists an individual with a [learning] disability in the selection, acquisition, or use of an assistive technology device.”

Responding to the times, technology has made considerable advances in helping individuals with learning disabilities become productive and independent participants in work, classroom, and leisure settings. Recent laws mandating civil rights for those with disabilities can be interpreted to imply that the implementation of technology is a significant opportunity for the provision of equal access.

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The forces of “equal access,” “non-discrimination,” and “reasonable accommodations” have created an environment which encourages the use of technology designed to help those with learning disabilities function on a more equal basis with their non-disabled peers.

The Americans with Disabilities Act of 1990 (ADA), P.L. 101-336, prohibits discrimination against all individuals with disabilities, requiring both the public and private sector to provide “reasonable accommodations”. The application of this mandate is legally interpreted to apply to the acquisition and modification of equipment and devices, such as adaptive hardware and software for computers. The Vocational Rehabilitation Act of 1973, P.L. 93-112, requires that electronic office equipment purchased through federal procurement meet disability access guidelines. The Tech Act’s 1994 amendments provide funding to help establish programs to promote the provision of technology-related assistance. The National Literacy Act of 1991, P.L. 102-73, encourages the use of technology in literacy programs.

Making Choices:

Appropriate assistive technology for adults with learning disabilities can range from common “low tech” tools, such as tape-recorders, to sophisticated “high tech” electronics, such as voice input/output equipment. Equipment designed for individuals with other disabilities, e.g., personal FM systems originally developed for the deaf, may be an appropriate selection. The key is to determine the functional limitation of the disability, i.e., how it hinders the individual’s performance within a defined setting, and then identify an appropriate accommodation.

Before the employer or teacher can determine the kinds of assistive technology that will best suit the needs of the employee/student with learning disabilities, the functional limitations that the individual displays need to be defined. First, what job duties or coursework obligations is the individual expected to perform? In what specific areas is the individual having difficulties? What is it specifically that the individual cannot do or does not do according to the employer’s/instructor’s expectations? The answers to these questions will determine the kinds of assistive devices that can be put in place to enable the person with learning disabilities to perform the essential functions of the job or meet the requirements of a course.

What follows is a sampling of tools and technologies that have been designed or adapted to help “improve functional capabilities.” Because every individual with learning disabilities has a unique profile of strengths, weaknesses, interests, and experiences, not all the technologies discussed will be appropriate for all adults who have learning disabilities. Again, before choices are made, it is important that specific technologies be considered relative to (1) the individual’s unique profile, (2) the function to be performed, and (3) the particular context in which the technology will be applied. In reviewing the following categories of assistive technologies, it is important for the teacher or employer to keep in mind that the technologies suggested to help an individual compensate for a learning disability in one area might be used creatively, alone or in conjunction with other technologies, to meet an individual’s needs in another area of disability. Experimentation and a creative approach to each individual’s unique needs are called for.

Assistive Technologies

Organizational Skills, Memory, Managing Personal Information, Time Management, Staying On Task

Devices and approaches that help individuals with learning disabilities get organized, stay organized and on-track, and make work and learning assignments more manageable include:

- ◆ **highlighters;**
- ◆ **index cards;**
- ◆ **color-coding;**
- ◆ **graph paper;**
- ◆ **beepers/buzzers;**
- ◆ **digital clocks, digital watches, talking watches;**
- ◆ **headphones or earplugs** to shut out distractions;
- ◆ **tape-recorders, mini pocket recorders** that allow the user to verbally store and retrieve telephone numbers, appointments, and individual notes ("to do" lists);
- ◆ **voice-activated day planners** which operate with voice-input technology; and
- ◆ **software programs, such as personal data managers and free-form data bases.**

Typical features of **personal data managers** include monthly calendars, daily schedulers and planners, clocks with alarms, memo files, "to do lists," address books, telephone directories, bank books, and check registers. The user can store, organize, and retrieve vast amounts of personal information. **Free-form data bases** enable the user to create his or her own notes of any length, on any subject. Rather than notes on paper, these electronically-stored notes can be retrieved by typing in any piece of information contained in the note. The ability to retrieve information by only remembering a portion of information contained within the note can be beneficial for individuals with memory and organizational difficulties. Through a simple cursor movement that highlights each note, the user can browse through all the notes within the data base until the one being sought is found. Database systems enable the user to easily store, sort, and retrieve data.

Also, **organizational software tools** are available to writers who need help with organization and benefit from visually-oriented systems of organizing. Pre-writing software programs help the writer get started with a writing assignment by organizing random ideas (See Writing Section).

Auditory/Listening

Individuals with learning disabilities may have difficulty auditorily processing information. For example, they may have difficulty following more than one direction at a time, misunderstand what is being said, have problems discriminating between similar words and various letter sounds, and

need information repeated. Following is a list of assistive technologies that can help make auditory tasks less difficult.

- ◆ **Pressure-sensitive paper** is carbonless paper that allows the user to tear off copies of classroom lecture notes to share with a fellow student whose note-taking abilities may be weak.
- ◆ **Individual FM amplification devices** are designed to isolate and amplify a single sound source, such as the voice of an instructor, thus reducing the effects of distractive noise. The system includes a teacher-worn transmitter and a student-worn receiver; it enhances auditory discrimination and auditory attention by improving listening conditions and attention levels.
- ◆ **Laptop computer** can be used for notetaking.
- ◆ **Electronic notebook** is a smaller compact version of a personal computer and can be used anywhere, anytime to take notes, produce information on disc, etc.
- ◆ **Small word processor** can be used for notetaking and later plugged into a home computer for simple transfer of material.
- ◆ **Variable speech control tape-recorder (VSC)** can help the individual who has difficulty processing speech; it enables the user to play back audiotaped material at a slower or faster rate than it was initially recorded without the loss of intelligibility/voice quality. Increasing the playback rate is helpful when reviewing lecture notes, as well as for practice in strengthening listening skills; the option to decrease the rate is helpful in re-listening to taped textbooks, etc.
- ◆ **Basic tape-recorders/audio-cassette recorders** are a helpful means of recording classnotes and, in the workplace, instructions given by one's superior; also, tape-recorders are required to play back **taped books**. Listening to a taped textbook while following along the same material in printed form is an effective multisensory approach to learning.
- ◆ **Books on disc**, loaded onto a **computer** with **voice output** which is produced through a **voice synthesizer** (see Reading Section), provide multisensory input (auditory strengthened with visual input) for the user with auditory processing problems.
- ◆ **CART (Computer-Aided Realtime Translation)** is used in group meetings, such as workshops, classroom settings, on-the-job training; a "reporter" types into a machine that is connected to a computer, and the computer simultaneously displays the information on a computer monitor or projects it onto a large wall screen.

As referenced above, **multimedia/multisensory approaches** that combine audio and visual are particularly effective when working with individuals with learning disabilities, e.g., reading machines that combine visual and voice output/voice synthesizer, video tapes, video tapes that include closed-captioning, taped textbooks used in conjunction with printed textbooks, and talking keyboards.

Visual Processing

Individuals with learning disabilities may have difficulty visually processing information. For example, they may perceive words incorrectly. They may frequently look up when reading and lose their place. They may have trouble recognizing written mistakes. Assistive technologies that can help make visual tasks less complicated and less strenuous include:

- ◆ **tape recorded** lectures or work presentations;
- ◆ **software program options** that enable the user to **change background** and **text colors** or to **change font size**;
- ◆ **adjustable task lighting**;
- ◆ **large print written materials**;
- ◆ **large print transparencies** for prolonged viewing of computer screens that can result in eye strain and ultimate decrease in productivity;
- ◆ **magnification hardware** (special monitor screen) or **software** (program applications) that enlarge and enhance the text and graphics displayed; as well as enlarging text, the user can alter colors, font, or print size;
- ◆ **enlarged cursor control panels** that allow the user to choose among a number of big cursors, as well as the option of a 'lefty' cursor
- ◆ **on-screen keyboards** and **keyboards that speak**, that provide **voice output**;
- ◆ **talking, large print browsers** that allow users with visual processing problems to search the Internet;
- ◆ **books on disc**, once on the computer screen, that can be enlarged and read back to the user with **voice output**;
- ◆ material that is scanned (see **scanner** under Reading Section), enlarged, and read back to user with **voice output**; and
- ◆ to capitalize on visual learning strengths, material presented through **videotape** (using a **VCR**) or **videodisc** (using a **computer**).

Math

Deficits in math can be compensated by using any of the following:

- ◆ **color coding** for maintaining columns
- ◆ basic **hand-held calculators** that can help a learner who has problems writing numbers in correct order;
- ◆ **hand-held talking calculators** that vocalize data and resulting calculations through speech synthesis and, thus, provide multisensory feedback (visual and audio);

- ◆ **special-feature calculators** that enable the user to select speech options to speak and simultaneously display numbers, functions, entire equations, and results;
- ◆ **on-screen computer calculator programs** with speech synthesis;
- ◆ **large screen displays** for calculators and adding machines; and
- ◆ **big number buttons and large keypads.**

Finally, more and more, **computer-assisted instruction (CAI)** math courses are being developed. These are particularly helpful to the user with learning disabilities if the learning is reinforced with **voice output**.

Reading

For reading and writing activities, individuals with learning disabilities will likely find **voice output/text-to-speech systems** effective compensatory tools. One such system, an **optical character recognition (OCR) system**, scans and converts written text into computer documents that can be read by a **speech synthesis/screen review system** (referenced under Written Language Section). **Books on tape** are available on loan to students with learning disabilities. Finally, help in researching and information-gathering can be obtained from **books on computer disc, CD-ROM discs**, and entire texts that can be downloaded from **on-line services**.

- ◆ With the use of an **OCR system with speech synthesis**, an individual with poor reading skills, yet strong receptive oral language abilities, is able to “read” and, thus, comprehend with greater ease. OCR systems provide a means for directly inputting printed material into a computer and displaying it on the computer screen. The input is accomplished through a full-page scanner that scans an entire page at once or a hand-held scanner that the user moves across or down the page of material. Another option available is the use of a hand-held “wand” that is used to scan single words or phrases at a time. When used with **voice output**, the scanned material can be read back, thus creating what can be thought of as a “**reading machine**.”
- ◆ Basic **tape-recorders** are helpful for recording directives, messages, and materials and can be used as devices for learning through listening (reading skills can be strengthened if the learner follows along the material in the printed textbook while listening to the same taped version--multisensory). Tape-recorders are necessary playback equipment for listening to **taped books**.
- ◆ **Books on tape** are provided by **Recordings for the Blind and Dyslexic, Inc. (RFB&D)** and the **National Library Service for the Blind and Physically Handicapped (NLS)**, Library of Congress. Taped textbooks are available from **RFB&D**, while taped leisure-reading books and magazines can be obtained from **NLS**. Taped books from these

sources are available on loan and must be played on specially-designed tape-recorders that also can be borrowed.

- ◆ RFB&D, as well, sells **books on computer disc** (E-Text) that are loaded onto the computer and can, with a **voice synthesizer**, be read to the user. These kinds of assistive technologies help the reader with poor reading skills learn through listening.

RFB&D specializes in producing academic and professional books on tape and requires a one-time registration fee, accompanied by formal documentation of a learning disability. The NLS collection consists of popular novels, classical literature, poetry, biographies, and magazines that can be borrowed through a registration process. RFB&D's computer discs consist largely of reference materials and can be used on an individual's personal computer with most adaptive equipment, such as **screen readers** and **speech synthesizers**.

- ◆ For those whose reading deficits make conducting research a seemingly insurmountable challenge, use of **CD-ROM discs** (a means of providing large amounts of information on computer, e.g., a CD-ROM encyclopedia) and **on-line services** (sources of hundreds of electronic books and information texts) provide numerous resources. **Speech synthesis**, providing the user with auditory input, adds an additional support to the user of a CD-ROM resource (See Written Language Section).

Written Language

Word processing is a computer-based writing system that enables the user to write without having to be overly concerned about making errors. This freedom can release persons with written language deficits from concern about the mechanics of writing, allowing them to redirect their efforts toward the meaning of their writing. Using the **computer** and various features of **assistive software** for writing makes the writing process easier, allows more writing to take place, and ultimately, boosts the user's self esteem.

A growing number of assistive computer software programs that go beyond basic word processing are available to the user to support the writing process. Many of these software features are available with **voice output**.

- ◆ **Spell checkers, dictionaries, and thesauruses** are available as features of word-processing programs, enabling the user to verify or correct spellings and access word definitions and synonyms.
- ◆ **Grammar check and proofreading software programs** scan documents and alert the user to probable errors in grammar, word usage, structure, spelling, style, punctuation and capitalization.
- ◆ **Template-producing software** provides forms, applications, etc., making yet another writing task that much easier.

- ◆ **Brainstorming and outlining programs** enable the user to approach writing tasks by “dumping” information in an unstructured manner; this information can subsequently be placed into appropriate categories and ordered more easily. Related pre-writing programs, **webbing** or **concept-mapping applications**, allow the user to diagram ideas and make connections between ideas. The idea “map” can be transformed into an outline, the outline into a draft and, finally, with **revising-tools applications**, the draft becomes a finished document. These approaches can be particularly helpful to those individuals who have difficulty getting started, organizing, categorizing, sequencing, and polishing writing assignments. They are also useful in the workplace by providing fast, easy, and intuitive ways to create organization charts, flowcharts, and other diagrams.
- ◆ **Word prediction or word completion programs** predict words on the basis of the first few letters typed, providing an excellent support tool to poor spellers.
- ◆ **Abbreviation expansion programs** allow users to create their own abbreviations for frequently-used words, phrases, or standard pieces of text, cutting down the number of keystrokes needed to complete sentences. Some programs offer a combination of abbreviation expansion with the word-completion feature. A number of these software applications can be used with speech synthesis.
- ◆ **Other software writing programs** can take the user, guided by easy-to-use on-screen prompts and reinforced by speech synthesis, through the writing process from beginning to end. Once the kind of writing has been identified (e.g., journal, personal story, one-act play, research paper, newspaper article, review, letter), customized prompts take the user through the different stages of writing. Some programs enable the user to include graphics. Other programs take the user through the process of creating multimedia projects.

For individuals with written-language problems related to lack of organization and difficulty staying focused, the opportunity to conduct research while sitting at the computer is available through the use of **encyclopedias on computer** via a **CD-ROM disc**, or through a link with an **on-line service**. Much information is available to the computer user who has connection to the **Internet** and the **World Wide Web**. The user is thus able to access reference materials without shutting down the word-processing program. Depending on the particular product, one can consider incorporating the use of speech synthesis and, as such, have the information read aloud. Stand-alone computers can be connected to larger systems, such as the Internet, through the phone lines via a hardware device called a **modem**.

Laptop computers, tape-recorders, and pressure-sensitive paper (see Auditory/Listening Section) can be used for notetaking during lectures to support the individual with written language problems.

As well as using pre-writing and writing software programs, an individual with strong auditory skills might try dictating ideas onto a **tape** and listening as a pre-writing technique.

Besides computer-related tools, there are **hand-held talking electronic devices**: spell checkers, dictionaries, and thesauruses are available with speech synthesizers that provide voice output.

As stated earlier (Reading Section), **screen review systems with speech synthesis and highlighting** are assistive technology tools that are particularly helpful to individuals with reading and written-language problems. This multisensory approach can be achieved for the individual with written-language deficits through both of the following technologies:

- ◆ **Text-to-speech/voice output systems**, also known as **speech synthesis, screen review systems and talking word processors**, highlight and read what has been keyed into the computer. As the user types in data on the computer, a voice synthesizer “speaks” what is being typed at the same time the print is highlighted on the computer screen, or the entered text can be “read back” at a later time. In addition, materials produced by others, e.g., instructor and employer materials, books on disc, and CD-Rom discs, can be reviewed and read aloud to the user.
- ◆ **Speech-to-text or voice input**, also known as **speech recognition**, on the other hand, is technology that allows the user to operate the computer by speech. The user speaks into a headphone-mounted microphone; the system then converts the spoken words to electronic text displayed on the computer screen. This system is particularly useful for those adults whose oral language exceeds their written language abilities. These technologies provide the kinds of support that capitalize on strengths, while working around or circumventing the individual’s written-language deficits.

Beyond the Basics

Greater Independence

For the individual with learning disabilities who has difficulty with **directionality**, i.e., deciphering maps, legends, and street signs, software programs are available that enable the user to explore, on-screen, a neighborhood, city, or larger geographical area. Once the user decides on a route, the directions can be printed out or entered into a tape-recorder to be taken en route.

Software programs have been developed to encourage **creative thinking, problem solving, and analytical thinking**. Through the opportunity to manipulate shapes, objects, and blocks to create pictures, animations, and sequential effects, the user becomes acquainted with spatial relations and figure-ground discrimination. Further, using a variety of modeling tools, other software introduces the concepts of frequency and relative frequency to build **an understanding of probability**.

In addition, the adult with learning disabilities who wants to work on **social skills** can do so through a software program that takes the user on a guided tour of taking turns to talk.

These are but a few of the opportunities open to individuals with learning disabilities to become more independent, self-confident participants in different kinds of surroundings.

Multimedia

More and more assistive technology is being designed around a **multimedia approach**. Material presented through some mix (text, graphic arts, photographic images, audio and visual) plays to

a variety of individual learning strengths while accommodating a variety of learning disabilities. Many of the assistive technologies thus far referenced are examples of the use of multimedia, or become so when integrated with another technology. A few more include **interactive videos** that use the video source, a videodisc player connected to the user's computer, to augment computer text, and **interactive videodiscs** that store, on laser disc, both audio and visual information for instructional programs that can be played on a computer. When multimedia information is linked to and accessed by a computer, it is called **hypermedia**.

Telecommunications/Distance Learning

Finally, telecommunications technologies offer all learners the opportunity for **distance learning**. Distance learning is defined as instruction received by learners who are in a different physical location than the instructor. This approach to learning includes courses offered by educational institutions, businesses, or other entities. Some of these courses can be accessed by the student at home. Others may be offered at a company's headquarters, factory meeting room, public library, or other community site. Such non-traditional settings can provide students with the flexibility they need to be involved in the learning process and, thus, a valuable form of accommodation.

Courses can be taken:

- ◆ via the **computer**;
- ◆ through university consortium programs that include **cable television**;
- ◆ via **telephone conference calling** (interactive telephone), whereby the instructor conducts class from a telephone--the telephone lines of the students and teachers are linked through a bridging device;
- ◆ through **interactive television broadcasting** received at a learning site furnished with equipment that allows students at that site to see and speak with the instructor and even learners in other sites;
- ◆ through courses organized around a core of **videotaped presentations** (these videocassettes can be closed-captioned as well);
- ◆ through **correspondence courses**, beneficial to students with learning disabilities who benefit from working in a non-threatening environment at their own pace or have auditory processing problems and, thus, need to rely on this essentially print-based method of instruction; and
- ◆ through **combinations** of the above technologies.

Students with learning disabilities can tape these courses and review them later at their own pace and as many times as needed to acquire the knowledge. Accompanying printed coursework materials can be obtained in audiocassette for reinforcement.

Closed captioning, now a standard feature in new television sets, allows learners to see and hear the words on broadcast or cable television. **Closed-circuit** television is an effective training tool used in many work settings, a tool that can be adapted to the special needs of those with learning disabilities.

Given the finding that well over half of the community colleges responding to a recent survey conducted by the American Association of Community and Junior Colleges report having distance learning programs currently in place, the potential is great for developing special materials and programs for this medium. Literacy programs have led the way. Hopefully, learning disabilities programs will follow suit.

Services and Resources

Again, before making accommodation choices it is important for the employer or teacher to be specific about the functional limitations of the learning disability in question and then to be specific about what it is that is expected on the job or in the learning situation that will be better accomplished with the help of some assistive technology tool or device. As well, the strengths of the individual with learning disabilities must be weighed. It is at this point that one is prepared to seek assistive technology support services for help in (1) identifying the kinds of assistive technologies that will help compensate, (2) learning how to use various technologies, and (3) preparing all participants within the given environment to be comfortable with adaptations set in place.

The provision of assistive technology services is an essential element in the overall process of helping individuals with learning disabilities identify appropriate assistive technology adaptations and accommodations. Resources available to assist consumers include publications, professional organizations, national and state technology centers, and private vendors. For help identifying specific products, vendors, price ranges, and hardware requirements for use with software programs, see the Tools for Life publication listed below. Following is a list of several other well-established sources of information and services:

The **Alliance for Technology Access** is a national coalition of community-based resource centers that provide guided problem-solving technical assistance for individuals with disabilities. For the nearest center, contact Alliance for Technology Access, 2175 E. Francisco Boulevard, San Rafael, CA 94901. Telephone 415-455-4575.

The **Center on Technology and Learning Disabilities (CTLD)** at The Frostig Center is a program that assesses and trains individuals for their assistive technology needs, trains professionals to use the technology, and conducts research to evaluate assistive technologies and their benefits to persons with learning disabilities. CTLD, The Frostig Center, 971 N. Altadena Drive, Pasadena, CA 91107. Telephone 818-791-1255.

Closing the Gap is a disabilities information center that produces a quarterly newsletter on disabilities technology and hosts a yearly hands-on assistive computer technology conference. Closing the Gap, Box 68, Henderson, MN 56044. Telephone 507-248-3294.

Job Accommodation Network (JAN), established in 1983 by the President's Committee on Employment of People with Disabilities, is an information and consulting service which provides accommodation solutions to educators, employers, and individuals with disabilities. JAN is staffed



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