CHAPTER 6
TECHNOLOGY AND STUDENTS WITH DISABILITIES: DOES IT SOLVE ALL THE PROBLEMS

Emily C. Bouck

"Remarkable new technology is introduced into the school system and experts predict education will be revolutionized" (Lewis, 1988). This quote from a 1988 New York Times column on personal computers by Peter H. Lewis referenced the perception of many regarding personal computers. However, it could be considered applicable to almost any innovative technology as it could describe the feelings in the years after 1988 toward liquid crystal display (LCD) projectors, document cameras, and the Internet. But this quote was referencing the introduction of the blackboard in the 1840s. However, neither the blackboard nor personal computers have revolutionized education. As Lewis wrote, "the magic fail[ed] to materialize."

One should not be surprised that the invention and implementation of any one piece of technology does not revolutionize education. Any technology, whether it be personal computers or specific technology designed for particular populations (i.e., augmentative and alternative communication (AAC) devices, and text-to-speech), will not radically transform education. After all, technology is not a panacea; technology is a tool (Edyburn, 2001). Technology use in education is just one tool in an educator's toolbox; a tool to assist in educating students in academic, social, or functional skills.
It has great potential, but the expectations of technology typically far-succeed what it is capable of doing and hence leave feelings of frustration and dissatisfaction.

While many cannot think of living without our current modern technology (e.g., the Internet, cell phones, mp3 players, and notebook computers), we recognize while these tools can make our lives easier, they do not fix all aspects of our lives. Technology does not solve all the problems we face in modern society; in fact, the innovative technologies that have become commonplace in society have actually created some challenges (e.g., some contend modern technology has enslaved us [Lahm, 2008], and others indicate that it has made cheating easier [Dick et al., 2003]). Yet, we continue to use these technologies and hold them in high esteem.

This chapter will address technology for students with disabilities and specifically will question whether technology for students with disabilities solves all the problems. While the quick answer is no, the question is actually more complicated. Technology—including assistive technology—makes things possible for some students with disabilities that would otherwise not, yet it does not solve all the problems these students encounter in and out of school. Despite the potential of technology to improve the lives of students with disabilities, it is still a tool facing obstacles to address all problems.

**TECHNOLOGY: THE GREAT EQUALIZER**

Technology, particularly for students with disabilities, is often viewed as "the great equalizer" (Wyer, 2001, p. 1). It is perceived as a means of providing access and opportunity, promoting independence, and encouraging empowerment (Edyburn, Higgins, & Boone, 2005b). Technology can greatly benefit students with disabilities and solve many of the challenges these students face. Perhaps, this was put most profusely by former Assistant Secretary of the United States Department of Education, Office of Special Education Programs Judy Heumann, "For most of us, technology makes things easier. For a person with a disability, it makes things possible" (Edyburn et al., 2005b, p. xiii). The potential of technology is enormous for students with disabilities. For example, technology can provide a voice to those students who may not otherwise have one per their disability (i.e., AAC devices), read a text to a student who struggles with reading as a result of his/her disability (i.e., text-to-speech devices, screen readers, and Reading Pens), grant access to a computer and other electronic tools
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(i.e., switches and speech recognition), and offer low-tech devices such as pencil grips or lined paper to aid students in writing.

Yet, technology is sometimes more hype than reality; its potential highlighted more by intuition and belief than research and actual in-practice evidence. Hannafor (1993, p. 12) captured this sentiment years ago for one particular piece of technology, stating,

Much of what is presented as being known about the use of computers with exceptional persons is actually what is believed, felt, or hoped. While there is an increasing amount of research and evaluation support associated with various uses of the technology, there is still relatively little empirical support for many statements found in the popular literature.

While almost two decades have passed since the sentiment was expressed, the field still lacks a substantial research base for an array of technology for students with disabilities, but especially for students with mild disabilities (Edyburn, 2007). While an increase in attention has been made (i.e., the relatively recent Handbook of Special Education Technology Research and Practice), additional research is needed, especially research involving robust designs (Edyburn, Higgins, & Boone, 2005a).

Although technology for students with disabilities has its supporters and research to validate its effectiveness, it also has its critics. Specifically, technology can be criticized for failing to deliver on its perceived promise to solve the problems faced by this population (Edyburn et al., 2005a). Technology for students with disabilities does not live up to its proclaimed potential for many reasons, including (1) it is not well understood and (2) there is a general failure to address contextual issues related to technology use.

GREAT EQUALIZER

With disabilities, is often viewed as (1). It is perceived as a means of enhancing independence, and encouraging & Boone, 2005b). Technology can and solve many of the challenges put most profusely by former Department of Education, Office of Technology, “For most of us, technology is disability, it makes things possible” potential of technology is enormous for technology can provide a voice otherwise have one per their disability, who struggles with reading as a speech devices, screen readers, and computer and other electronic tools

UNFULFILLED PROMISES ... UNREALISTIC EXPECTATIONS

A Definition of Confusion

Technology for students with disabilities will not solve all the problems faced by these students because, for one, technology for this population is not well understood. Technology for students with disabilities is typically referred to as assistive technology, which is defined 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 functional capabilities of a child with a disability” (Individuals with
Disabilities Education Improvement Act [IDEIA], 2004, 602.1A). This
definition is broad, convoluted, and open to interpretation. For example,
debate exists over what is, or more aptly what is not, assistive technology
given the word any that appears in the commonly accepted definition
(Edyburn, 2005). Some believe anything can be assistive technology given
the vagueness of the federal definition, whereas others apply a more
conservative interpretation, excluding tools not commonly associated with
technology (i.e., concrete manipulatives) (Edyburn, 2005). Thus, leaving the
following questions unanswered (a) is a stepladder assistive technology?,
(b) is a hearing aid assistive technology?, and (c) is an instructional strategy
assistive technology?

The confusion over what is or is not assistive technology is further
fueled by the division of assistive technology into categories of low-tech and
high-tech; no-tech, low-tech, and high-tech; or low-tech, moderate tech,
and high-tech; and the different interpretations applied to these terms
(Blackhurst, 1997; Edyburn, 2005; Johnson, Beard, & Carpenter, 2007;
Vanderheiden, 1984) (Table 1). Depending on one's perspective, no tech
can mean (1) no assistive technology is deemed appropriate for the student;
(2) a tool is selected for a student that requires no technology per se, such
as a strategy; or (3) a nonelectronic device (Behrmann & Jerome, 2002).
Low-tech, or light tech, is typically considered as (1) a tool that requires

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<th>Category</th>
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<tr>
<td>No-tech(^a)</td>
<td>No assistive technology deemed appropriate</td>
<td>POSSE (Englert &amp; Mariage, 1991)</td>
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<td></td>
<td>Tools requiring no technology (e.g., strategy)</td>
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<td>Nonelectronic devices</td>
<td>PECS (Bondy &amp; Frost, 1994)</td>
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<td>Tools requiring little technology and lower in cost</td>
<td>Pencil grip, concrete manipulatives</td>
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<td>NonSophisticated electronic devices</td>
<td>Tape recorder, four-function calculator</td>
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<td>Low-/light tech(^b)</td>
<td>Tools with electronic components but not computerized</td>
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\(^a\)Behrmann and Jerome (2002).
\(^b\)Behrmann and Schaff (2001).
\(^c\)Edyburn (2005), Johnson et al. (2007) and Vanderheiden (1984).
little technology and is lower in cost, or (2) a nonsophisticated electronic device (Behrmann & Schaff, 2001). Moderate technology, when referenced as a category, is commonly referred to as technology that has electronic components but is not computerized and is generally more reasonable in cost. High-tech is then technology that uses the computer and has a higher cost factor (Edyburn, 2005; Johnson et al., 2007; Vanderheiden, 1984).

Given the above distinctions, or more aptly overlap in distinction, many are often left to wonder what is not assistive technology, or what specifically makes something technology for students with disabilities. A debate truly does exist regarding what is assistive, and issues are more often taken with the low-tech or no-tech options. For example, are concrete manipulatives assistive technology, albeit a low-tech or no-tech tool? Concrete manipulatives are common tools used with all students in mathematics classrooms, yet also a standard evidence-based accommodation for students with disabilities in mathematics (Maccini & Gagnon, 2000). Students with disabilities are probably given concrete manipulatives by teachers on a daily basis, without regard for the challenges this tool addresses or how using a particular concrete manipulative can help students with disabilities access the general education curriculum. Given the aforementioned duties of concrete manipulatives, one can stipulate that this tool helps to increase, maintain, or improve students’ functional capabilities relative to mathematics.

Furthermore, some technology for students with disabilities has become so commonplace in everyday teaching and learning that it is not recognized as being assistive technology, and hence, its benefits are understated or unnoticed (Hitchcock et al., 2005). Technology use in general has increased in schools, with computers becoming necessities not luxuries in the education of all students, and teaching tools standard in many classrooms (Prensky, 2001a, 2001b). Because many of the technologies considered assistive technology for students with disabilities potentially benefit all students (e.g., computer-based concept mapping, virtual manipulatives, and software programs), the distinction between technology for students with disabilities and technology for teaching is blurry. In this case, the technology is not solving a problem; it is merely doing its job.

**Standing in the Way**

Another reason technology does not, or cannot, solve all problems is the current failure to fully address contextual issues related to technology use for students with disabilities. It may be technology does not solve all the
problems because as a field and a society we do not allow it. Although technology holds great promise, its potential can only be achieved if it is used, and many factors influence students with disabilities getting access to assistive technology, using assistive technology, and not abandoning it.

Technology for students with disabilities can only be used if students actually have access to it. Access to technology is not equivocal across contextual factors for students with disabilities; issues such as socioeconomic status and culture interact with access to technology (Hitchcock et al., 2005). Students with disabilities from lower socioeconomic status typically have less access to technology (Bray, Brown, & Green, 2004; Warschauer, 2007), and research suggests individuals from some cultures have different reactions toward using assistive technology (Heur, Parette, & Scherer, 2004). To address problems faced by students with disabilities—and particularly diverse students with disabilities—greater attention needs to be paid to the equality of access, the equality of options for assistive technology, and the knowledge of assistive technology service providers toward issues of culture and diversity and its intersection with assistive technology selection and use.

Aside from access, appropriate selection of assistive technology is critical, as inappropriate selection sets up students with disabilities to fail (Alper & Raharinarina, 2006). Assistive technology selection should involve consideration of the person–technology match (Bryant & Bryant, 2003; Raskind & Bryant, 2002), ensuring a fit (i.e., compatibility) between the student and the device (Lahn & Sizemore, 2002). Compatibility includes examining not only the student’s strengths and limitations to see if they align with a device, its features, and the tasks it is to be used for, but also the student’s attitude and interest toward the device. If a student is disinterested in the particular assistive technology device or assistive technology in general, it will not work. Furthermore, if a student is embarrassed about using the tool, abandonment will occur, as some assistive technology can create a stigmatizing effect given the student will stand out in the classroom from its use. Educators involved in making assistive technology decisions need to carefully consider a range of factors when making decisions, such as the tasks for which the students will be using the assistive technology, the context in which the assistive technology is to be used, the individual, and the actual device (Bryant & Bryant, 2003; Raskind & Bryant, 2002).

Aside from a mismatch between student and technology, another major reason why assistive technology is abandoned or not used is insufficient training. Training is a key factor to assistive technology use and implementation (McGregor & Pachuski, 1996; Riemer-Reiss & Wacker, 2000).
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Without training, students with disabilities may have technology and not know how to use it or use it to its full potential. Training is essential not only for the students but also for teachers and family members. Teachers have indicated a lack of training impacts their use and acceptance of assistive technology in their classrooms (Alper & Raharinirina, 2006; Lee & Vega, 2005). Challenges encountered by students with disabilities and their teachers cannot be solved, let alone addressed even, if the assistive technology is not used, and its use is compromised without proper training.

A final reason why technology for students with disabilities does not solve all the problems is the negative connotations surrounding technology for students with disabilities and the lack of effort to counteract these perceptions. The true value of the assistive technology will not be realized if negative connotations continue to prevent its use. This is particularly so for students with high-incidence disabilities in which assistive technology more often addresses academic content and access to the general education curriculum. Educators need to understand as well as help parents and others comprehend when and why one uses assistive technology to bypass or compensate for a student’s disability and how use of the assistive technology supports and helps to teach the student academic content (i.e., reading, mathematics) (Edyburn, 2007). Edyburn (2005) illuminated this idea through a story of parents of a child with a disability who expressed frustrated that their child’s school had given up on her because they recommend she be given a calculator for her struggle in learning (aka memorizing) math facts.

Similar concerns arise with other technology that supports basic skills students with disabilities struggle with, such as decoding (i.e., text-to-speech software, screen readers, and Reading Pens). According to Edyburn (2005), there is concern or prejudice about technology being a “cognitive prostheses” and a belief that what students with disabilities are able to do with a technology is less valued than what they can do without one (p. 246). This is related to the apprehension that assistive technology can become a crutch for students with disabilities; the technology is not assisting the students in gaining a skill (e.g., reading, computation) but rather substituting for that skill (Rapp, 2005). In other words, technology for students with disabilities is not viewed as a tool offering the same support as a “more knowledgeable other” which students with disabilities can utilize to help them make sense of and demonstrate what they are capable of within a content area, but rather as a replacement for actual instruction in the area that students struggle (Ferdig, 2007; Scardamalia & Bereiter, 1991).

Another negative pervasive attitude toward technology limiting its use is concern over fairness (Parette, Peterson-Karlan, Smith, Gray,
& Silver-Pacuilla, 2006). Some educators indicate providing students with disabilities technology, which may not be offered to other students, is unfair as it gives students with disabilities an undue advantage. This is particularly so for students with more high-incidence disabilities whose recommended assistive technology may be more commonplace in the classroom and perceived to be beneficial to all students (e.g., calculators and pencil grips) (Ashton, 2005). Yet, this notion applies a child’s definition of fairness – giving everyone the same thing, rather than the true definition of fairness which involves giving each child what she/he needs (Edyburn, 2006; Welch, 2000). These negative attitudes toward technology limit its use and its potential to truly assist students with disabilities.

TECHNOLOGY’S POTENTIAL

Despite the criticism and concern, technology for students with disabilities solves a lot of problems, or at the very least, helps to alleviate them. The beauty of assistive technology is its capability to address the challenges faced by students with high-incidence disabilities (i.e., mild), those encountered by students with low-incidence disabilities (i.e., severe), and its role in creating a Universal Design for Learning (UDL) experience for students with and without disabilities (Bryant & Bryant, 2003; Council for Exceptional Children [CEC], 2005; Edyburn et al., 2005a, 2005b). There are the notable heroes of assistive technology (e.g., AAC devices and text-to-speech programs) and, as Langone (2005) stated, “unsung heroes,” such as the low-tech devices of switches, adaptive utensils, and pencil grips (p. xi). There are also the frequently, and unfortunately, unknown heroes, such as Microsoft Reader (Microsoft, n.d.a) – a free, downloadable ebook reader from Microsoft that also allows users to convert Microsoft Office documents into ebooks, CLiCK Speak – a free screen reader for the browser Firefox (Chen, 2008), and a magnifier that comes as part of the accessibility options with the Windows Operating System to enlarge a screen (Microsoft, n.d.b).

Technology for students with disabilities can assist students in the content areas, providing a means to engage in the domain of study (e.g., literacy, mathematics, science, and social studies) which might not otherwise be possible. This is particularly so for Web-based technology and the Internet. For example, advanced technology now allows virtual science labs for students who may struggle with fine motor skills or visual impairments (Schaff, Jerome, Behrmann, & Sprague, 2005). Web-based technology allows students to use virtual manipulatives, such as those in the National
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POTENTIAL

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Library of Virtual Manipulatives, to explore and understand mathematical
cepts in a manner that enables interactivity and immediate feedback
(Bouck & Flanagan, in press; Cannon, Dorward, Duffin, & Heal, 2004).
For social-studies, a Web-based learning environment – the Virtual History
Museum – provides access and interest in learning about history and
ography by utilizing images, sound, teacher-controlled text, and video as
well as relying on free assistive technology (e.g., text-to-speech and spell-
check) (Okolo, Engilt, Bouck, & Heutsche, 2007).

Specific technology for students with disabilities can also solve generic
access problems. For example, technology can help students with print
disabilities (i.e., reading disabilities and visual impairment) and students
with physical disabilities get access to printed text, and in a manner that
promotes greater independence. With technology, these students can read
text independently through a text-to-speech or screen reader program
(i.e., JAWS and Universal Reader), or through separate hand-held devices
(e.g., Reading Pen), rather than being reliant on a teacher or a peer
(Anderson & Anderson, 2005; Banks & Coombs, 2005). While these
technologies have their limitations, they grant access and, more importantly,
independence in controlling one’s own learning and knowledge acquisition.
Similarly, speech recognition technology can provide greater access and
independence in general education curriculum (e.g., writing a paper or
email, using a calculator on the computer, and controlling a computer)
(Higgins & Raskind, 2000; Raskind & Higgins, 1999).

Technology for students with disabilities is not only for school but involves
lifelong tools (e.g., employment), helping students to access, increase, maintain,
or improve their performance in a particular area (i.e., reading, communicat-
ing) at a particular time. Assistive technology are tools promoting success
in school by helping students to access material, environments, and learning
as well as promoting independence at home, work, and the community.
Technology can make things possible for students with disabilities that at once
seemed improbable, and work to solve various problems – common and more
obscure – students with disabilities encounter (see Edyburn et al., 2005a).

THE FUTURE ...

Given the noted benefits of technology for students with disabilities, another
answer to the question if technology solves all problems is not yet. New,
nnovative technology is continually being developed. The technology of
tomorrow can solve the problems of today. Think back to when reading
printed text was a challenge for students with reading disabilities or visual impairments, and no options existed (aside from perhaps books on tape). Then text-to-speech software, screen readers, and Reading Pen technologies were developed and marketed for educational purposes. We can only guess what future technologies might entail considering today's technology allows students with disabilities to write papers using only their voice (i.e., speech recognition) (Jehs, Behrmann, & Bannan-Ritland, 2006), receive prompting from a pentop computer (i.e., FLY Pen) (LeapFrog, 2008; Pogue, 2005), and use an AAC tool from cell phones or personal digital assistants (PDAs) (Bryen & Pecunas, 2004).

Although technological innovations have provided increasingly sophisticated, effective, and efficient technologies for addressing the challenges faced by a range of students with disabilities, problems still exist. These existing problems are a result of both technology not overcoming the depth or breadth of the challenges and technology not currently existing to address the problem. For example, a problem the field still faces is providing accessible graphing calculators for students with disabilities (i.e., talking or speech-output graphing calculators), and at an affordable cost. Students with visual impairments often face challenges getting access to higher level mathematics and science education, and one reason is the limiting nature of technology (Banks & Coombs, 2005). While talking scientific calculators exist, these calculators do not support graphing, and the options for students with visual impairments in terms of sophisticated calculators for advanced mathematics are limited.

**CONCLUSION**

Given the allure of the potential of technology and society's apparent obsession toward it (e.g., smart phones and mp3 players), a return to the original question is needed – does technology for students with disabilities solve all the problems? While the quick answer may be no, to truly answer the question one needs to ask if technology for students with disabilities has done what it has intended to do. And perhaps that should be the question; does technology for students with disabilities do what it needs to do? Possibly technology for students with disabilities has been set up to fail, to be under-appreciated and devalued by being viewed as the solution to all the problems faced by students with disabilities. Perhaps, technology for students with disabilities needs to be viewed for what it does do, what it has contributed, and the potential it still offers.
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Technology and Students with Disabilities

One could argue that technology for students with disabilities was never intended to solve all problems. By its very definition, assistive technology does not have to solve problems; it can simply help students maintain the status quo. Furthermore, according to the Technology-Related Assistance for Individual with Disabilities Act (1988, p. 1044), known as the Tech Act, the goal of assistive technology is to

- enable individuals with disabilities to (a) have greater control over their own lives,
- participate in and contribute more fully to activities in their home, school, and work environments, and in their communities,
- interact to a greater extent with nondisabled individuals, and
- otherwise benefit from opportunities that are taken for granted by individuals who do not have disabilities.

When one stops to reflect on these ideas, technology for students with disabilities is addressing what it has been asked, and can reasonably be expected, to do.

Technology for students with disabilities does allow individuals with disabilities to have greater control over their lives. From the simple example of wheelchairs allowing students with physical disabilities to control their mobility to the more complex example of computer-based voice input speech output tools that give students with visual impairments greater control over their participation in school and employment, technology enables independence. Technology also allows students to participate in their environments, such as talking microwave ovens and vibrating alarm clocks (Freitas & Kouroupotregolou, 2008; Kordas, 2008). Furthermore, AAC devices, from the low-tech Picture Exchange Communication Symbols to the high-tech Tango, encourage interaction between students with and without disabilities (Bondy & Frost, 1994; Ellenson, 2006). Finally, technology, such as text-to-speech, helps make opportunities (i.e., reading) possible for students with disabilities that many individuals without disabilities take for granted.

REFERENCES


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