Assistive Technology
A Modest Overview & Some Autism Solutions

Assistive Technology is defined by the “Tech Act” of 2004 as “any item, piece of equipment or product system, whether acquired commercially modified, or customized that is used to increase, maintain, or improve functional capabilities of individuals with disabilities.” These technologies have been applied to help improve the situations of the disabled community for the last two centuries, but the advent of the microcomputer has taken the field to new levels. Applications to enhance mobility, hearing, vision and communication are now available to all, but there are still obstacles to their use. Poor advertising, high equipment costs and poor teacher expertise are just a few. Even so, many educational applications are helping disabled students stay in regular classrooms everyday and some targeted autism solutions are trying to ameliorate some of the social problems that are part of that condition. A combination of better exposure, lower technology costs and younger “tech-savvy” teachers can only improve the assistive technology landscape moving forward.

Lars Sorensen
Intellectual and Developmental Disabilities: 293:521 Fall 2008
December 4, 2008 – biglars@cs.rutgers.edu
Introduction

Every time you've seen a wheelchair, a hearing aide or a braille watch you've seen assistive technology (AT) in action. In order to enjoy the fullest life experience possible, people with disabilities have employed a variety of adaptive aides to cope with the world at large and enrich their interaction with it. AT should not be confused with other areas of technology that play a role in the lives of the disabled, areas like instructional or medical technology. Think of AT as “any device that has the ability to enhance the performance of peoples with disabilities.” (Lewis, 1998). These include things like mobility devices, computer applications, electronic interfaces, adaptive games and toys, and communication aides. In the area of special education AT has been crucial in helping people with intellectual disabilities (ID) combat problems with communication, inclusion and independence. AT can provide a boost to abilities already present or provide whole new avenues of functionality. AT can be implemented in homes, schools and the workplace.

We will look at some of the formal definitions of AT and the issues involved with using AT in schools. We will examine the benefits of AT and consider some of the current trends in this dynamic subject. There are countless benefits to implementing these technologies but the area of AT is not without its problems. We also take a look at some of the obstacles that stand in the way of AT use. We will look at the attitudes and practices of teachers and then, because no treatise on AT would be complete without it, we will examine some of the actual technology. We take a look at some of the technology used in today's schools and then we'll take a look at how AT is trying to help social impairments in cases of autism.

What is Assistive technology?

The Individuals with Disabilities Education Act (IDEA) defines AT as follows, “Assistive technology device means any item, equipment or product used to increase, maintain, or improve the functional capabilities of a child with a disability.” This definition has been seen as fairly vague,
there's no definition of “functional capability” included, and was constructed that way on purpose as, “Congress did not want to limit the range of tools and equipment that might be made available to individuals with disabilities by committing to a specific definition.” (Beirne-Smith, 2005). The Technology-Related Assistance for Individuals with Disabilities Act of 1998 (known as the “Tech Act”, it was reauthorized in 2004) also omitted any definition of functional capability, but was more specific in their definition of AT. It reads, “any item, piece of equipment or product system, whether acquired commercially modified, or customized that is used to increase, maintain, or improve functional capabilities of individuals with disabilities.”

Lewis (1998) reports that there are two main purposes of assistive technology. First, they can be used to augment a strength by counterbalancing the effects of a disability. Second, they can provide an alternate path to performing a task if a disability has road blocked a certain method, compensating for the disability or bypassing it completely.

Blackhurst (1997) lists four different levels of AT. High-tech, medium-tech, low-tech and no-tech. A high-tech solution might be a computer application to read a newspaper to a blind person. A medium tech solution is less complicated but still mechanical or electronic, like a VCR or a wheelchair. Low tech means special handles for utensils, Velcro fasteners or a raised desk to accommodate standing. No tech is interesting in that it requires no equipment, just an AT idea being taught or used. Some no-tech solutions are used to combat some of the biggest problems in AT, like dissemination of information and teaching problem solving techniques. Tech level is a distinction that's crucial to understand when implementing AT. If a child with cerebral palsy is having trouble buttoning a shirt we do not invest millions of dollars to build a shirt buttoning robot, we replace the buttons with three cent Velcro snaps. It's best practice in the AT industry to start at the lowest, and usually least expensive, solutions first and then climb the ladder from no to high to find the solution that provides the best fit for the need.
Benefits – The Obvious and the Unseen

The benefits given to the disabled community by AT are many and varied, some obvious and some unseen. One of the obvious benefits is when AT allows one to function better in their world. A wheelchair that provides mobility, a hearing device that allows someone with a hearing impairment to hear better or a screen reader that allows a blind person to have a newspaper read to them are good examples. These solutions allow people to overcome daily limitations and also provide a degree of dependence they would not have otherwise.

One critical area where AT enables the disabled is in the world of communication. AT solutions can allow a person without the ability to speak a way to talk. We are all familiar with seeing Stephen Hawking sitting in his wheelchair on the Science or Discovery channel speaking to us through his AT voice synthesizer. AT allows him to communicate even though ALS has taken the ability to speak away from him. Professor Hawking's rig is rather sophisticated and expensive, but a regular store bought laptop with word processing software and a screen reading program, JAWS for Windows for example, can perform the same function at a price that's very affordable.

Once a user has the ability to use a computer, via custom input and output solutions if necessary, communicating with the world is a snap. Via email, social networking sites and even virtual worlds, a disabled person interacts with the world just like those without challenges. It's truly a level playing field at this juncture, an email is an email, a disabled person's Facebook page looks the same as every other, an avatar in Second Life is not disabled at all, in fact they can fly. The online world can strip disabilities away for precious periods of a disabled person's life.

These are the obvious applications of AT that we all can see working, but there are a few aspects of AT's use that may escape a quick look. One is the way it fosters inclusion in special education. Inclusion, providing education for the intellectually disabled in the same school and classroom as other students, is made possible in some cases by AT. By giving access to educational materials via a
computer, being able to use hearing or visual aides or by taking advantage of AT's increased communication avenues, a student can enjoy the benefits of inclusion and remain in the regular classroom. In the past certain limitations have made it necessary for these students to spend part of their day using resources elsewhere in their schools. Now, a student using a wheelchair who cannot speak can use his laptop or PDA to email the teacher in class, use a voice synthesizer to ask a question, or visit a website to get a quick refresher on a topic. This has a great influence on the attitudes of the disabled student, making learning more interesting and enjoyable.

A second unseen benefit of AT, and perhaps the most important, is its real and perceived effect on the quality of life for the disabled person. In 1993 the National Council on Disability (NCD) conducted a nineteen month study to examine the benefits of AT devices and the services they provide. Their findings backed up claims that AT changed lives for the better. It stated that almost three quarters of school-age children with disabilities were able to remain in general education classrooms. Sixty two percent of working age persons where able to reduce their dependence on family members by using AT. Forty-two members of the study had paying jobs and ninety-two percent of them reported that the use of AT allowed them to work faster or better. Two thirds of them reported that it was AT that allowed them to obtain their jobs. One NCD statistic jumps off the page. Respondents were asked about the impact of AT on their quality of life, their overall well being and daily satisfaction. On average they reported that, on a scale of 1-10, their quality of life before using AT was around a 3. After using AT they reported that their quality of life was approximately 8.4 points. Added together the many benefits provided by AT make their implementation a “no-brainer”, but problems in their adaptation still persist.

**Issues & Obstacles**

There are quite a few reasons why the adaptation of AT is not as widespread as it should be. The major ones are a lack of knowledge of the technology available for the disabled, high costs of
equipment and training, and teacher expertise. A National Council on Disability's (2000) report, Federal Policy Barriers to Assistive Technology, stated that consumers consistently reported that they had no idea where to get information on the availability of AT. They did not know where to find products or where to get evaluations of the technology if they did find it. The Tech Act of 2004 tries to address some of these issues by providing funds for “projects of national significance to increase public awareness” and to provide funds to states to require programs to provide device demonstration. Even with these funds one of the major issues in the world of AT remains this advertising and targeting issue. Advocacy groups like COSAC, The New Jersey Center for Outreach and Services for the Autism Community, provide materials to help New Jersey's autism community understand AT and assist in helping families find solutions, but it seems services like theirs are the exception and not the rule.

The NCD (2000) report also found that a lack of funding to purchase AT was the second greatest barrier to AT's widespread use. A large percentage of the disabled community come from low socio-economic status (SES) situations. Families who have trouble making ends meet dismiss expensive AT solutions out of hand without investigating ways to fund their purchase. The “digital divide”, a term that refers to the gap between those people with effective access to digital and information technology and those without, exists in the disability community as well as the general population. Not using information technology adds to the problem of poor information dissemination as well, as most information about AT resides online where it is unseen by the lower SES families. The Tech Act of 2004 attacks this situation directly. Its stated purpose is to “provide financial assistance to states to engage in activities that assist them in maintaining and strengthening a permanent comprehensive state-wide program of technology related assistance.” Alas, they cannot afford to go door to door advertising, people must seek these programs out. Some people in need simply do not avail themselves of these programs.

Before examining the last major barrier to AT's use let's look at some minor, but important,
issues that also stand in the way. Fear of technology, a form of new age luddism, is pervasive in the disability community. Close to sixty percent of disabled people have never used a computer, a very high number when compared to the general population where twenty-five percent of people have not used a computer (LoPresti, Bodine & Lewis, 2008). There's a lack of confidence in the use of technology and a fear of its complexity. Most of these technologies are not made specifically for people with disabilities and at times learning how to use them can be daunting. Also present is a problem that exists in the computer science field, a gender gap. Culturally, computer use and technology in general is male dominated. Any solutions addressing the problem of AT's wider use must include plans to increase female use of computers. Lastly, at times families have unrealistic expectations. They believe that technology will cure a child or just “begin working” without any investment in time and effort. When this is not the case frustration ensues and technology as a solution for their family is no longer seriously considered. It seems to this author that education is the answer to all of these issues.

A lack of teacher expertise is the last major barrier to the use of AT for the disabled, specifically the intellectually disabled, community. There are three major reasons that prevent new teachers from using AT, sometimes causing them to abandon technology altogether (Bryant, Erin, Lock, Allen & Resta, 1998). Limited access to technology is the first. A lack of funding often keeps AT out of the hands of new teachers. If a teacher does acquire access to the technology the second reason, minimal technology training, rears its head. Few schools provide the proper instruction for the use of AT. Training guidelines like those of Roblyer and Erlanger (1998), hands on experience, training over time, mentoring & coaching and post-training access, are rarely followed. The last reason new teachers do not make greater use of AT is a lack of incentives. This may be changing as it is now part of the law that an IEP team must include the “consideration” of AT when formulating educational plans. The 2004 reauthorization of the IDEA requires a school to provide said AT if the services and equipment are
necessary to provide the student with a free appropriate public education. When present levels of performance are determined it is now often the case that prior IEPs are reviewed to determine the effectiveness of past and present AT use (Parette & Peterson-Karlan, 2007). Because of this, improvements in this area are appearing, slowly but surely. Having new teachers that are involved in promoting the use of AT in the classroom is a vital part of the solution to the problem of AT's limited use in the classroom. Younger teachers just entering the field grew up with technology and are using AT as a matter of course in their classrooms. Their enthusiasm for AT, from laptops to iPhones to hand held games, leads one to believe that the future of AT in the classroom is bright.

The Technology

When thinking about the history of AT it's easy to forget that it existed well before the advent of the computer. One of the first AT success stories was the appearance of raised Braille printing technologies in 1834. Radios were distributed to the blind in the United States in 1928. The Megascope, a device used for magnifying and projecting text was introduced in 1953. A laser cane for the blind appeared on the market in 1966. Technology was always used to aid the disabled, but the true breakthrough occurred at the end of the 1970s with the invention of the microcomputer.

AT is often thought of as existing in two distinct eras, the “Pre-Computer Age” and the “Computer Age” (Blackhurst, 2005). The impact of the personal computer (PC) in AT cannot be overstated. Scientists instantly recognized the potential for improving the quality of education and the quality of life for people with disabilities by using PCs. Computer assisted and multimedia instruction for children began to appear in the early eighties. Computer screens could now easily enlarge text and give a visually impaired user a chance to read. Translation of text to the spoken word through voice synthesizers began to read to those who could not see. The wide spread use of the Internet in the mid-nineties allowed educators and scientists to collaborate on even greater AT solutions. The quality of
life for people with disabilities rose accordingly.

Today, AT is put to use in the home and school lives of the disabled. Hand held Personal Digital Assistants (PDAs) can help a person with intellectual disabilities or dementia remember when to take their medicine with a reminder program. GPS “way-finding” systems can help a person navigate their town or find a bus stop (LoPresti, 2008). Companies like GIMP-GEAR sell technology solutions for a variety of situations, from wheelchair add-ons and accessories to deep pressure chambers to help people with autism to relax and concentrate. The personal lives of the disabled have been affected for the better by modern technology, but many of the greatest gains have been seen in schools.

In the field of education every part of the curriculum has an AT solution for the disabled. In the case of reading there are low-tech solutions like magnifiers and high-tech solutions like Text To Speech (TTS) systems. In TTS optical character recognition technology allows a document to be scanned and turned into text for screen reading. Screen readers like JAWS for Windows will read the contents of the screen out loud for the visually impaired or for the student who cannot maintain attention. Voice recognition programs will even correct a reader's pronunciation if they choose to read along.

Dictation programs allow a disabled student who cannot write to orally compose their work. Voice recognition dictation software, like Dragon Naturally Speaking, allow a disabled student to write and have text read to them with just their voice as an interface. Low-tech writing solutions like pencil grips and raised line paper have helped disabled writers for many years, but the computer age has introduced the portable keyboard, a low cost writing answer for those who cannot afford a laptop. Software, like word predicting, word processing and spell checkers also help the disabled writer. Programs like Draft Builder and Writer's Companion can help a disabled writer organize their writing and perform better in school (Parette, Wojcik, Peterson-Karlan & Hourcade, 2005).

Mathematics education has been using an old AT standby, the calculator, for years. Now calculators can be used to calculate money and coins for an intellectually disabled student who needs to
learn real world skills. Graphical applications called “Electronic Worksheets” let disabled students do math equations in the form they learn them, in columns not straight lines. They can get assistance when carrying over numbers and doing long division as the program keeps the numbers organized for them.

Video productions, computer programs, voice recognition, Encyclopedias on DVD, even virtual worlds to simulate real life experiences, the list of what AT has given to the education field is lengthy. AT and learning software is not being used in just academic areas though, it's now being used to address behavioral issues as well.

**Autism and Assistive Technology**

When looking at some of the applications of AT for the autism community one sees the technology addressing social components. Autism Spectrum Disorder (ASD) is diagnosed by a person's symptoms and behaviors, not necessarily a biological condition. One of the behaviors, as listed in the DSM-IV-TR, is a “qualitative impairment in social interaction and communication.” When we look at AT for autism we see some interesting technology solutions.

One is the PARLE (Portable Affect Recognition Learning Environment) project. People with autism tend to take things literally, too literally. If I were to say, “I would kill for a glass of lemonade”, a person with autism would likely be frightened, especially if they were holding a pitcher of lemonade. They are sometimes made to feel socially inadequate when they aren't able to understand such idioms and begin to avoid situations where social events might happen. This begins a downward spiral that hurts the social growth of the person with an ASD. PARLE provides a way to begin to combat this.

PARLE takes some of the techniques from SST (Social Skills Training) and puts them in a handheld device. When involved in a social situation a person with ASD can take a step back, consult the PARLE system and get a response they understand. For example, when asking for help in a grocery store a man with ASD becomes quiet all of a sudden. The woman helping him says, “What's the
matter, the cat got your tongue?” As you can imagine, a literal interpretation of this sentence would be
a bit confusing. Enter PARLE. The user can enter the phrase into a mobile Internet based phone that
connects to a database system that fields the man's query. The database then responds, “you appear
quiet, how come?” This is something our man in the store can understand. He can respond to the
woman properly now and their social interaction can continue. Such social learning would be
enormously beneficial to a person with ASD, expanding their zone of comfort and allowing them to
experience more in their lives. They could be confident that they will be able to react and respond
properly to a host of social situations and socialize more as a result.

In a feasibility study ten people with an ASD made use of the PARLE system and reported that
they found it useful, easy to use and efficient. Hearkening back to one of AT's biggest unseen benefits
participants also said they felt that the PARLE system exceeded their expectations and made them feel
good about themselves after they used it (Bishop, 2003). Special games aimed at improving social
performance for people with ASD are even being made for popular game consoles and portable game
players like the Nintendo DS Lite (Pulman, 2007). Using hand held devices to quickly navigate social
situations is a use of AT that is growing very popular in the ASD community.

The ASD community has employed the use of video technology for instructional purposes,
using recorded programs to demonstrate life skills like dressing, taking a shower and to teach cooking
skills (Graves, 2005). Step by step guidance systems and special event prompting systems can provide
information on how to complete an activity or recover from an error. Many people with ASD can
easily operate a VCR, so steps on how to perform their favorite activities is only as far away as their
living rooms.

While video has been a successful instructional tool for people with ASD, nothing can approach
the success this community has had with the personal computer. It is widely believed that people with
ASD have trouble screening out sensory information, often becoming overloaded and upset.
Concentrating on a computer screen where there is only pertinent information may minimize this difficulty (Moore, 1998). Having trouble dealing with change, a person with ASD likes the fact that a computer provides consistent and predictable responses. These responses can be repeated by the computer over and over again without fatigue or anger. People with ASD find computers free of social demands. The instructional materials used with computers can be programmed for any level. They can be made relevant to an individual's environment via customization of hardware or software, making each situation a personal one.

In several studies children with autism showed more enthusiasm for their computers than their toys. They also showed increases in learning, motivation, attention, response rate, problem solving and communication. Children with ASD also reduced incidences of acting out during computer instruction when compared to personal instruction (Chen & Bernard-Opitz, 1993).

Because people with ASD sometimes have difficulty recognizing or understanding emotions in others, the AT community has turned to computer training to provide “Emotion training.” Software was developed and tested in England that displays a face and lets the user choose what emotion is being displayed. There is no pressure or score when going through a session. Wrong answers are just met with a small sign that says, “try again.” After twenty correct answers the student can go on to the next level. Here they are presented with a picture, a small story and a question asking them how they would react to the situation. Again there is no pressure and no score. The session ends when twenty correct answers are tallied. A sample of twelve people afflicted with ASD used the experimental 'Emotion Trainer” software and all displayed significant improvements in emotion recognition. They even generalized the results for use elsewhere, a result rarely seen in these kinds of studies (Silver & Oakes, 2001).

Computer instruction has also been used to train people how to respond to situations in their favorite fast food restaurant. David, a teenager with ASD and an IQ of 46, was too insecure to walk
into his local McDonald's to grab a cheeseburger and a coke when he wanted. Whenever he was asked a question by a cashier or an employee there was always a small delay in his responses and he would often look to an adult he was with for an answer. Because he sometimes showed aggression when stressed, his caregivers were concerned about letting him try to order and eat food himself.

David became part of a study of CBVI, Computer Based Video Instruction. Using a laptop that David could bring to McDonald's with him, the CBVI application would lay out step-by-step instructions for Davids to depend on. They included the process for walking up to the counter, ordering his food, paying for it, even throwing away his garbage when he was done. After 56 days of training David was scoring 100% mean correct verbal responses when ordering food. This was up from 35% before the trails began. As the study states, “Results indicate that verbal skills and fast food restaurant purchasing skills can be taught to students with moderate to severe intellectual disabilities through CBVI.” (Mechling, Pridgin & Cronin, 2005). Depending on your opinion of McDonald's food, it could be said that this development has increased David's quality of life enormously, especially from a self esteem standpoint.

Sometimes computer AT solutions do not hold all of the answers though. Sarah Parsons conducted a study (2005) that attempted to train people with ASD in Virtual Environments (VEs). A virtual environment, like Second Life or SUN Microsystems's “Wonderland”, is a cartoon like computer game land. Users control their own characters or “avatars” and can interact with the “virtual” world in anyway they like. Ms. Parsons set up a world to test whether people with ASD would conform to social conventions “in-world” or whether they would see their experience in the VE as “just another game.” She set up a situation where a user would have to reach a goal. They could either follow a long path or take a shortcut and walk across a garden, not a nice thing to do in the real world. There was also a situation where an avatar would have to walk in between other avatars while they were speaking to each other, a faux pas in the real world. If people with ASD responded as if this were the
real world it could mean that simulations and training situations could be developed for the ASD community using VE. Many see VEs, a land where countless mistakes can be made without penalty, as a place where people with ASD can hone their social skills and practice real life situations.

Unfortunately, and for a reason yet unexplained, the ASD subjects tested did not feel like they were part of a secondary world where conventions were needed. They trampled over flowers and walked straight to goals, regardless of what was taking place. A few test takers used the path saying, “Maybe it's someone else's garden, I would squash the flowers.” (Parsons, Mitchell & Leonard, 2005), but they were in the minority. It seems the ASD community takes the world of VEs as literally as they do idioms. The opportunity for vast training spaces and the ability to have a virtual area where a person with ASD can “login” from anywhere, their home, school, etc. is too tantalizing not to investigate further. Research in this area is not promising right now, but efforts to understand how people with ASD interpret and understand VEs continues.

While the proven benefits of computer use for people with autism are evident, there is still a lack of computer programs written specifically for people with autism. One piece of intervention software, Gaining Face (http://www.ccoder.com/GainingFace/), is a public program written to help children with autism or Asperger's to learn about facial expressions. While useful, this program has no published evidence or research as to its effectiveness. Commercial software has not made full use of research evaluated interventions, strategies and methods for working with children with autism (Moore, 1998). Research into computer use and software for autism continues, but the gains already realized have been impressive. The empowerment this subset of AT has provided the ASD community alone makes it a worthwhile area for considerable research in the future.
Conclusion

As we have seen, the world of assistive technology is full of promise. Technology continues to get more powerful, smaller and more easily integrated into everyday items. While there are obstacles to implementing these solutions, a combination of education and AT advocacy will go a long way towards getting these solutions to as many people as possible in the future. A promising sign is that microcomputer technology continues to get less expensive, the One Laptop Per Child (OLPC) project advertises a laptop for less than $199. By improving advertising, increasing AT education and lowering costs many of the obstacles mentioned here can be overcome. The possibilities are endless.
References


