



NASET's Educating Children with Severe Disabilities Series

Assistive Technology

Introduction

Raising a child with a disability presents families and professionals with many challenges. Today, one of the major challenges facing people who care for and about children and youth with disabilities is technology -- what to get, where to get it, how to use it, how to pay for it, how to evaluate its effectiveness, and where to put it.

Technology is receiving the attention of families, advocates, legislators, and professionals due to its potential for enhancing the lives of individuals with disabilities. From computers to communication devices to environmental controls, the world of technology offers many children and adolescents with disabilities the tools necessary to be more successful in school, at work, and at achieving independence in daily living. Indeed, opportunities not thought often years ago are now becoming available to some children with disabilities with the assistance of new technology, and rumors of emerging technology are raising new hopes.

Yet, the diversity of available technology, its ever changing nature, the lack of general sophistication regarding it, and the decisions to be made prior to purchase, prompt many and continuous questions. Presently, much information does exist on all issues related to the choice and purchase of any piece of technology; much of the information is, however, of varying degrees of readability, in many and disparate places, and often requires the skills of a super sleuth to uncover or decode.

Technology is bursting into the classroom at all levels, as a tool for professionals to develop, monitor, and provide instructions, and for students to access and engage in learning. P.L. 100- 407, The Technology-Related Assistance for Individuals with Disabilities Act of 1988 (Tech Act) was designed to enhance the availability and quality of assistive technology (AT) devices and services to all individuals and their families throughout the United States.

Computer and other technologies have expanded and enriched lives and given many children with disabilities options not imagined twenty years ago. As there is a wide array of assistive technology, so too are there many decisions, choices and options for families and professionals. Making informed decisions about technology is a challenge that many consumers will encounter in coming years. Resources are available to assist consumers such as: current periodicals; disability, parent, and professional organizations; national technology centers; and private companies. Walking the assistive technology maze can be made less complex and confusing by understanding the implications of technology in the lives of children and youth with disabilities, and by knowing where to go for help.

This section will present an overview of assistive technology devices available to individuals with disabilities. After reading this section you should understand the following:

- Assistive Technology Defined
- Assistive Technology Devices
- Assistive Technology Devices-A Historical Overview
- IDEA 1997 and Assistive Technology
- Applying Assistive Technology in Instruction
- Computer Technology
- Computer Technology and Educational Software
- Technology Applications-Case Studies
- Selecting Assistive Technology Equipment: Becoming Informed
- Integrating Technology into the Student's IEP
- State Level Support for Assistive Technology
- Factors for Success
- Funding for Assistive Technology Devices and Services in the Individuals with Disabilities Education Act (IDEA) of 1997
- Concluding Thoughts

Assistive Technology Defined

Assistive Technologies are the tools and strategies that act to liberate the use of technology for all students as well as to provide new ways to "assist" interactions and learning. They act to "augment abilities and bypass or compensate for a disability" (Lewis, 1994, cited in AT Basics, 2003).

Over the past 10 years, the percentage of students with disabilities served in schools and classes with their nondisabled peers has gradually increased and continues to grow. In fact, approximately 95.9% of students with disabilities, ages 6-11, receive their education in regular education classrooms/resource rooms (OSEP, 2002). The 1997 Reauthorization of the Individuals with Disabilities Education Act (IDEA) calls for providing access to the general education curriculum in order to improve outcomes for all students.

As we enter the twenty-first century we find that recent legislation and technology innovations are changing the ways professionals teach and children learn. Since 1990, the Individuals with Disabilities Education Act (IDEA), has mandated that "to the maximum extent appropriate, children with disabilities... are educated with children who are not disabled". Broadly defined, assistive technology includes any device or piece of equipment that increases the independence of a person with disabilities. Assistive technology for those with disabilities, of course, is not new. For instance, the wheelchair has long been an indispensable assistive device for those with impaired mobility.

The distinction between adaptive technologies employed by individuals without disabilities and assistive technologies for the individuals with disabilities blurs at times. Some of the assistive technologies designed for the individuals with disabilities have proven so ergonomically sound that they have been incorporated as standard features. One such example is the placement of the keyboard on/off switch, which was designed so that people with motor impairments would not have to reach to the back of the machine to turn the power on and off.

Assistive technology has increased enormously the ability of those with disabilities to lead independent lives. Computer-based environmental control units allow users to turn on lights and appliances and open doors from a wheelchair. Augmentative communication devices enable those who cannot speak to voice thoughts and needs using touch- or light-activated keyboards coupled to synthetic speech systems. Screen reading programs for the blind, screen magnification systems for those with low vision, and special ability switches that permit the mobility impaired to use a computer are only a few examples of the technology by which the individuals gain access to the computer screen and keyboard.

Assistive Technology Devices

Assistive technology devices can be anything from a simple tool with no moving parts (e.g., a toothbrush with a built-up handle) to a sophisticated mechanical/electronic system (e.g., a robotic arm). Simple, mechanical devices are often referred to as "low tech" devices while computer-driven or complex assistive technology may be called "high tech." However, many people in the assistive technology field have argued that this complexity-based classification is not a useful one as there is no clear division between "simple" or low tech and "complex" or "high tech" devices. Many low-tech devices can be purchased at a hardware store, selected from a catalog, or fabricated using tools and materials found in home workshops (Franklin, 1991). Examples might be note-taking cassette recorders, pencil grips, NCR paper/copy machine, simple switches, head pointers, picture boards, taped instructions, or workbooks. High-tech devices frequently incorporate some type of computer chip, such as a hand-held calculator or a "talking clock." Examples might be optical character recognition (OCR) calculators, word processors with spelling and grammar checking, word prediction, voice recognition, speech synthesizers, augmentative communication devices, alternative keyboards, or instructional software.

Assistive Technology Devices-A Historical Overview

In the late 1800s, the population of the U.S. was growing rapidly. Census information, gathered by hand, resulted in long delays and inaccuracy in the information reported about the nation's population. In fact, the 1880 census took eight years to count. Estimates at that time indicated that if the census process continued in the same manner, the 1890 census would take twelve years to complete and the 1930 census would be available in 1985.

Help arrived in the form of the 1890 Census Machine developed by John Shaw Billings and Herman Hollerith. The 1890 census took three years to complete and computerization was underway. Hollerith turned to big business to market the invention, now called the Tabulating Machine. He joined a company that eventually called itself International Business Machines (IBM). IBM joined with Harvard in 1938 to create the first electronic computer, the Mark I. The Mark I required 46,000 vacuum tubes to perform its operations.

The ENIAC computer, completed in 1947, weighed 30 tons, stood nine feet tall, and took up 1,500 square feet. In 1951 the UNIVAC computer was completed. Weighing in at a mere 3 tons and occupying only 575 square feet, UNIVAC was the first computer to handle numbers and words. Commercially produced computers continued to evolve, with more power packed into less space at a lower price.

In 1973, the first computer chip, the 8080, was manufactured by Intel. Less than a square inch in area and thin as cardboard, this chip could perform a million calculations per second (like the ENIAC) but only cost about \$4 to purchase. These chips were inexpensive because their main ingredient was silicon, which is more common than sand, and they were produced in enormous quantities (Budoff, Thormann, and Gras, 1985).

The interest in using computer technology with people with disabilities began in October 1981 with the Johns Hopkins First National Search for Applications of Personal Computing to Aid the Handicapped. In November 1980, the Applied Physics Laboratory at The Johns Hopkins University began a national search for applications of personal computing to aid the handicapped. Enthusiastic responses from professionals, amateurs, and students resulted in introductory workshops and regional fairs, and culminated in an exhibit of the top national entries at the National Academy of Sciences, an awards ceremony in Washington, D.C., and a two-day workshop on computing for the handicapped at Johns Hopkins in October 1981.

In March 1983, The Council for Exceptional Children held its First National Conference on the Use of Microcomputers in Education. This conference reflected the need for basic workshops on microcomputer use and for information on practical applications of computers in special education.

In 1983 CEC/ERIC published: *Microcomputers in Special Education* by Florence M. Tabor; The *Exceptional Parent* magazine published its first annual technology issue; and the IEEE held its first Computer Society Workshop on Computers in the Education and Employment of the Handicapped.

The year 1984 saw the first U.S. Office of Special Education Programs (OSEP) document published by COSMOS Corporation: *Microcomputer Implementation in Schools*, by Robert K. Yin and J. Lunne White. The document described and analyzed the use of microcomputers in the schools and district offices of 12 school districts. In September, 1984, Closing The Gap held its first conference on Computer Technology for the Handicapped. A 1985 OSEP publication, *Robotics, Artificial Intelligence, and Computer Simulation: Future Applications in Special Education*, by Gwendolyn B. Moore, Robert K. Yin, and Elizabeth A. Lahm, identified ways in which technologies might be used to help special education students in the future.

The vehicle for introducing technological devices for educational use was put into place in 1975 with the passage of the Education of the Handicapped Act (EHA), P.L.94-142. Increased federal interest was demonstrated with the passage of the Amendments to the Education of the Handicapped Act of 1986, P.L. 99-457. These amendments created a new Part G designed to promote the use of new technology, media, and materials in the education of students with disabilities. Discretionary grants under this new authority were targeted to:

- assess usage and promote effectiveness;
- design and adapt new technology, media, and materials;
- assist public and private sectors in development and marketing; and disseminate information

Following P.L. 99-457, the Technology-Related Assistance for Individuals with Disabilities Act of 1988, P.L. 100-407, was signed into law. The primary purpose of the act is to assist states in developing and implementing statewide programs of technology-related assistance for meeting the needs of individuals with disabilities. The program enabled individuals with disabilities to acquire assistive technology devices and services.

IDEA 1997 and Assistive Technology

The 1997 reauthorization of the Individuals with Disabilities Education Act (IDEA) emphasizes the importance of technology and the need to share cutting-edge information about advances in the field. The law requires that assistive technology devices and services be considered for all children identified as having an exceptional education need. These amendments mark a significant shift in how educators view assistive technology--which previously had been viewed almost exclusively within a rehabilitative or remediative context. Now, within the context of planning individualized education plans (IEP), technology is being considered as a viable tool for expanding access to the general education curriculum. However, there is still much work to be done to ensure that IEP teams consider the maximum benefits of technology use.

Assistive devices are not a new area of interest created by the new law. As shown above, interest in the new higher technologies began shortly after the silicon chip invention. Prior to that, low technology assistive devices were being developed and used for centuries. Consequently, definitions of what an assistive device is are numerous, and are often based on the perspective of a specific agency or disability group.

The wide variety of assistive devices, and their applications to children and youth with disabilities, is currently receiving a great deal of attention from many disability-related fields. This flurry of activity stems from the potential that new and emerging technologies hold for individuals with disabilities to lead full and independent lives.

According to *AT Basics* (2003 p.1), "school districts are required under law to provide appropriate AT to students with disabilities when it supports their acquisition of a free and appropriate public education (FAPE).

In order to support the inclusion and participation of students with disabilities in regular education classrooms, all IEP's developed for children identified as needing special education services, must indicate that AT has been considered to "to provide meaningful access to the general curriculum" (IDEA, 1997). More specifically, IDEA indicates that AT devices and services must be made available to a child with a disability if required as a part of the child's:

- Special education;
- Related services; or
- Supplementary aids and services.

There have been several clarifications from the Office of Special Education and Rehabilitative Services (OSERS) on the use of AT by students with disabilities. These include:

- AT must be provided by the school district at no cost to the family.
- AT must be determined on a case-by-case basis; it is required if needed to ensure access to free and appropriate public education (FAPE).
- If the IEP team determines that AT is needed for home use to ensure FAPE, it must be provided
- The student's IEP must reflect the nature of the AT and amount of supportive AT services required.
- A parent is accorded an extensive set of procedural safeguards, including the provision of AT to the child.

Keep in mind that AT is any item that is used to increase, maintain, or improve functional capabilities of a child with a disability. For some students with disabilities, AT may be the only way that access to the general curriculum can be ensured!

Applying Assistive Technology in Instruction

Lahm and Morrisette (1994) outlined seven areas of instruction where AT could assist students with mild disabilities. These areas include organization, note taking, writing assistance, productivity, access to reference materials, cognitive assistance, and materials modification. A number of approaches are available to assist students with mild disabilities in these areas of instruction:

1. Organization: Low-tech solutions include teaching students to organize their thoughts or work using flow charting, task analysis, webbing or networking ideas, and outlining. These strategies can be accomplished using graphic organizers to visually assist students in developing and structuring ideas. A high-tech solution might be the outline function of word processing software, which lets students, set out major ideas or topics and then add subcategories of information.

2. Note Taking: A simple approach is for the professional to provide copies of structured outlines for students to use in filling in information. A high-tech approach might include optical character recognition, which is software that can transform typewritten material into computer-readable text using a scanner.

A professional's typewritten notes can be duplicated using either NCR paper (carbonless copies) or a copy machine. A slightly more high-tech method is to use micro cassette recorders. Or, notes can be read by a voice synthesizer, allowing students with reading difficulty to review the notes much the same as reviewing a tape recording. Recorders are beneficial for students with auditory receptive strength, but they may be less useful for those needing visual input. Videotaping class sessions may be helpful for visual learners who pick up on images or body language, or for students who are unable to attend class for extended periods of time. Laptop or notebook computers can provide high-tech note taking for many students with disabilities. An inexpensive alternative to a full-function portable computer is the portable keyboard. The limitations of these keyboards are in formatting information and a screen display limited to four lines of text.

3. Writing Assistance: Word processing may be the most important application of assistive technology for students with mild disabilities. Many of these students have been identified as needing assistance in the language arts, specifically in writing.

Computers and word processing software enable students to put ideas on paper without the barriers imposed by paper and pencil. Writing barriers for students with mild disabilities include mechanics:

- spelling
- grammar and punctuation errors
- process
- generating ideas
- organizing, drafting,
- editing, and revising
- motivation
- clarity and neatness of final copy
- reading ability
- interest in writing

Grammar/spellcheckers, dictionaries, and thesaurus programs assist in the mechanics of writing. Macros, a feature that allows keystrokes to be recorded in a file that can be used over and over, also assist in mechanics. Macros can be used for spelling difficult text, for repetitive strings of words, or for formatting paragraphs and pages. Macros also save time for students who have difficulty with either the cognitive or motor (keyboarding) requirements of writing. Word prediction is assistive software that functions similarly to macros. If a student has difficulty with word recall or spelling and cannot easily use the dictionary or thesaurus feature, then word prediction software offers several choices of words that can be selected.

Teachers can use the editing capabilities of the word processor during the writing process, making electronic suggestions on the student's disk. If the computer is on a network, students can read each other's work and make comments for revision. Painter (1994) indicated that peer feedback was an effective way to assist students in generating and revising text. Computer editing also reduces or eliminates problems such as multiple erasures, torn papers, poor handwriting, and the need to constantly rewrite text that needs only minor modifications. The final copy is neat and legible.

Motivation is often increased through the desktop-publishing and multimedia capabilities of newer computers. A variety of fonts and styles are available, allowing students to customize their writing and highlight important features. Graphic images, drawings, and even video and audio can be added to the project to provide interest or highlight ideas. Multimedia often gives the student the means and the motivation to generate new and more complex ideas.

4. Productivity: Assistive productivity tools can be hardware-based, software-based, or both. Calculators, for example, can be the credit-card type or software based, which can be popped up and used during word processing. Spreadsheets, databases, and graphics software also offer productivity tools, enabling students to work on math or other subjects that may require calculating, categorizing, grouping, and predicting events. Productivity tools also can be found in small, portable devices called personal digital assistants (PDAs). Newer PDAs can be used as note taking devices via a small keyboard or graphics-based pen input. Some PDAs can translate words printed with the pen input device to computer-readable text, which can then be edited with the word processor and transmitted to a full function computer.

5. Access to Reference Materials: Many students with mild disabilities have difficulty gathering and synthesizing information for their academic work. In this arena, telecommunications and multimedia are providing new learning tools for the students.

A computer and a modem can transport students beyond their physical environment to access electronic information. This is particularly appropriate for individuals who are easily distracted when going to new and busy environments such as the library.

Telecommunications networks offer access to the information superhighway. Students can establish "CompuPals" with other student, which often motivates them to generate more text and thus gain more experience in writing.

Students can also access electronic encyclopedias, library references, and online publications. However, these experiences should be structured, because the information highway is complex and it is easy to get distracted or lost as opportunities are explored.

Multimedia-based tools are another way in which information can be made accessible to students. Multimedia's use of text, speech, graphics, pictures, audio, and video in reference-based software is especially effective in meeting the heterogeneous learning needs of students with mild disabilities.

6. Cognitive Assistance: A vast array of application program software is available for instructing students through tutorials, drill and practice, problem-solving, and simulations. Many of the assistive technologies described previously can be combined with instructional programs to develop and improve cognitive and problem-solving skills. Multimedia CD ROM-based application programs offer another tool for assisted reading.

Similar to talking word processors, CD-based books include high-interest stories that use the power of multimedia to motivate students to read. These books read each page of the story, highlighting the words as they are read. Additional clicks of the mouse result in pronunciation of syllables and a definition of the word. When the student clicks on a picture, a label appears. A verbal pronunciation of the label is offered when the student clicks the mouse again. These books are available in both English and Spanish, so students can read in their native language while being exposed to a second language.

7. Materials Modification: Special educators are familiar with the need to create instructional materials or customize materials to meet the varied needs of students with disabilities. Today there are powerful multimedia authoring and presentation tools that educators can use to develop and modify computer-based instructional materials for students with mild disabilities, providing a learning tool that these students can access and use to balance their weak areas of learning with their strong areas.

Authoring software allows professionals and students to develop instructional software that can incorporate video, pictures, animation, and text into hypermedia-based instruction. Multimedia authoring software is very easy to learn and use. In fact, authoring software packages are even available for young children. For example, if the objective is to teach map reading, an image of a local map can be scanned in and specific locations can be made into buttons that the students can click on, causing a short video clip playing of the familiar location. A set of questions might be asked using both text and synthesized speech to have students give directions on how to get the location shown on the video.

Students could then write directions (or draw their own map). Digitized pictures of landmarks could also be incorporated into the directions. These directions, along with the images, could then be printed for use in completing the assignment. Without the ability to author and incorporate multimedia easily into instructional software, such computer-based training would be impossible because of the need to incorporate the shared learning concepts inherent in local environments into the assisted-learning process. Such instruction can make learning more efficient and certainly more real for students for whom abstract learning and generalization may be difficult.

Computer Technology

Another major classroom change is the use of computer technology. Computers have become an essential literacy tool in our society; its use crucial for future success in the workplace. Over 76% of American students use a computer at school; 83% use one at home for school assignments/word processing (NCES, 2001). Internet access in public schools has increased to 78%, with 27% of classrooms with Internet access (NCES, 2001). However, to best take advantage of the potential of technology, professionals and students must have adequate and equitable access; schools must build the capacity to use technology, develop a technology plan and offer adequate training and technical support; and professionals and students must use technology in effective ways (Jerald, 1998).

With increased access to education technology, it can be used to create more accessible curricular materials in fast and easy ways for students with disabilities (Research Connections, 1999). As classrooms materials are created in digital format, they can then be accessed and manipulated in a variety of ways to be heard, seen and manipulated. For example students can change how they interact with digitized materials by:

- Enlarging the size of the text
- Changing the color or font of the text

- Having the text read aloud
- Hearing labels read of pictures/simulations
- Speaking into a computer microphone to write
- Using alternate input options: trackballs, larger keyboards, touch screens, etc.

Software companies are designing programs that meet a wider range of needs. CD textbooks and e-Books are just two examples. Universal Access features are embedded in programs that present content in alternate ways, with multiple options for student control (i.e. text-to-speech, enlarged fonts and tool bars with large, well labeled buttons) (CAST, 1998). Other characteristics promote student engagement, interest, and motivation. These "built-in" options make learning more relevant.

Computer Technology and Educational Software

Many of the computers purchased each year are bought for use in the home. Well over 50% of home computer owners report that the major reason for buying a computer is for educational applications. Exactly how computers are used depends on the software selected. Depending on the design and content, software can present new skills or concepts, reinforce previously learned skills, or require the learner to apply skills to a task or problem. Educational software generally falls into four categories: drill and practice, tutorial, simulations, and games. Tool software such as word processing are another option. Each type of software can be used for instruction at home.

Drill and Practice: These programs provide opportunities for the child to practice previously learned skills. The content of the drill and practice program is usually structured, focusing on a specific sequence or kind of skill-building. For many students with disabilities, drill and practice activities are very important for mastering skills, and using this kind of software at home can reinforce learning that takes place at school.

Tutorials: These programs introduce new skills or concepts. It is assumed that the learner has not been introduced to the material presented in the software. The child may have learned related skills, but the content of the software is essentially new. Because the content is new, the learner will need guidance and supervision that aids understanding and teaches correct use from the beginning.

Simulations: Simulations are a type of problem-solving software. The learner applies skills and information that they have mastered. Simulations place learners in real life situations. The learner applies rules, uses facts, and draws conclusions to solve a problem. In addition to academic skills, simulations require good coordination and keyboarding ability. The necessary academic and physical skills should be assessed when considering this type of program for a child with a disability.

Games: Computer-based games can be either drill and practice or problem-solving activities. Arcade-style games are usually drill and practice programs. The learner practices skills by competing with the program in which facts or problems are presented. The learner is timed and gets points for giving the correct answer within the time limit.

Tool Software: This software helps the user find, organize, and reorganize information. Word processing programs, database management systems, and music or graphics editors are all examples of tool software. No content is specified with tool software. Instead, the program provides a framework for writing, creating files, or drawing. To use a word processing program or a spreadsheet, the learner must become familiar with its features. Tool programs are more versatile for home use than drill and practice or tutorial programs and family members can use them for different purposes.

Many possibilities exist for computer learning at home. Yet, because of differences in age, skills, and interests, few products will appeal to all members of the family. Knowing how a child learns and thinks about his or her strengths or weaknesses is important for it can affect learning.

Technology Applications-Case Studies

Shown below are three case studies of how AT is used every day by individuals with disabilities:

Case 1: A high school student with a visual impairment in a Current Events class has an assignment to follow a recent major event, present available facts about it, write a report, and complete a presentation about the event to his classmates. A major source of information for his sighted classmates is the newspaper, but unless someone reads it to him, he cannot use that source. The radio is an available option, but typically radio news coverage contains too little detail. With the available computer technologies, though, he can receive the newspaper on a computer disk and, using his personal computer equipped with synthesized speech, he can auditorily scan the newspaper, find relevant articles, and have the computer read them to him. Using the same computer, he can begin to write his paper, print it out in Braille so he can check it and change it if necessary, and then print it in standard text to hand into his professional.

Case 2: An adolescent with quadraparalysis shows all the signs of becoming a teenager. She wants control of her own life: to decide which radio station to listen to, to decide when to turn the reading light off at night, to call her friends and have a private conversation, and to stay home alone when her parents go out. Without assistive devices she would be unable to be an independent teenager, but with a single switch connected to an environmental control unit and placed on her head, she can control her personal radio, turn the lights on and off, access the telephone for calling friends, and call for emergency help when her parents are out.

Case 3: A toddler with severe disabilities attends a special education preschool program. The professionals are unable to determine the child's cognitive abilities because the child has no verbal skills and very few motor skills. In the past, professionals had few ideas for appropriate educational programs for this type of child. As a result of available technologies, the child's educational program includes motor training, language and communication training, and professionals can more easily see the child's potential and can build on it. Now the professionals are working on training him to use a consistent motor response using switches and battery-operated toys. The child is learning to reach and touch a switch which turns on a battery-operated teddy bear. Other times the child has two or three switches to choose from and must decide which toy is preferable. The language therapist is using the same switches to teach the child to make consistent "yes" and "no" responses for communication.

Selecting Assistive Technology Equipment: Becoming Informed

Technology is an investment. Therefore, consumers should become more informed and critical of the limitations of technology. Consumers should also be aware of alternate possibilities for achieving a specific goal.

In addition to standard considerations such as cost, available software, expandability, ease of use, and available peripherals, it is also important to consider how the adaptability of the hardware. For students with special needs, adaptability in most types of materials is necessary. For example, students with physical disabilities might need to use switches which are operated by a head movement, a head wand, a foot switch, an eye blink, or a sip and puff method. Students with a visual impairment may need a speech synthesizer. For students with a moderate disability, a combination of speech synthesis and alternative inputs may be necessary. For students with behavioral or attention disabilities, timing is important. In addition, a special feature that is essential to these students is just how fast the computer can load programs from the disk.

Fortunately, there is a wealth of information that parents and professionals can access, thus allowing them to make informed choices about the products they purchase and the services they select.

1. Where to Begin: If you or the parents are interested in using computers or assistive technology with a student but do not know where to begin, start by reading general information on the subject. There are books available as well as publications, some of which are specific to special needs.

2. School and Community Services: Print information alone may not be enough to help you with your technology decisions. You may need to contact agencies and organizations that provide special services. To do this, first become aware of resources that exist in your community. Local resources can supply personalized assistance to fit technology to children.

Perhaps the most important community resource is the school. You can often help parents assess the potential of using technology at home given their child's needs. You may also be able to guide you in selecting appropriate software their child. Some districts allow parents to borrow computer equipment for home use.

Another local resource is a computer users' group. User groups can provide valuable information about the use of software and hardware. Technical questions can be answered by members who are experienced with both. Check with your local computer dealer or telephone directory to find a user group in your area. Computer manufacturers may also know of a local user group.

3. Specific Information: If you are looking for information about using technology with a student with a specific disability, try contacting the local chapter of the disability organization serving that population. For example, if the child has a learning disability, contact the local Learning Disabilities Association of America (LDAA). Other organizations like the Easter Seal Society and the United Cerebral Palsy Association often provide direct services to families and to local schools in the use of technology.

Given the number and different types of computers that are available today, it is almost impossible to do a comparison. Generally, though, one or two factors tend to influence your decision to purchase particular equipment. These factors might include specific software compatibility, cost, or compatibility with other computers in the school.

Some questions to ask when considering a computer system are:

- Do the software programs you plan to use run on this computer?
- Is the amount of memory of the computer sufficient to operate the software you plan to use?
- Can the memory be expanded?
- Is a color monitor necessary?
- Does the software you plan to use work with the printer?
- Can the printer print graphics?
- How much will the total computer system cost (including monitor, printer, disk drives)?

While parents may not be able to afford all the options they want initially, get them to think of the future. They will want a computer that can be useful in a number of situations and can be adapted to suit different needs.

4. Hardware: Hardware information may be harder to find locally. Computer dealers that sell computer systems can usually be found in most cities. Companies that sell assistive or adaptive equipment may need to be contacted directly.

5. Software: Your local public library can be a gold mine for information on computer software. Some libraries set up mini computer labs for the public use.

6. Assistive Technology: If you don't know what assistive equipment is needed, local hospitals and community rehabilitation or vocational centers may be active in designing and fitting assistive devices to complement your child's capabilities. Some states have established centers to provide information about particular devices.

7. Funding: Finding funding for technology devices requires an individualized approach. To begin your search, check out resources that are available to you locally, such as the Lions or Kiwanis Clubs, and religious organizations.

Nationally, the Easter Seal Society in connection with IBM has an assistance project that allows eligible persons with disabilities to purchase discounted computer systems. Additional funding sources may soon emerge with new federal legislation and more national interest in technology by insurance companies.

To really make technology work for parents and their children, it is important to become an informed consumer. Inform them to use the abundant resources available; read about technology, talk to others who use it, and try out various technology options before purchasing anything.

Integrating Technology into the Student's IEP

The new requirements in IDEA '97 to consider assistive technology devices and services for all students with disabilities creates a massive task for school districts. Already, special educators across the country are reporting an increased number of referrals for children with mild disabilities in which the issue is access to the curriculum and productivity once in the curriculum. School-based professionals are finding that the "fix-it" approach taken with traditional assistive technology applications is not appropriate for these new types of technology referrals. More often than not, instructional issues are at the heart of these referrals--they require educators to start with the curriculum and then ask how tools might assist students in achieving the outcomes.

The student assessment/evaluation process, as outlined in The Individuals with Disabilities Education Act (IDEA), specifically states that a student's need for assistive technology devices and services are to be considered and addressed when his or her Individualized Education Program is planned. These devices and services can be provided by the school as either a part of special education or as related services.

This next section will examine various types of technology that may be integrated into a student's IEP.

A. Sensory Enhancers

Sensory enhancers are adaptive/assistive devices and/or software that allow a sensory-deficient student access to the environment through the use of technology. Individuals in the following categories can be served: hard of hearing, deaf, speech impaired, visually handicapped, seriously emotionally disturbed, orthopedically impaired, other health impaired, deaf-blind, multi-handicapped, and specific learning individuals with disabilities. Following are examples of types of sensory enhancers:

- audio output devices
- Braille writers (input/output)
- character magnification devices
- digitizers
- electronic scanners (with speech synthesizers)
- eye movement detectors/eye sensor devices
- voice analyzers and recognizers

B. Keyboard Adaptation and Emulators

Keyboard adaptations are alternatives to using the standard keyboard to input data. Keyboard emulators are peripheral products that make the computer "think" that its own keyboard is being used. Examples of keyboard adaptations/emulators are:

- alternative key pads (sketch pad, graphic pad)
- bar code scanners
- fist/foot keyboard
- firmward card
- joy stick
- key guard
- light pen
- membrane keyboard
- mouse
- touch screen

C. Environmental Controls and Manipulators

Environmental controls and manipulators modify the operation of a device to compensate for environmental restrictions due to a student's handicap. Some examples of environmental controls and manipulators are:

- adaptations of timers, light switches, telephone/radio amplifiers, headphones, buzzers (environmental control systems)
- control mechanisms with sonar sensing devices
- pressure plates
- robotics
- additional external switches and sensors (eyebrow switch, breath switch, pressure switch)
- telecommunication devices for the deaf (TDDs)

D. Instructional Uses of Technology

Instructional uses of technology are those which utilize software and/or related applications of technology which allow the student full educational opportunity. Examples of the instructional uses of technology are:

- Computer-assisted instruction (software for drill and practice, simulations, tutorials, demonstrations, problem-solving)
- computer-managed instruction (tracking and placement, grading display and analysis, scheduling, and various information management tasks)
- computer-supported activities (word processing, data bases, spread sheets, utilities)
- video disks
- telecommunications
- alternative languages (LOGO)

E. Motivational Devices

Motivational devices encourage the student to interact with his/her environment through exploration, manipulation, and play. Two motivational devices are:

- battery operated devices
- modifications of toys and games

Traditional and Technological Considerations in the IEP

The following questions identify content of traditional assessment/evaluation reporting, and suggest the addition of questions which would support technological considerations in the IEP.

1. Health

Traditional:

- Does the student have any acute, subacute, or chronic health problems?
- Does the student have a progressive and/or degenerative condition?

Technological:

- Given the student's attendance record, could the use of technology allow the student more continuous access to school and the curricula?
- How can technology be used to compensate for the effects of a degenerative condition?

2. Visual

Traditional:

- What is the student's visual acuity?
- What is the student's tracking ability?

Technological:

- What kinds of physical adaptations need to be made to allow the student to access technology?
- How will technology allow the student to utilize compensatory senses; i.e., could a student use a magnified screen or does s/he need large print on the screen?
- Is the student able to discriminate presented visual stimuli? Would speech-produced input facilitate learning?

3. Hearing

Traditional:

- Is there a decibel loss?
- How will the decibel loss affect the student's ability to learn?

Technological:

- What adaptations will allow the student access to the instructional program; i.e., how can technology (micro-computer, software, and a voice entry system) help to produce vocalization training?
- Would speech output facilitate learning? Is the student able to discriminate presented auditory stimuli?

4. Social and emotional status

Traditional:

- How does the student respond to differing social situations?
- What are the student's basic character traits?

Technological:

- What is the positive/negative psychological impact of the use of a computer with certain students; i.e., how will the student who has normal intelligence, but no means of expressive communication, deal with the use of a computer to provide his/her voice?
- What is the impact of the use of technology to the environment, peers, class?

5. General intelligence

Traditional:

- How does the student perform on a standard IQ test?

- What is the student's potential for learning?

Technological:

- Does the student have the ability or will the student develop the ability for higher cognitive functions that will allow for conceptualization, symbolization, generalization and abstraction; i.e., will the student be able to understand cause/effect relationships when making a selection on the computer, causing it to output information?
- Does the student have the notion of causality and the desire to bring about an effect?
- Does the student have the cognitive ability to learn and remember the use and operation of given devices?
- Does the student have symbolic functioning; i.e., the ability to associate a symbol or set of symbols with units of experience?

6. Academic performance

Traditional:

- How does the student perform on a wide range of screening measures which reflect achievement?

Technological:

- How can the current level of achievement be affected by the use of technology; i.e., how will the use of drill and practice, educational games, simulation, demonstrations, tutorials, problem-solving, word processing, information search and retrieval, graphics, and/or spread sheets, affect academic performance?
- Will the use of technology affect the speed of learning?
- Will the probability of the learner achieving his/her goals and objectives set forth in the curriculum be increased?

7. Communication status

Traditional:

- What is the student's receptive and expressive language ability?
- Does the student have any problems with voice, articulation, and fluency which affect the production of spoken language?

Technological:

- What is the relationship between the student's level of expressive and receptive language; i.e., how will the use of technology affect the student's ability to communicate?
- What skills are present (spoken, incomprehensible but consistent, written, speed of communication with and without device)?
- What is the present language structure (nonvocal from birth, nonvocal from injury)?
- Does the student understand the intent to communicate?
- What is the symbolic level of functioning?
- How will speech output affect the student?

State Level Support for Assistive Technology

States can support local education agencies in meeting these new requirements to consider assistive technology in each child's IEP. To ensure that technology benefits children with disabilities, states need to implement policies and practices that support its effective use. Louis Danielson, Director of the Division of Research to Practice at OSEP, suggests that state directors of special education put into place a clear policy on assistive technology that includes:

- A statement of desired AT outcomes.
- Policies for delivering AT services.
- Staff development and technical assistance policies.
- Verification that the technology plans includes research-based practices.
- Mechanisms for interdisciplinary involvement.
- Policies for purchasing, using, and managing equipment.
- Strategies for obtaining adequate funding.
- Strategies for communicating these policies.
- Promoting Access to the Curriculum: Promising Practices

As a result of the new law, technology is increasingly being recommended to help students with cognitive disabilities achieve in a challenging curriculum. Technology that supports students in accessing the curriculum does not need to be expensive or complicated to make a difference in learning. Both low tech and high tech applications have been used successfully to ensure students' success in the general education curriculum. What do we know about the positive benefits of using technology in academic subject areas to help children with disabilities achieve to high standards? The following research-based applications have been selected to show how technology is being integrated into curriculum and instruction to support a wide range of student abilities.

Elements to Consider in Implementing Technology

- Locate equipment where instruction and learning are taking place.
- Technology needs to be in the classroom and accessible to the child.
- Select low tech applications whenever possible.
- Integrate the use of technology into lessons in a purposeful and meaningful way.
- Have the same equipment used in the classroom available in the child's home to promote continuity of learning, if possible.
- Offer training and technical support to classroom professionals initially. When the technology is available in the home, provide training to family members.
- View the initial fiscal and human resources as an investment that the child will continue to benefit from in subsequent years.
- Don't reinvent the wheel each year--when possible use the technology that is already in place.

Factors for Success

Ongoing research identifies key factors in the successful use of AT in educational settings (Todis, 1997 cited in AT Basics, p.3):

- student and family goals and values form the basis of the student's educational programs
- the acquisition and use of AT is tied directly to student academic and personal goals
- students, family and educators (including professionals, therapists and instructional assistants) work as a team to select, obtain, implement and monitor AT
- communication about all aspects of the students school program is frequent and honest
- devices and equipment that are worn or outgrown are replaced. Those that are not meeting student needs are modified, replaced or abandoned, either temporarily or permanently

- both major and minor glitches are regarded as inevitable but solvable problems are dealt with quickly and systematically by the team.

Conclusions

The potential of assistive technology to improve and enhance the lives of individuals with disabilities is virtually unlimited. Now, with the help of current Federal laws, assistive technology will provide more children with the opportunity to maximize their learning in a challenging curriculum. The benefits of technology are as extensive as the abilities and goals of the students using them. However, professionals and parents should exercise certain cautions. Technology must not be seen as a panacea; it alone will not "fix" a disability or guarantee a successful inclusion program.