Incorporating Assistive Technology for Students with Disabilities

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In the past three decades, there has been a growing exploration and recognition of the importance of assistive technology (AT) in the lives of students with disabilities in various forms of academic settings. The rapid expansion of the many uses of technology and computers in almost every aspect of our lives in general, and in most of our educational settings in particular, has drawn the attention of researchers regarding the impact of technology as a mediator in the learning achievement and performance of individuals with disabilities (Adebisi, Liman & Longpoe, 2015; Alper & Raharinirina, 2006; Atanga, Jones, Krueger & Lu, 2019; Blackhurst & Edyburn, 2000; Goor, Schwenn & Boyer, 1997, King-Sears, Swanson & Mainzer, 2011; Stearns, 2012). This awareness has pushed the agenda of policymakers worldwide to provide assistive devices needed to promote self-care, education, employment, leisure, and recreation for learners with disabilities (Ajuwon & Chitiyo, 2016). It has also brought to the forefront the need for effective legislation to train professionals in AT and to provide necessary supports for school principals, teachers, and educational providers to alleviate the learning and social inclusion gaps.

Background

As the vast majority of educators and policy makers strongly promote the philosophy of including individuals with disabilities to the maximum extent in the least restrictive environment (Howard, 2004; Rozalski, Stewart & Miller); the need to meet such an educational approach is critical and the challenges for adjustments and accommodations for all children and adults with disabilities are great as well (Marshak, Van Wieren, Ferrell, Swiss & Dugan, 2010; Owuor, Larkan, Kayabu, Fitzgerald, Sheaf, Dinsmore, ... & MacLachlan, 2018). According to the mandates in the Individuals with Disabilities Education act of 1997 (IDEA), all students must have the opportunity to access the core curriculum (Irish, 2003). Among those integrated individuals with disabilities are students with learning disabilities (LD) who are considered to be the largest student population with disabilities to be integrated within the general education system.

Since the reauthorization of the Individuals with Disabilities Education Act (IDEA) in the United States which was passed in 1997, the number of LD students who are included within the regular education system and taught in general education classrooms has increased consistently and substantially (Kim, Woodruff, Klein, & Vaughn, 2006; Perelmutter, McGregor & Gordon, 2017). According to the report of the US Department of Education in 1994, over 70% of LD students were integrated in the regular education classroom (Koury, 1996). Later the US Department of Education (2000) reported

that over 80% of LD students spend more than half of their learning time in regular education classrooms. In a recent report, the National Center for Learning disabilities (2016), indicated that 70% of students with specific LD spend more than 80% of their academic day in the general education classrooms.

This substantial increase in the percentage of integrated students with LD in the general educational system has drawn the attention of researchers and educators, who have tried to explore more educational methods and strategies that target their learning engagement to the maximum extent by examining the effect of AT on their learning performance (e. g., Anna Courtad & Bouck, 2013; Carver, Ganus, Ivey, Plummer & Eubank, 2016; Hall, Huges & Filbert, 2000; Hutinger, Johanson & Stoneburner, 1996; Raskind & Higgins, 1998; Watson, Ito, Smith & Andersen, 2010).

Students with LD experience significant difficulties with learning and grasping academic concepts in these settings, due to their processing deficiencies and social and behavioral adjustment problems. They are cognitively challenged in many areas, such as comprehension, organization, retaining information and linking it to prior knowledge, which affect their performance in reading, writing, math, reasoning, and grasping abstract concepts (Cheung & Slavin, 2013; Floyd & Judge, 2012; Hetzroni & Shreiber, 2004; Maccini, Gagnon & Hughes, 2002).

A major goal for educators working with LD students is to provide appropriate support and alternative teaching strategies to enhance their performance in academic and social skills to the maximum of their potential abilities (Hetzroni & Shreiber, 2004; McArthur, Ferretti, Okolo & Cavalier, 2001). One of the promising fields in education that is connected directly with the work of both teachers and students is the use of technology and computers in various ways to promote their learning (Maccini et al, 2002; McArthur et al., 2001). Recently, technology has been viewed as a promising instructional tool to mediate and accelerate the learning of all students, including those with various types of disabilities (Kim et al., 2006; Edyburn, 2004; Poonam & Nitika, 2017; Svensson, Nordström, Lindeblad, Gustafson, Björn, Sand,... & Nilsson, 2019; Stauter, Prehn, Peters, Jeffries, Sylvester, Wang & Dionne, 2019).

The importance of using technology in education has been widely discussed in the literature over the last three decades (e.g., Behrmann & Jerome, 2002; Bouck, 2010; Bouck, 2016; Bouck, Flanagan, Miller & Bassette, 2012; Hutinger, Johanson & Stoneburner, 1996; Kim et al., 2006; Poonam & Nitika, 2017; Raskind & Higgins, 1998). Just to give a brief glimpse of the growing interest of researchers regarding the integration of technology in the field of special education, a one year review of published articles in 31 international journals in the fields of early childhood, regular and special education, and technology in 2001 yielded 192 published articles related to assistive

technology or and computer assisted instruction (Edyburn, 2002). In another review that was conducted by the Edyburn, two years later, a total number of 224 studies were located with a direct connection to special education and technology (Edyburn, 2004). In the recent years, the number of studies conducted on this topic has just increased.

Categories of Technology Integration

Recently the literature identified two main categories that include technology integration in the field of education for students with disabilities: a) tools that are used as a tutor and aim to enhance the learning skills, and b) tools that assist students in engaging in the learning activity (Sun Associates, 2010). Emerged from those two categories, four subcategories that have been identified as specific tool for the learning improvement. They include: a) technology used as stand-alone activity which provides instructions that are independent of the core school curriculum, b) technology that provides more independent learning chances and various practice drills, c) technology that is embedded into the teaching process, and d) technology for at risk students to accommodate for their skill deficits, especially for students with mild disabilities. When technology is being used as a stand-alone instruction, students would interact with the program and receive integrated practice as opposed to direct teaching where the teacher in the center. Such programs, are described as computer-based or web-based programs or interventions and they are designed specifically for struggling students.

The second major category in technology is to be used as an embedded instruction. The instructor uses graphic organizers, maps, or virtual manipulatives to illustrate concepts and to provide another method for those who have difficulties grasping concepts in a direct teacher-led fashion (Lacina, 2006). Those activities can be used with interactive tools to assist the learning, such as whiteboard, desktop computers, tablets, or other mobile devices. Interactive devices can help with the learning planning, analyzing, organizing, and summarizing of the materials.

Continuum of Assistive Technology

Assistive Technology (AT) has been regarded as a pivotal instrument in the educational system for all students in general and for those with disabilities in particular. AT defined as technology that increases, improves, or maintains the functional capabilities of students with disabilities (Mittler, 2007). It is designed to create more independence for individuals with disabilities to overcome environmental barriers that may hinder their learning in the various educational settings (Rose, Hasselbring, Stahl & Zabala, 2005).

AT devices are 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” (IDEIA, 2004b).

Similarly, AT services can be defined as “any service that directly assists a child with a disability in the selection, acquisition, or use of an assistive technology device” (IDEIA, 2004c).

Blackhurst (2005) explores the various types and designs of assistive technology (AT) methods that have been developed and used in the educational arena to promote the learning and educational environment of students with learning disabilities. AT includes mechanical, electronic, and microprocessor-based equipment, non-mechanical and non-electronic aids, and specialized instructional materials, services, and strategies that people with disabilities can use to (a) assist them in learning, (b) make the environment more accessible, (c) enable them to compete in the workplace, (d) enhance their independence, or (e) otherwise improve their quality of life.

Among these AT services Blackhurst (2005) suggests productivity tools which include computer software, hardware, and related systems that enable people to work more effectively and efficiently. For example, computer software such as database programs can be used to store and rapidly retrieve information; word processing programs can be used to easily edit text material; expert system computer programs can aid in decision making, such as the educational placement of students with disabilities. The use of productivity tools with LD students can include specialized writing tools, such as writing organization tools, spelling checkers, speech synthesis and word prediction software, writing prompts, and multimedia composing tools (Blackhurst, 2005).

The Use and Importance of Assistive Technology

While it is important to understand the various uses of AT and computer based instruction, our primary concerns should relate to issues such as making decisions about the types of technology that are most appropriate for individual students with disabilities and ensuring that those technologies are obtained, implemented appropriately, and evaluated to determine their effectiveness (Alper & Raharinirina, 2006; Goegan, Le, Rioux & Daniels, 2019). Generally, AT implies different things to different people.

AT may refer to the use of different technological resources to support individuals with different types of disabilities to acquire social benefits and to reduce the negative influence of their disabilities on their well-being and community participation. For others, AT may relate to a wide spectrum of tools, technological aids, strategies, services and practices whose main objective is to improve the quality of life of persons with disabilities (Owuor et al., 2018).

The National Center on Educational Statistics, according to the U.S. Department of Education report, illustrated the degree to which the use of technology, particularly computers and the Internet, has become a pervasive part of the educational system

(Wehmeyer, Smith, Palmer & Davis, 2004). The various uses of electronic technology and computers among children and youth between the ages 5-17 in the US at the national level exceeds 90% of the students. Three out of four children at the age of 5 uses computers, and over 90% of the youth have access to a computer either at home or at school. (Wehmeyer et al., 2004).

Special education teachers in general promote the use of technology in teaching basic skills such as literacy and math. A recent study conducted with 1,000 special education teachers showed that 85% of the teachers use technology in teaching literacy. In addition, 97% of those teachers believe that technology can help students with disabilities acquire basic literacy skills (McArthur, et al., 2001). Further, the IDEA amendment of 1997 mandates that assistive technology (AT) needs of all students must be considered as part of the individualized educational program planning process (Alper & Raharinirina, 2006).

Raskind and Bryant (1996) emphasized the importance of selecting the most appropriate technology for individuals with learning disabilities, which requires a careful and systematic plan. Acknowledging the fact that individuals with learning disabilities have their own unique set of strengths, weaknesses, special abilities, interests, and experiences, they noted that not all assistive technologies are appropriate for all individuals in all situations. Therefore, a technology that may be appropriate for one person may be inappropriate for another. Similarly, a technology that is helpful for one purpose in one particular setting may be irrelevant in another situation or setting. Consequently, selecting the appropriate technology for an individual with a learning disability requires careful analysis of the interplay between the individual, the specific task/functions to be performed, the specific technology, and the specific contexts of interaction (Raskind, & Higgins, 1999).

Finally, without assistive technology and accessible environments, children with disabilities may NOT be able to:

- go from home to school,
- see what is written on the blackboard,
- hear and understand the teacher,
- read the textbooks,
- Use sanitation facilities,
- participate in sports and recreation,

- interact with classmates

Continuum of Assistive Technology

Students with disabilities are being treated and educated in settings that often can be without sufficient tools that meet their needs. They may receive educational assistance that does not necessarily requires technology, such as physio therapy or occupational therapy for their gross or fine motor skill. This would be considered as a no-tech assistive technology.

Others may need more specific help that demand the use of different degrees of technology in the like of low tech technology, mid-tech technology, and high-tech technology (Edyburn, Higgins & Boone, 2005; Zabala & Carl, 2005).

Low-tech Assistive Technology. Technology in general does not make the disability vanish, rather it lessen its impact on individuals with disability. There are, however, simple technologies that considered to be essential for individuals with disabilities. Such technologies are called Low-tech. Low tech AT are devices or equipment that do not require much training, may be less expensive and do not have complex or mechanical features. Such technologies include, ramps, switches, switch-operated toys, communication boards, car door openers, roll-in showers, handheld magnifiers, large print text, using paper and pen to communicate, canes and walkers, grabbers, specialized pen or pencil grips, post-it's, highlighter, squishy ball or sensory input, tactile ruler, page protector or colored transparency, manipulatives and much more.

Mid-tech Assistive Technology. AT devices or equipment that range in the middle of the continuum may have some complex features, may be electronic or battery operated, may require some training to learn how to use and are more expensive than the low-tech devices. Some examples include: manual wheelchairs, electronic organizers, Closed Caption Televisions (CCTV's), amplifiers, books on CD or E-Reader, environmental control units (ECU), alternate mouse or keyboard for the computer, braille translation software, switch adapted games or toys, adapted switches, adapted seating, adapted keyboard, calculator, electronic speller or dictionary, word prediction software etc.

High-tech Assistive Technology. High Tech AT refers to the most sophisticated devices or software, that have digital or electronic components, may be computerized, will likely require some training and effort prior to apply them to learn how to use. This is what we consider to the kind we "plug in." This is the most intense and expensive form of technology. Examples of High-tech AT may include: power wheelchairs and scooters, digital hearing aids, computers with specialized software such as voice recognition or magnification software, electronic aids to daily living, digital hands-free headsets, voice activated telephones, communication devices with voices, blue-tooth integration, digi-

drive technology, portable word processor, text to speech, speech to text, smart board, alerting device.

In our modern societies, one cannot avoid using different types of AT devices. However, due to its cost and complexity, some families of children with disabilities may not be able to afford high-tech AT devices. Therefore, solutions of low-tech AT should be offered to those children. Low-tech assistive technology might be a better option for many children because it involves incorporating furniture or toys that a family already owns and with which the child is already familiar. Low-tech assistive technology can be adapted quickly to meet the different needs of children as they grow and change. Family members can make these changes as they need to do so, without relying on a specialist. Low-tech is usually less expensive and requires fewer repairs. By trying out low-tech options first, families can help their children participate more naturally in family routines and activities.

Benefits of AT on Students with Disabilities

AT has the potential to increase developmental skills and provide solutions to challenges, such as behavior, attention, and communication, faced by students identified with disabilities (Parette & Stoner, 2008). Since the IDEA 2004 mandates for the provision of AT for all students with disabilities upon their educational or functional needs, researchers report on many benefits of using AT to support students with disabilities. While all learners are different, such benefits may include: a) provision of practical options for supporting students with disabilities in their least restrictive environment, may be used to enhance a student's communication skills, b) can support student's access to academic instruction, c) may be used to create visual supports and positive behavior support systems for students (Parish, 2017).

Chiang and Liu (2011) in their research on the benefits of assistive reading software noted that children with reading impairment could benefit from assistive technology in regards of their reading development process and increase their chances of not falling behind peers. Further, AT as in the form of smartphones and tablets may assist children with reading impairment to have an equal chances for learning in school as their peers without reading difficulties. Furthermore, AT could facilitates information gaining process, and subsequently increases motivation and interest to learn in reading activities. Finally, the authors noted that AT had wider effects on its users due to reducing stigmatizing situations when learners with learning disorders leave the classroom for special education were avoided and positive effects on family life were noted.

In their review of the literature on the benefits of AT Copley and Ziviani (2004) noted that one of the chief benefits of AT use that is highly relevant for children with multiple disabilities is as a means of enabling mastery or control over their environment,

including enhanced exploratory play and independence in activities of daily living. The authors indicated that facilitation of independence was among the most frequently cited benefit by parents and teachers. Further, they added, among the benefits enhance social interactions among peers, increased motivation, and reported self-esteem. Another area that AT beneficial for children with disabilities as noted by Copley and Ziviani (2004) is the improvement of academic skills, such as hand writing, motor skills, reading acquisition and comprehension, visual attention and perception, and mathematic skills. Finally, AT has improved the overall working habits and productivity of children with disabilities.

Challenges and Barriers to AT

Although AT considered as an essential component in the education of students with disabilities, it is however, a challenge for many parents, students and educators. AT intended to facilitate psychosocial functioning, lack of resources to purchase AT equipment constitutes an environmental barrier. Scarcity of trained teachers to assist in choosing and obtaining AT devices also represents a barrier within the social environment and educational setting (Scherer & Glueckauf, 2005). Scherer and Glueckauf (2005) in their review to the provision of AT noted that despite the increased availability of AT, approximately 30% of ATs are discarded within 1 year. They referred this to several reasons, including the product not meeting user expectations or needs, setting the user apart from others, and failing to save time or energy. Further, it is the understanding that AT features designed to address one need may negatively affect other needs. One example Scherer and Glueckauf (2005) provided: a device that is highly customizable may have many features and optional controls that makes it too complex for someone with a cognitive disability to handle it alone.

Copley and Ziviani (2004) conducted an intensive literature review on the application of AT for children and youth with multiple disabilities and noted that the barriers were found include: a) lack of appropriate staff training and support, b) negative staff attitudes, c) inadequate assessment and planning processes, d) insufficient funding, e) difficulties procuring and managing equipment, and f) time constraints. Much of the literature emphasize the role of the teacher in the day to day implementation of technology. Lack of appropriate preparation for those teachers resulted in lack of applications of the AT, lack of familiarity with the equipment, incomplete awareness of the application, and negative attitudes towards the implementation of such devices and programs with the children.

Assistive Technology Frameworks and Aplications for Students with Disabilities

With the digitized revolutionary era, one cannot ignore the rapid change in the modern life in terms of the various available choices of AT devices and programs. To name just

few of them, recently we have witness high-tech AT apps of touch phones and smart devices, in the form of memory applications, emotional, social, and directive and so on. The following are just few examples that are mostly available for free of charge:

1. **Be my eyes app**. for the blind, is a free app that connects blind and low-vision people with sighted volunteers and company representatives for visual assistance through a live video call. It has been translated into more than 80 languages around the world.

2. **Autism Xpress.** A simple app designed to help young people with autism express their emotions. Autism Xpress uses a feeling finder and games in a fun and easy-to-use package.

3. **Voice Dream Reader.** For children and adults with reading disabilities and ADD/ADHD, Voice Dream Reader allows a student to highlight text which will then be read to them. For a learner who comprehends things better aurally.

4. **Stop, Breathe & Think.** Fantastic for students with anxiety and stress disorders, this is a meditation app which encourages users to think about how they're feeling, while also providing short mindfulness and meditation exercises tailored to their mood.

5. If… The Emotional IQ Game. Fantasy game promotes real-life social and emotional skills. If… helps children aged between 6-12 years develop the skills that lead to emotional intelligence. Parents and teachers can view reports on a student's progress, potentially opening further productive conversations and opportunities.

6. **Dyslexia Toolbox. A** free app on Apple iTunes and a recent addition to the Apple app store Marketed as being "by dyslexic people, for dyslexic people", this toolbox features a whole host of assistive technology features for K-12 students with dyslexia. Type pads, word prediction, digital overlays and text readers are all included.

7. **My Talk Tools Mobile.** This is an innovative app which enables students with communication difficulties to say what they want, using a sequence of words, sounds and images. A good solution for people with down-syndrome, cerebral palsy, hearing or visual impairments, and autism. It can be configured to feature certain images and play certain sounds, so it can be set up for a particular student to best aid them.

8. **ModMath.** ModMath is a free app for the iPad, targeted at helping students with dyslexia and dysgraphia do math. It was created by parents of a child

with dysgraphia, and remains focused on providing a clear tool to solve math problems without ever picking up a pencil.

The SETT Framework

In an educational framework developed by Zibala (2005), the researcher suggested that for students with disabilities to progress in learning there should be four components interact with each other: a) student, b) environment, c) tools, and d) task. At least one key question should be asked by the educational team for each of the four components for the purpose of considering the appropriate assistive technology for students with disabilities. As for the student, a teacher should ask: what is the area of instructional concern and what are the student's current abilities? For the environment, the questions that should be posed are: what are the main characteristics and physical arrangement of the learning environment of the students? This may relate to the learning setting, such as learning in small group, a whole class, or pre designed learning stations. As for the task, the teacher should ask: what are the task expectations and specific learning tasks required to enhance student's achievement and performance? Finally, for the framework to be more effective the teacher should be concerned of the AT that is suitable for each of the students. The question to be asked here is: what tools or devices (low or high tech) should be used to support the student's learning?

According to Zibala (2005) the SETT framework is built on the premise that AT teams must first gather information about the student, the customary environments in which the students spend their time, and the tasks that are required for the students to be active participants in the teaching/learning processes that lead to educational success.

To conclude, AT is a powerful tool that teachers, parents and children with different types of disabilities can rely on and benefit from. The benefits of applying AT in educational settings and day-to-day conditions for students with disabilities in general and for those students with LD who are fully included in mainstream classroom obviously overcome its shortages. What is needed to succeed in applying such technology, is to continuously train teachers and parents on the use of such devices and programs, to make sure they are aware of its importance to the learning and development of children with disabilities, and to make sure that the school setting is equipped with the necessary structure and technology devices.

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