

Using Assistive Technology to Enhance the Learning of Basic Literacy Skills for Students with Learning Disabilities

By

Faridah Serajul Haq & Hala Elhoweris

Faculty of Education, United Arab Emirates University
Department of Special Education, Faculty of Education, UAEU, Al-Ain City, UAE,
P. O. Box 15551 Email: halae@uaeu.ac.ae

Abstract

An important component of special education is the provision of quality education for all students with disabilities irrespective of the severity of the disability. Quality education in both primary and secondary schools emphasize access to the general and functional curriculum with appropriate adaptations and modifications made to promote and enhance learning. Almost all students with learning disabilities are taught basic literacy skills which are essential for independent living and employment. However, for many students learning reading, writing, and mathematical skills is challenging because of difficulties related to memory, language deficits, and poor study skills. Therefore, this paper attempts to highlight the potential of using assistive technology in the classroom to improve students with learning disabilities academic performance. Additionally, this paper will provide guidelines for all teachers, specifically for selecting appropriate assistive technology to meet their students' individual needs.

Keywords: *Assistive Technology, Learning Disabilities, Literacy, Mathematics, Instruction*

1. Introduction

John is an elementary school teacher. One of his students, Mike, has a severe learning disability that causes him to have trouble reading textbooks. He reverses the letters and write backwards most of the time. On the last reading exam, Mike earned a "D" on the test. Mr. John felt this was a fair grade because most of Mike's peers scored much higher on the test.

Sara is a 4th grade student. She has particular problems with mathematics. It appears that she falls below her classmates in word problems, multiplication, division, and fractions. Sara likes working with peers and using computers. However, Sara's math teacher is faced with an overwhelming number of assistive technologies. She felt so disappointed because she doesn't know how to select the appropriate assistive technology to meet Sara's individual needs.

Special education requires increasing the academic standards of students with disabilities and monitoring of their achievement in an effort to improve the quality of education. Quality education focuses on appropriate special programs which promote and enhance learning. The ability to learn both academic and life skills allow individuals with disabilities to be independent and achieve a higher quality of life. Recent technological advancement has indicated that special education programs that include assistive technological adaptations successfully promote academic learning and access to knowledge (Blackhurst, 2005; Forgrave, 2002; Hertzroni & Shrieber, 2004; Lueck, Dote-Kwan, & Senge, 2001; Montgomery & Marks, 2006).

Assistive technology can be broadly defined as any technology which enhances the performance of individuals with disabilities (Lewis, 1998). An assistive technological adaptation can be a device, item, equipment or product system that increase, maintain, or improve the functional capabilities of individuals with disabilities (Individuals with Disabilities Education Act Amendments, 1997). Today, the availability of assistive technology such as computers has enabled students with disabilities to acquire basic literacy

skills. Although the use of assistive technology in the classroom is widely accepted, it is a relatively recent phenomenon (Lueck, et al., 2001).

Basic literacy skills such as reading, writing and mathematics are important core curricular areas in schools. However, for students with learning disabilities, learning the essential skills and knowledge for literacy is challenging because of difficulties related to memory, retention and comprehension of basic content (Pierce & Potter, 1996). The role of assistive technology is to provide a range of instructional options to completely bypass or compensate for the disabilities (Forgrave, 2002; Lewis, 1998; Montgomery & Marks, 2006). For example a calculator helps an individual with poor computational skills to count and a word processor helps a person with poor spelling ability to write a story.

Assistive technological adaptations are therefore important to promote academic success for students with learning disabilities. The design of instruction using assistive technology should focus on the unique needs of the students, the requirements of the curriculum and the technological resources to be used for teaching (Blackhurst, 2005, National Science Foundation, 2000). The integration of assistive technology in teaching refers to systematically designed approaches that are applied in specific ways which include well-defined instructional objectives, procedures and sequenced tasks (Blackhurst, 2005). Although technology is an important part of teaching, teachers should be primarily concerned with selecting, implementing and evaluating the most appropriate technology to meet students' individual unique needs (Blackhurst, 2005; Blackhurst, 1997; Lewis, 1998).

The purpose of this paper is to demonstrate the possible application of assistive technology for instruction of basic literacy skills. First, the discussion will focus on programs for teaching reading, writing and mathematics because most students with learning disabilities are experiencing difficulties in these basic literacy skills. Second, the authors will provide guidelines for all teachers, specifically for selecting appropriate assistive technology to enhance their students' well-being.

Reading

Reading has become very important in modern societies as a component of social survival (Bryant & Bryant, 2003). Reading is a complex cognitive activity that requires skills in word recognition and text comprehension (Forgrave, 2002). The ability to read is the gateway to both academic and life success. Many students with learning disabilities struggle to read because of their inability to retain, remember and retrieve information and to construct meaning from the text (Hertzroni & Shrieber, 2004; Salend, 2005). They have difficulty decoding unfamiliar sounds and possess limited vocabulary due to lack of reading experiences (Lewis, 1998). Young children with reading disabilities require explicit and extensive stimulation and modeling to acquire reading skills (Bryant & Bryant, 2003).

In the last few decades, computer assisted instruction has been applied to reading instruction to improve word identification and comprehension skills (Bryant & Bryant, 2003). The increase in the number and options for reading programs software has helped students to overcome their disabilities in various ways. For example scanning devices provide access to reading for students with physical disabilities.

Recent development in technology has introduced numerous reading programs software for struggling readers. *Simon Sounds It Out* and *Let's Go Read* are software programs that teach word identification skills using graphics and speech. Both programs provide practice and immediate feedback for responses. *First Words* and *First Verbs* provide tutorials and practice for matching spoken verbs to appropriate pictures. Electronic books such as *Start-to-Finish Books* use highlighting of words and speech synthesizers to teach reading comprehension. Most of the reading software programs are easy to use but certain reading software programs require requisite abilities before adaptation in the classroom. When selecting instructional software, teachers need to identify the type of assistive technological device that can remediate reading difficulties in accordance to students' individual needs (National Science Foundation, 2000).

Writing

Writing consists of two processes which include handwriting and composing. Writing is a challenging and often a frustrating activity for students with learning disabilities because they lack specific competencies to successfully accomplish writing tasks. The writing products revealed spelling errors, poor text organization, limited vocabulary and sequence of ideas (MacArthur, 2000). As students progress through the grades, writing tasks become more demanding and impaired writing ability affects academic outcomes.

Writing software programs empower students to become independent writers (Montgomery & Marks, 2006). Technology helps the student to focus on the writing process of planning and generating content instead of the mechanics of writing (MacArthur, 2000). Effective teaching methods which integrate assistive technology often result in improved written products (Bryant & Bryant, 2003). The use of assistive technology has a positive effect of compensating for writing weaknesses (Hertzroni & Shrieber, 2004). Word processors used in classrooms are motivational and beneficial for students with learning disabilities. The written products tend to be longer in length, contain fewer errors in spelling and punctuation, increase the number of revisions as well as time engaged in writing (MacArthur, 2000).

To gain maximum benefit from integrating assistive technology in writing instruction, teachers can select appropriate technology in accordance to the three phases of writing activities (Bryant & Bryant, 2003). In the pre-writing phase, students brainstorm and organize their ideas using semantic webbing. By using the computer it eliminates frequent re-writing while students reorganize ideas from varied sources. The organizational program *Inspiration* (available at www.inspiration.com) is suggested for pre-writing activities.

In the writing phase, word prediction programs such as *Co-Writer* and *Aurora* (available at www.qurora-systems.com) provide students with spelling difficulties with word choices to overcome frustration and avoidance of writing tasks. Word prediction programs are equipped with dictionaries which teachers can use to assist students to construct correct sentences and match vocabulary to the students' level of oral language competence. Word prediction programs has the additional advantage of teaching students to remember sounds of words, to identify target words from a list and to generate sentences that are grammatically correct.

In the revising phase, students are required to identify errors by reading the written text themselves. Studies have found that voice output programs identified more errors in the revision process (Bryant & Bryant, 2003; Hertzroni & Shrieber, 2004; MacArthur, 2000). When students listen and edit their work using a voice out put, the errors are tracked by highlighting the incorrect word while the document is being read. Corrections are then made when the spelling or grammatical errors are identified.

The grammar checker is an important assistive technological tool that can be incorporated in the revising phase of the writing activity. Grammar checks are effective in identifying errors of usage, syntax, grammar and punctuation but can be complex for students with learning disabilities. Teachers need to explicitly teach the terminologies of the grammar checker by incorporating it with grammar instruction and customizing the software to identify common errors made by students.

Mathematics

Mathematics involves skills in number concepts, computation, geometry, algebra, time, money, measurement and word problems (Bryant & Bryant, 2003). Students with mathematical difficulties are unable to perform mathematical skills that are necessary for academic success. Problems in numeration, counting, determining the sequence and value of numbers and understanding abstract concepts caused students to lag behind their same age peers (Bryant & Bryant, 2003).

Computer-assisted instruction can provide individualized instruction and practice for basic mathematical skills. *Mind Twister Math* teaches basic mathematical facts for addition, subtraction, division and multiplication by using a game format. *Math Pad* is an electronic processor that consists of a toolbar and worksheet to solve problems in computation. Additional features of the program include graphic presentation using charts, fraction bars and decimal grids. *Basic Coins* provide practice in identifying the value of coins by using a computerized vending machine. Students purchase various products from the vending machine through a touch screen. *Number Heroes* is a problem solving program that helps students to solve computational problems by playing a game of super heroes. Calculators are also included to solve the word problems and convert the numbers into fractions and decimals

Selecting Appropriate Assistive Technology

Assistive technology helps to circumvent students' disabilities by allowing them to work independently and effectively to improve academic performance (Lewis, 1998). Numerous computer programs are currently available to assist the teaching of basic literacy skills to students with special needs (Edyburn, 2000). However, the use of assistive technology is underutilized in classrooms because teachers are uninformed about the benefits for students with learning disabilities (Forgrave, 2002). This lack of awareness is attributed to inadequate training in technological applications for teaching and limited technological resources available in the schools (Edyburn, 2000).

Integrating assistive technology adaptation into the classroom is often quite challenging for general and special education teachers. Teachers may not be familiar with how to select the appropriate assistive technology to meet their students' individual needs. Today teachers are faced with an overwhelming number of assistive technologies. According to Edyburn (2005), there were an estimate 25,000 assistive technology products available in 2003. Therefore, it is essential to help teachers become proficient with technology integration into instruction.

In order to incorporate assistive technology for instruction in reading, writing and mathematics, teachers need to consider various elements of the technology to ensure it is appropriate for students' needs and to meet the desired educational outcomes (Blackhurst, 2005). The selection of assistive technology could be facilitated by adopting an appropriate framework for assistive technology selection. Several options of frameworks have been explored in the literature. For example, Bryant and Bryant (1998) proposed a framework that school professionals, parents, and users can use to examine an individual's needs for appropriate adaptations. Bryant and Bryant (2003) suggested the following considerations for adaptations that teachers can use to match selected assistive technology with students' skills and abilities.

1. Purpose of the adaptation
 - * Is it use for a specific target group and for specific tasks such as reading?
2. Requirements to Use the Adaptation
 - * What abilities must the student have to use the adaptation successfully?
3. Environmental Accessibility
 - * Is the adaptation transferable, easily transported and adapted for various environments such as electrical?
4. Technological Components
 - * Does the adaptation needs electrical hardware and software, voice/speech input and output, adapted keyboard and other technological components?
5. Ease of Use
 - * Is the adaptation easy to use, takes time to learn and promote student's independence?
6. Training Requirements
 - * How much training is requires for the student/family/caregivers, necessity for follow-up training and support for technological problems?
7. Maintenance Requirements
 - * Is the adaptation durable, reliable, needs regular maintenance and time to correct problems?

The SETT (Students, Environments, Tasks, and Tools) framework, developed by Joy Zabla (2002), also provides a structure for collaborative teams to create student-centered approach when selecting assistive technology. It is built on the premise that in order to select an appropriate assistive technology device, team must gather information about the student, the environments, and the tasks that are required for the student to perform. The collaborative team must consider the following factors when using the SETT framework:

1. Student
*What are the student's needs?
2. Environment
*Where will the student participate?
3. Task
*What activities is the student expected to?
4. Tools
*Are the tools student-centered?

Assistive technology must be appealing, age appropriate, fashionably, and culturally and socially acceptable. According to King (2001) assistive technology devices that look "handicapped" are not adopted. Exploration of student's motivation, opinions, beliefs and expectations regarding the AT should be considered in the selection of AT (Fuhrer & Jutai & Scherer & DeRuyter, 2003).

The selection of appropriate assistive technology is a collaborative team effort. A team of professionals should carefully evaluate the software selected to ensure the technology would maximize student's learning potential. Benefits derived from the technological adaptation can be determined by monitoring student's progress. The adaptation also needs to be evaluated when students overcome specific disabilities, change the educational setting and learn more complex skills.

2. Conclusion

A major goal of teachers working with students with learning disabilities is to provide appropriate support to enhance their academic achievement. Assistive technology that is systematically incorporated in the learning process of basic literacy skills through effective instructional practices has the potential to assist students in two important ways (Blackhurst, 2005). First, assistive technology is the tool to make learning more accessible and to increase individual motivation and productivity. Second, assistive technology empowers students to learn reading, writing and mathematical skills fluently, accurately and independently instead of relying constantly on the assistance of others.

The full benefits of applying assistive technology for teaching literacy skills is yet to be realized (Forgrave, 2002). However, the obvious benefits for improving the learning potential of students with learning disabilities have been demonstrated by available research (e.g., Blackhurst, 2005; Forgrave, 2002; Hertzroni & Shrieber, 2004; Lueck, et al., 2001; MacArthur, 2000; Montgomery & Marks, 2006). Teachers need to be cautioned that although assistive technology can help in facilitating teaching and learning, it is not a substitute for effective teaching. Technology is merely a tool whose effective use is dependent on careful planning and implementation by trained professionals.

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