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Overview of Assistive Technology Possibilities for Teachers to Enhance Academic Outcomes of All Students

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Abstract Despite enormous improvements in AT devices and services in American classrooms, the number of students with special needs, and the complexity of needs that they and their families experience continues to be sky rocketed nationwide. In response to these urgent needs, more advanced and specialized assistive technologies have been developed that educators can use to revamp and redefine education of individuals with special needs, multiple learning styles, and physical challenges. AT helps students with special needs develop independent thinking skills, maintain self-reliance, increase autonomy, develop problem-solving skills, facilitate a sense of continuity in living conditions as much as possible, and become more actively involved in their educational activities at home, schools and communities. It allows teachers to reach out to all children at home, in the classroom, workplace, and community through outreach programs. AT, both high and light provide enormous potential for students with special needs to capitalize on their strengths and by bypassing, or compensate for loss of function, making the most out of their educational experiences. This article investigates the potential of AT to revamp education of students with special needs. In addition, this paper will help make educators and the learning community aware of AT availability and the use of and benefits afforded by AT devices.

Keywords Computers, AT, Integration, Special Needs, Physical Challenges, Achievement, Strategies, Functional Capabilities, Learning Impaired, and Interventions

1. Introduction

American classrooms are changing and are more challenging than before. The purpose of education in America is to provide equal education to all students so that all students can become productive, contributing citizens in the society. Of the many issues that parents, teachers, school administrators, politicians, and philosophers have debated for centuries and perhaps one of the most encompassing is how to promote greater independence for people with special needs by enabling them to perform tasks that they were not able to perform. The growing influence of thinking drawn from the humanities and the behavioral and social sciences has brought about the development and implementation of AT to assist all students, not just students with special needs to increase, maintain or improve their academic outcomes and life skills (IDEA, 2009; Rothstein, Rothstein, & Johnson, 2010; Beard, Carpenter, & Johnson, 2011; Shih, Shih, & Luo, 2011; Krieg-Bruckner, Shi, Fischer, Rofer, Cui, & Schill, 2009; Shi, & Krieg-Bruckner, 2008; Rofer, & Laue, 2009). Students with special needs must be provided equal access to AT education programs. Numerous research studies suggest that students with special need can benefit from experiences that involve hands-on minds-on learning, equivalent to those experiences students in technology education programs receive (Luo et al., 2011; Wressle & Eek, 2011; Jay, Brown, & Harper, 20011; Beard et al., 2011; Shi, & Krieg-Bruckner, 2008; Rofer, & Laue, 2009). The potential of AT to facilitate students with special needs' hands-on minds-on learning by "doing" strategies in the classroom cannot be ignored. This paper presents assistive technologies that teachers can use to enhance academic outcomes of students with special needs in the classrooms. AT allows students with special needs opportunities to explore, explain, elaborate, expand ideas, evaluate, and actively participate in problem solving environment without distractions that may interfere with their focus. Teachers should envision AT as a key for students with special needs to succeed academically by helping them learn better in the classroom environment and makes learning possible for those students who may have difficulties. AT has the potential of increasing student's motivation to develop and acquire effective life skills and cognitive functions that prepare them to function effectively in today's society. It presents enormous benefits for special need student's caregivers, parents, and school personnel by reducing the cost and time spent for giving individual assistance and increasing the time available for other outdoor activities, duties, and social skills that can enhance their opportunities to achieve academic success.

Recognition of students with special needs' learning disabilities became part of the law when the Americans with

Disabilities Act (ADA) defined learning disabilities as "a physical or mental impairment that substantially limits a major life activity." The Individuals with Disabilities Education Improvement Act, 2004 helped to secure a place for students with special needs students in the public schools. IDEA combined with No Child Left Behind Act ensure that all children with disabilities have access to a free, appropriate public education in the least restrictive environment. These laws include students with deafness, hearing disability, mental retardation, orthopedic impairment, other health impairment, serious emotional disturbance, specific learning disabilities, speech impairment, and visual impairment. To help all students overcome their learning disabilities, AT was implemented in classrooms across the nation. AT became part of the school's plan based on a student's assessment and determined need. AT helps put students in the "least restrictive environment" (LRE) according to ADA. The LRE emphasized that students with disabilities should be educated in an environment that provides equal access to the same services and curricula as their peers. To achieve educational objectives in their respective educational settings, students with disabilities must be provided with AT devices to compensate for diminishing physical and cognitive facilities (ADA, p.2.).AT can be used to design, modify and differentiate instruction, or customize instructional delivery to augment the needs of students with special needs across their lifespan. AT can cater to impairments or disabilities of students with special needs by providing guidance to improve learning ability of all students regardless of their disabilities. Educators can use AT to create visual aids, auditory aids, outlines and concept maps for students who have difficulty comprehending a complex concept. In language arts, teachers can use recorded books or optical readers to help students with special need read. Teachers can use AT to develop hands-on minds-on inquiry- based activities commensurate with the learning ability of students with special needs, just as they differentiate lessons to meet the individual differences of all students.

What is AT?

AT is special tool designed to enhance academic outcomes, performance, and longevity of all individuals not just students with special needs in the general classroom. As defined by the Individuals with Disabilities Education Act Amendments of (IDEA), AT is "any item, piece of equipment, or product system that is used to increase, maintain, or improved functional capabilities of individuals with special need" {Part A, Sec. 602 (1)}. It enables all students to be successful in the general education classroom (Moore, 2012, p.37.) IDEA (2004) defines AT 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 an individual's functional capability for an individual with disabilities. The law strongly encouraged and enforced AT development and implementation to enhance instruction of students with special needs in the classroom. The U.S. Congress supported the effective use of AT in the classrooms on two fronts. First, AT can be used to reduce cost and eliminate potential barriers that may block instruction and improve teachers' ability to better address the needs of all students. Second, AT can be used to provide compensatory supports for students with disabilities as required by law. Education professionals are required to consider AT when developing individual program plans for all students with disabilities in public school settings as potential for compensating for the effect of any disabilities or impairments the user might have. AT is a tool that is capable of increasing, maintaining, or improving the functional capabilities of students with special needs. It is a tool that "sustains life, protect the special need student from bodily injury, promote communication, increase mobility, improve cooperative interaction with the environment, and allow the individual to participate in recreational or fitness related activities" (Krieg-Bruckner, Shi, Fischer, Rofer, Cui, & Schill, 2009; Shi, Krieg-Bruckner, 2008; Rofer, & Laue, 2009; Marino, Marino, &Shaw, 2006).AT can facilitate students with special needs' ability to build cognitive links between lesson representations by providing quick access to multiple representations (Krieg-Bruckner et al, 2009; Shi, et al., 2011).AT has the potential to stimulate and foster problem-solving solution strategies and the internal locus of control of students with special needs. AT devices enable students with special needs to receive special education, significantly improving their physical and psychological wellbeing by enhancing their social and life skills. Using AT, students with special needs are encouraged to pursue their own strategies for solving real life problems, and in doing so they demonstrating that they are in control of their own learning. As cognitive tools that support problem-solvers critical thinking and engagement AT "such as closed circuit monitors, Braille readers, voice-activated software, TTY telephones, and motorized wheelchairs, students are able to participate in educational activities that might have been difficult or impractical otherwise" (Moore, 2012, pp. 97-98; Smith & Dangiolo, 2009; Cook & Hussey, 2010; Day & Huefner, 2010). Other assistive technologies include adaptive keyboards, assistive-writing programs, eye-gaze technology, interactive SMART Boards, screen readers, touch screens, voice recognition and voice production software, wireless headsets, amplifiers, switches, and table PCs. Assistive devices of all kinds that provide visual, aural, or tactile support greatly extend the capabilities of students to use the computer effectively. AT is viewed as essential part of instruction to help students with special needs develop basic and critical thinking. It makes it easier for students with disabilities to overcome their disability and succeed academically. Under IDEA, all students with disabilities are entitled to accommodations and academic services to assist them in achieving in school and beyond. Commonly, these accommodations include technology tools known as AT. Tools falling under this category, which range from simple to complex, make knowledge more accessible to struggling student's skills, skills that would have been otherwise

impossible, impractical and costly.

Today, teachers use AT to design, modify and plan effective instruction, to teach inquiry-based lesson, and as instructional tool to help students with special needs. AT connects special needs student's cognitive abilities to an educational opportunity that may not be available due to a disability. AT increases the independence of students with special needs in daily activities, academic, or vocational work (Shi, et al., 2011). AT ranges from computers, software, modified desks, writing aids, paper holders, tape recorders, audio books, headphones, visual timers, page turners, books holders, and Rolland wheelchairs. The use of or modification for use in educational purposes can enable people of all ages with disabilities to benefit from educational programs. AT use by the students with special needs and students with disabilities can be applied within one or more of four functional areas in home, community and school environments: communication, manipulation, mobility, and learning (Moore, 2012, pp. 97-98; Smith & Dangiolo, 2009).

Mobile technologies, such as smartphones and tablet computers are profoundly impacting the way students send and receive information, thus revolutionizing the education of all students. They provide new channels for social mobility outside the limits of space and time. Students can communicate, collaborate, and share all sorts of information and files nationwide with friends and family members. They can interact and socialize crossing geographical boundaries and bridging many obstacles between individuals. This revolution opened new ways of communication such as email, online forums, blogs, and social networking

2. Communication

Some students with special needs, particularly students with physical disabilities, present severe communication impairment and complex communication needs (Sigafoos, 2010). To remedy this situation, immediate and effective intervention strategies are needed because without good communication skills all students will be at a severe disadvantage. AT has the potential of reducing this impairment and improving the overall quality of life; of students with developmental and physical disabilities to enable them to communicate effectively and appropriately (Lancioni, O'Reilly, Singh, Buoncunto, Sacco, Colonna, Navarro, Oliva, & Megna, 2010; Dangiolo, 2009; Schlosser, Wendt, &Sigafoos, 2007). Communication disorders involve vocal and/or hearing impairments and extensive motor disabilities. Today, microswitches exist that may be attached to a communication device that a person with communication impairment may use to control environmental events with minimal responses. For example, a touch sensitive pad that detects the person's finger movements and is connected to a communication device and a verbal statement may enable the person to communicate through movements of the fingers.

Language Learning Communication

Sigafoos (2010) asserts that students with special needs may have problems with understanding spoken or written language. Encouraging students with special needs to communicate appropriately across various disciplines and environments should be the primary objective of language programs. AT can help all students to develop the needed skills to interact with their environments. To overcome this language barrier AT can be used to help students with special needs speak, write and spell. Pronunciation difficulties can be remedied by using various AT devices to learn pronunciation as well as talking. In some cases, if organization poses a serious problem for all students, they can use electronic organizers to organize their work. Students with special needs who have trouble understanding the sequencing of words or letters may use word scanners, audio books and players, alternative keyboards, text readers, voice-recognition software, or word-prediction software (Olsen, n. d. a).

Speech Communication

A speech-language impairment can hinder special needs student's ability to interact with the immediate environment. Students with special needs who have trouble communicating can use AT to help them communicate with others. The AT specialist and speech-language pathologist play vital roles in the referral and assessment process by creating support for successful learning to occur in the classroom (Beard, Carpenter, & Johnson, 2011; Dangiolo, 2009; Shi, et al., 2011). AT that is available for all students are voice-output devices, pantomime, pocket translators, pictures and symbols on paper, electronic switches, and computer-generated speech-output devices. Receptive communication software can also improve the quality of speech communication of students with special needs. Additionally, text-to-voice and voice-to-text software, touch screens that give choices for communication, and translating devices can help those with mild speech disorders on an as-needed basis or can provide a communication lifeline for those whose speech is profoundly affected. An electronic communication device with speech output has potential of changing the life of special need student who has speech impairment.

Reading Comprehension

Students with special needs with reading skills may have trouble gaining meaning from text without supervision. Light-tech reading supports, such as magnification are available for all students to learn reading on their own. Text-to-speech software assists students with reading difficulties and visual impairments. Concept-mapping software is a helpful resource for visual learning, planning, and collaboration. Audio books, players, and scanners with optical character recognition and computers with text reading software can help them bridge the gaps in their reading skills, and pens that recognize specific words or letters can also help students better understand information. Computer applications such as word processors with spell and grammar check, font size and color options can aid

students with special needs with reading skills (Bauer and Ulrich 2002; Alvermann, and Moore, 1991). Some notable programs that can also aid students with special needs improve their reading skills are speech recognition software that takes the spoken word and convert it into written text. Other Devices such as smart phones, eReaders, visual thesauri, iPod eBook creator, bubbl.us (a graphic organizer for students to create a visual representation of text to assist in comprehension) and other compensatory technology can also improve the reading ability of students with special needs. Reading difficulties can frustrate, embarrass and reduce enthusiasm in students and present significant barriers to students with special needs as they progress through school. Teachers are encouraged to use E-books accessible with screen-reading software to help these individuals read.

Listening Communication Devices

A classroom lecture can pose a serious challenge to students with special needs' ability to learn. Students with special needs who have difficulty hearing speech or who need to hear certain sound in noisy situations benefit from using an LCD. One of the examples of LCD is the white model Super Shaker from Sonic Alert will alert even a heavy sleeper. Simply place bed vibrator under your mattress or pillow and plug it into any specialized wake-up alarm clock. This works well with white model Sonic Boom clocks. The LCD devices can help students with special needs with hearing loss problems by reducing the effect of distance between the sound source and the person making the sound (Olsen, n. d. a). It also overrides poor acoustics such as echo. It allows students with special needs to attend work-related conferences, performers, television shows and other sounds more effectively. LCD allows students with special needs to amplify the sound of the teacher's voice while filtering out unwanted noises, such as the sound of other students talking, chairs scraping or someone typing on a keyboard. This type of device improves on previous hearing-aid technology, which simply amplified all sounds (Olsen, n. d. a; Lancioni, O'Reilly, Singh, Buoncunto, Sacco, Colonna, Navarro, Oliva, & Megan, (2011; Shih, et al., 2011). There are several types of assistive listening devices such as hearing enhanced headphones, door transmitters and signalers, alarm clocks and bed shakers, vibrating wrist watches and vibrating alarms that can help students with special needs function better in day-to-day communication situations.

Alert Communication Devices

Students with special needs can enjoy and exercise their rights by using audible alert devices. Alert devices such as telephones, baby signalers, door/knock sensors, smoke detectors, silent call, sonic alert, smoke alarms that come with flash lights or vibrating devices can help students with special needs to communicate effectively when communication situation is warranted. Students with special needs can carry the device with them, put the device under the pillow or attach to the bed (Olsen, n. d. a; Shi, et al., 2011). These devices are available for doorbells, smoke alarms, weather and emergency alerts, telephones, motion sensors, alarm clocks, baby monitors and doorway mats to help students with special needs gain normal life. Telephone ring signalers alert students with special needs to any phone ringing. Wireless doorbell signalers will alert students with special needs when it receives signals from the signalers. Sonic Boon Alert Clock/Receiver which is alarm clock with a built-in receiver that can wake up students with severe hearing impairments. Students with special needs can wake up because of the loud pulsating audio alarm, flashing lights or shaking bed (bed vibrator attached to the bed).

Sound Amplification Communication Systems

Sound amplification systems can help students with special needs' voice become louder and can be an effective tool in a large school auditorium that has a poor acoustic quality. The instructor uses a microphone as he or she talks, and a speaker is placed near the person who will benefit from the sound amplification system (Roth, 2009). In addition, telephones can be fitted with amplifiers to make telephone conversations more comfortable and productive for a person with hearing loss" (Roth, 2009). Wilson, (n. d. a), research findings indicate that sound-field amplification can support and benefits for both students with special needs and teachers are in the classroom by:

"Improved academic achievement, especially for younger students; decreased distractibility and increased on-task behavior; increased attention to verbal instruction and activities and improved understanding, decreased number of requests for repetition; decreased frequency of need for verbal reinforcers to facilitate test performance; decreased test-taking time; improved spelling ability under degraded listening conditions; increased sentence recognition ability; improved listening test scores; increased language growth; improved student voicing when speaking, Increased student length of utterance; increased confidence when speaking; increased preference by teachers and students for sound-field amplification in the classroom; improved ease of listening and teaching; reduced vocal strain and fatigue for teachers; increased mobility for teachers; reduced special education referral rate; increase in seating options for students with hearing loss; Cost-effective means of enhancing the listening and learning environment" (Wilson, n. d. a).

Voice Amplifiers Communication

Students with hearing difficulties will find it much easier to participate actively in class when provided a voice amplifier. These tools fit in the ear and increase the volume of spoken words and ambient sounds within the classroom. This boosted volume can make it possible for a student who lacks the ability to hear a lecture to follow along during class. Voice amplifiers work by increasing the volume of your voice, which increases comprehension of your vocal communication.

Magnifiers Communication

For visually impaired students, seeing the textbook or computer screen can present quite a challenge. Examples of assistive devices that can provide access to information for students with special needs with vision impairment include magnification aids (optical and nonoptical), such as

handheld magnifiers, stand magnifiers (some with built-in lights), prisms of special lenses built into glasses to extend visual field, telescopes worn on the head or held in the hand; enlarged print books and enlarged print computer screen, high intensity lamps, and high contrast colors on print. These devices can transform small text to large print with the aid of a magnifier. Teachers can provide the student with a hand-held magnifier to move over books as he reads, or a large magnifier to attach to the computer screen. Also, consider using the enlarge function, available on most computers to magnify the font and icons on the computer screen, making them visible to the struggling student. Provide electronic aids, such as closed circuit television devices with larger image size, automatic reading of text, talking books, newspapers, magazines on cassette or diskettes.

Voice Recognition Software Communication

"Students with physical limitations that prevent them from both writing and typing can effectively communicate with the use of voice recognition software" (Schreiner, n. d. a). In addition, all students may use scribes, or individuals who followed them around and recorded their responses for them as they go. Voice recognition software eliminates the necessity of scribes, making the student more independent and capable of recording his own responses without assistance (Schreiner, n. d. a).

Augmentative Communication

Augmentative and Alternative Communication (AAC) can be a range of non-speech methods of communication, including gesture, manual signs, picture or symbol-based communication systems, and computer-based speech-generating devices. The device acts to compensate for the student's full communication capabilities, including any vocalizations, and aided communication with severe expressive communication impairments have difficulty communicating with peers and adults within their environments. It is used to augment unintelligible speech and provide an alternative when speech and language development is significantly delayed or severely impaired (Sigafoos, 2010). A range of light technology to high AAC technology solutions are available that can positively impact a range of functioning areas of students with special need besides communication. AAC users can gain more fulfilling life experiences from the following technologies, such as object-based communication displays, picture communication boards and books, alphabet boards, talking switches, light technology voice output communication devices, middle technology voice output communication devices, high technology voice output communication devices, and integrated communication solutions (Sigafoos, 2010).

Physical Aids Communication

AT can assist students with special needs in all aspects of lives. Physical aids can assist students with physical disabilities in controlling electronic appliances within the school and home. These devices allow the student to use an alternate input device such as a microswitch to control one or more electronic appliances such as lights, televisions, and electronically controlled doors. Examples of devices to assist with activities of daily living include voice output or Braille operating appliances, talking wrist watches and paper money readers. Examples of devices to ensure safe travel include canes, laser or sensor canes, and wheelchair-mounted sensory aides (Shi, et al., 2011).

Also, students with physical and cognitive disabilities who are enrolled in educational programs that address pre-vocational and vocational skills may benefit from the use of pre vocational and vocational aids. These types of technology solutions include modifications of the tools and manipulative used in the completion of work related tasks. Light technology solutions include grips for handling materials and stabilization devices for supporting work materials. For students using electronic appliances such as staplers and paper shredders, an environmental control unit such as the model available from Ablenet can be used to allow for micro switch control of the appliance. Many of the adaptations required for participation in work activities may be teacher constructed. For example, a picture-based task schedule can be created to represent all of the steps in a particular activity for students with intellectual disabilities (Cook & Hussey, 2001; Galvin & Scherer, 1996; Hawking, 1994; Lazzaro, 1998).

3. Conclusion

AT devices, such as smartphones and tablet PC's, hold the promise to improve education and lives of all students. To students with special needs, AT is a means of empowerment, hope and encouragement. AT typically relies on hands-on minds-on active knowledge construction that provides students with special needs with "real-world" experiences. Providing all students with AT programs may be their best chance for success both inside and outside the classroom. Denying them these options may exacerbate their special needs effects. Educators, parents and learning community must continue to express concerns with the welfare of students with special needs and continue to act as strong advocates for equitable distribution of AT resources to people with special need. Finally, educators, institutions, instructional designers, curriculum designers and government agencies must consider meeting the need of special needs students in their various fields by providing accommodations for all students to succeed academically.

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