ASSISTIVE TECHNOLOGY IN SPECIAL EDUCATION AND THE UNIVERSAL DESIGN FOR LEARNING

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ABSTRACT

Using technology can help students with disabilities to enhance and improve their independence in academic and employment tasks, their participation in classroom discussions, along with helping them to accomplish some difficult academic tasks. This paper discusses the role and benefits of using assistive technology in the Universal Design for Learning (UDL), in academic skills, and in transition services. A summary of the important principles that need to be considered in the integration of technology in educating or training students with disabilities is provided.
Keywords: Assistive technology, universal design, technology, special education.

INTRODUCTION

"The world of education is currently undergoing a massive transformation as a result of the digital revolution" (Collins & Halverson, 2009, p. 1). Because of this "digital revolution," it is both important and practical to make use of the availability and accessibility of technology in designing educational or training programs. Technology has the potential to contribute to a better quality of life for students with intellectual disabilities, which is more than just a matter of convenience (Wehmeyer, Palmer, Smith, Davies, & Stock, 2008). The use of technology in education is inevitable; it is only a matter of time before schools will fall behind unless they try to catch up. Students spend long hours of their day outside school using technology, so is it reasonable to expect them to come to school and find themselves in the world of no technology and feel attracted to this world. In addition to the factor of attractiveness, there is also the effectiveness of using technology, which has been proven through some studies. For instance, Patton and Roschelle (2008) argue that digital textbooks offer a better alternative than traditional textbooks because they can provide instant feedback, interactive representations, and the system of universal design for learning (UDL).

Continuing to deliver education and training in the traditional way and using the same tools that have been used for decades is affecting these programs' outcomes and making them fall far behind what the labor mark demands. Thus, updating school programs with current technological tools and devices for both students with and without disabilities has become necessary.

It is very important to ensure that students with disabilities are prepared to meet the challenges of postsecondary settings (Stodden, Conway, & Chang, 2003); many technological tools could increase, as much as possible, the possibilities for students with disabilities to overcome these challenges with fewer difficulties. In many cases adapting the right assistive technology for students with disabilities could save time and effort. Ignoring the existence of devices and tools that can help students with disabilities facilitate and maximize their educational and academic gains can also prevent students from having opportunities to reach their maximum performance, or at least to make them more confident while undertaking some tasks that can be done easily using low-tech assistive technology.

ASSISTIVE TECHNOLOGY

Assistive technology is defined as "an item or piece of equipment or product system either acquired commercially, off the shelf, modified, or customized and used to increase, maintain, or improve functional capability for individual with disabilities" (Johnston, Beard, & Carpenter, 2007, p. 4). Special education teachers, especially in middle and high school, should be exposed to technological tools that can help students to bypass their academic weaknesses (Mull & Sitlington, 2003). Teachers will help students by training them to use portable and cheap tools that, in most cases, could make students live and behave more independently when they leave high school, which will increase their chances of maximizing their degree of achievement and independence, though it will still be behind their peers without disabilities (Blackorby & Wagner, 1996). For instance, training students to use a calculator can be more practical than beginning to teach middle and high school students basic math (like adding two numbers). Furthermore, if students can use the calculator but have difficulty saying numbers correctly, they can use more advanced tools, such as a talking calculator, which helps students to say numbers correctly and can be used whenever or wherever they need it (Lankutis, 2004).

Mull and Sitlington (2003) reviewed the literature regarding the use of technology to help students with learning disabilities succeed after leaving high school. Based on their comprehensive review of literature, they came up with these recommendations:

1. Because assistive technology can vary significantly in cost from one device to another and sometimes can be too expensive for families or schools to afford, the funding resources for assistive technology must be addressed in the transition process. Additionally, it is important to identify the necessary device early, so this device can be located, and the student can have time to be trained to use it.
2. The assessment of students' needs and the demands of the postsecondary environment should determine the appropriate selection of assistive technology.
3. Training students in using the assistive technology properly will help them to increase their educational gains.

Seven principles of universal design to be considered when designing an AT device are identified by The Trace Center in Wisconsin: 1) equitable use; 2) flexibility in use; 3) simple and intuitive use; 4) perceptible information; 5) tolerance for error; 6) low physical effort; 7) size and space for approach and use appropriate (Trace Center, 1995).

Mull and Sitlington (2003) found there are five obstacles that prevent the general use of technological accommodations by students with disabilities: "1) the use of assistive technology in the role of 'cognitive prosthesis' 2) the availability and high cost of assistive technology; 3) abandonment by students of purchased assistive technology devices; 4) training needs related to the use of technology and assistive devices; and 5) eligibility questions." (p. 29)

It is important to choose an appropriate and efficient device or tool, which does not necessarily have to be an expensive device designed just for educational purposes or for students with disabilities; Stodden et al. (2003) found that complex and expensive devices (e.g., high tech devices) have been used less and appeal to a smaller percentage of students compared to low tech devices. Sometimes it is much more efficient to look within the normal, existing technology to find useful devices or software for students with disabilities than to just focus on finding a specific technology designed specifically for people with disabilities. For instance, Skylar (2008) calculated the cost that can be saved by using an iPod Touch for students with disabilities to replace many devices such as 1) SMART Boards, which can cost 3,000 dollars even without the necessary computer, speakers, and scanner; 2) Kurzweil 3000 software (designed for readers who face difficulties, dyslexics, and students with attention disorders), which can cost around 500 dollars; 3) a laptop (capable of running Kurzweil 3000, calculators, electronic organizers, calendars, multiple alarms, and portable Internet access), which can cost from 800 to 2,500 dollars; 4) a flash drive data storage device, which can cost from 20 to 100 dollars.

Universal Design for Learning (UDL)
Assistive technology is important for students with disabilities, but there are those who say the system as a whole should be supported for all students, and this system or framework is referred to as Universal Design for Learning (UDL) (Wehmeyer, 2006). Also, the challenge that students with disabilities face in the context of inclusive education is the single-faceted presentation of the general education curriculum, which leads us again to think of Universal Design for Learning (UDL) as a solution to meet this challenge (Ludlow & Fosha, 2007).

The official definition of Universal Design for Learning (UDL) by the Higher Education Opportunity Act is as follows:

> A scientifically valid framework for guiding educational practice that (A) provides flexibility in the ways information is presented, in the ways students respond or demonstrate knowledge and skills, and in the ways students are engaged; and (B) reduces barriers in instruction, provides appropriate accommodations, supports, and challenges, and maintains high achievement expectations for all students, including students with disabilities and students who are limited English proficient. (Higher Education Opportunity Act, 2008, 4137—11)

Accessible Environments
Designing environments and educational settings that are accessible to everyone, with and without disabilities, will reduce the need for individual accommodations (Burgstahler, 2003). Wehmeyer (2006) argues that a difference should be distinguished between a universal design for a curriculum (which he advocates) and using assistive technology to enable students with disabilities to access to the general curriculum, in which the disadvantage comes from determining the needed assistive technology prior to choosing the curriculum and causes the teachers to have no choice, except a little flexibility in instructional strategies; consequently, there might be a need for certain expensive assistive technology devices that could help with the chosen curriculum.

Rose, Hasselbring, Stahl, and Zabala (2005) state that the purpose of UDL and assistive technology work is to overcome barriers and provide students with disabilities access to the general curriculum. Assistive technology is essential in the application of a UDL instructional design and, in return, a Universal Design for Learning (UDL) provides accessible Curriculum Content, helping to raise the value of Assistive Technology (AT; Basham, Israel, Graden, Poth, &Winston, 2010).

Examples of Accessible Technologies

Burgstahler (2003) pointed out three examples of accessible electronic and information technology and how it can be useful for students with disabilities in educational settings, based on the concept of universal design: 1) Accessible web pages such as those that allow students with low reading skills to access information and communicate with others; 2) Accessible instructional software, such as programs that allow students to work side-by-side and collaborate with their peers to complete assignments in the classroom; 3) Accessible telephones that make communication accessible to everyone, whatever their disabilities.

Assistive Technology for Academic Skills

Technology could play an important and significant role, in many cases, in helping students with disabilities overcome the academic difficulties that they face and helping them to develop their academic skills as well. Cullen, Richards, and Frank (2008) conducted a study to determine whether computer software would help students with disabilities improve their performance in writing. A multiple baseline design was used to study seven fifth grade students with mild disabilities in three phases: baseline, intervention using a talking word processor, and intervention using word prediction software in conjunction with a talking word processor. In the first week (Baseline) students handwrote all writing samples with no accommodations; in the next three weeks (Intervention one) Students used Write:Outloud, a talking word processor for all writing samples; in the last three weeks (Intervention two) students used Co:Writer, a word prediction software, in conjunction with Write:Outloud for all writing samples. The results showed that five students out of seven in the study improved the number of words produced in the two intervention phases, while the number of words produced decreased with the other two students in both intervention phases compared with the baseline phase. The group mean indicated that there was an improvement in the number of words produced. There were improvements in the number of misspelled words across phases, both individually and in the group mean. In general, the results showed that the impact on most of the seven students was positive.

Another example of the important role that technology can play in helping students to overcome their difficulties with academic skills can be found in the study conducted by Bouck, Doughty, Flanagan, Szwed, and Bassette (2010) to examine how effective a pentop computer (a FLYPen) and the writing software (specifically designed for the FLYPen) was in assisting students with disabilities in writing. This tool "resembles a typical pen, larger in size and includes a slot at the top where a software cartridge is inserted. When using special paper created for the FLYPen, the pentop computer produces voice output to provide directions, prompts, reinforcement, and hints to students for various activities" (p. 36). In this study, three high school students were chosen based on the following criteria: 1) high school students receiving special education services between 15 and 18 years old; 2) students with a mild intellectual disability or learning disability; 3) students having difficulty in written expression; 4) students who had received special education services since early elementary school. The results showed that all students experienced initial gains in the quality of written expression while using the FLYPen. They concluded that technology-enhanced procedural facilitators not only can benefit the quality and quantity of written expression in students with mild disabilities, but it can also enhance students ability to plan their writing and help them complete these tasks more independently.

Examples of Projects With Hearing Disabilities

Mclnerney, Riley, and Osher (1999) examined six projects that have been conducted on students with hearing disabilities, and they found that text highlighting and supportive captions with digital instructional materials were helpful to and demonstrated consistent academic gain for students with hearing disabilities. Wehmeyer, Smith, Palmer, Davies, and Stock (2004) found that exposing students with intellectual disabilities to flexible technologies helped increase their functional skills, take advantage of their strengths, and compensate for their weaknesses. In the same context, Anderson-Inman, Knox-Quinn, and Horney (1996) found that students with learning disabilities have shown increased academic gain when exposed to technology- supported concept mapping strategies. Elbro, Rasmussen, and Spelling (1996) found that students with language-related disabilities showed positive effects for word recognition, comprehension, and fluency when using digital texts with synthetic, syllable- or letter name-level synthetic speech transformations.

Assistive Technology in Transition Services
Technology has the potential to enhance schools' outcomes and to help prepare students with disabilities for life after school (Burgstahler, 2003); also, it could add some enjoyment to these students' academic experiences and might be more practical in some cases. Mitchem, Kight, Fitzgerald, Koury, and Boonseng (2007) qualitatively investigated the usability and perceived effectiveness of an electronic performance support system designed for secondary students with mild disabilities. This software contains 39 strategy tools to support learning, behavior, and transition in high school and beyond. Two special education teachers used the software with their high school students for one semester. The results show that the usability features were rated very high by both teachers and students. Students indicated that the tools had been useful in helping them to recognize their inappropriate responses, along with identifying the more appropriate responses.

Teachers
It is vital that teachers are exposed to and have knowledge of the available technologies that could support students in their academic tasks (Raskind, 1994). Logically, teachers who do not realize and have not been exposed to the usefulness and applications of technology in education in general, and special education specifically, will be more reluctant to use them. It is therefore important that technology is included in preparation programs for special education teachers; in these programs, technology should be used as part of the preparatory program for teachers and cover technical applications at the classroom level. In this way, special education teachers will have the knowledge and experience in using technology that will contribute to the widespread of the use of technology in special education programs.

Course Management System (CMC)
Basham, Lowrey, and deNoyelles (2010) examined the Universal Design for Learning (UDL) framework using an online course management system (CMC) as the basis for a collaborative project between two universities. This study included 78 students from two special education programs enrolled in teacher education courses. Starting with the UDL framework, various online and collaborative instructional components were established between two pre-service education courses at two distinctly different universities.

It was demonstrated that UDL is a practical framework for planning a collaborative CMC project for teacher candidates in special education preparation courses. In addition, it was concluded that it helped teachers gain understanding, share experiences, and express course knowledge in authentic ways. Nevertheless, this study address the need for more research concerning designing elements that provide flexible ways for students to gain and express knowledge and engage with others, which will be important for the integration of CMC in the learning framework.

Examples of Useful Technologies
 Raskind (1994) suggested a number of technologies that may be helpful in assisting students with disabilities overcome their difficulties: word processors, spell-checking programs, proofreading programs, outlining (Brain Storming), speech recognition, abbreviation expanders, speech synthesis, proofreading programs, optical character recognition systems, Free-Form Databases, and talking Calculators. Cutler (1990) concluded that spell-checkers were useful in helping students with disabilities compensate for their spelling difficulties. Collins (1990) found that the use of word processors helped in improving the writing skills of students with disabilities. Brown (1987) found that speech synthesis in conjunction with word processing was useful in enhancing students' written language production.

CONCLUSION
In conclusion, technology has changed and continues to change the way people manage things in their lives, both in private and in practical life, so the natural extension of that is to see the impact and the integration of technology in education for students with disabilities in the same way it has been in other areas of life. Using technology can help students with disabilities to enhance and improve their independence in academic and employment tasks and their participation in classroom discussions, along with helping them to accomplish some difficult academic tasks (Burgstahler, 2003). (See Table 1 for Burgstahler's list of advantages of using technology for students with disabilities).

Table 1: Technology Advantages for Students with Disabilities

Advantages	Examples
1. Maximize independence in academic and employment tasks	A student with mobility impairment uses a hands-free keyboard and mouse to operate a computer to take class notes, access library resources, and complete papers rather than have an assistant write for her.
2. Participate in classroom discussions.	A student who cannot speak uses a computer-based communication device to deliver speeches and participate in class discussions.
3. Gain access to peers, mentors, and role models.	In a supported Internet community, a student who is deaf uses email to chat with other teens, gain support for college and career transition from mentors, and meet role models.
4. Master academic tasks that they cannot accomplish otherwise.	A student with a learning disability uses a set of software tools to support her management of reading, writing, and study demands in a postsecondary setting.
5. Gain access to the full range of educational options.	A student who is blind and uses speech output technology fully participates in an Internet based distance learning course that employs universal design principles to assure access to people with disabilities.
6. Participate in experiences not otherwise possible.	A young man with no functional use of his arms and legs experiences completing a chemistry experiment through a computer simulation and observing sea life while swimming in the ocean through virtual reality.
7. Succeed in work-based learning experiences.	A student who has no use of his hands independently operates a computer to draft and edit articles in a journalism internship at the local newspaper office.
8. Secure high levels of independent living.	A young person who has a developmental disability uses a cell phone to maintain regular contact with caregivers as he participates in community activities.

Note. Burgstahler, 2003, pp. 10-11.

There are a few points that summarize the important principles that should be considered in the integration of technology in educating or training students with disabilities: 1) low tech tools should be the first option when looking for assistive technology that will help promote students' learning (Johnston et al., 2007); 2) educators must search among the available tools and devices first before looking for tools that were specially made for educational purposes, which could be very costly (Skylar, 2008); 3) the most expensive tools or devices are not always the best choice, which will be determined based on the student's needs and prior skills ; 4) small adjustments to existing technologies, often, will make a difference for students with disabilities (Johnston et al., 2007); for example, the highlight and enlarge functions, and programs that color important words in the text or buttons on websites will be helpful (Mclnerney et al., 1999).

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