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Contents

Supporting Reading Instruction Through The Use of Assistive Technological Devices for Students with Learning Disabilities

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Abstract

Many students are being identified with learning disabilities as a result of unexpected underachievement that cannot be explained by sensory impairments, cognitive or intellectual disabilities. This condition has put teachers under pressure because they are saddled with the responsibility of providing quality education to all learners in their classrooms, including those with learning disabilities. In view of this, it is believed that the achievement of students with learning disabilities can only be maintained and/or improved by providing moderate to high levels of effort and support. A typical example of instructional support that the school can provide to students with learning disabilities is the use of assistive technological devices for reading instruction. This paper therefore, examined the different kinds of assistive technological devices that teachers of students with learning disabilities can adopt for effective teaching of reading to students. The study is anchored on the SAMR (Substitution, Augmentation, Modification, Redefinition) model of classifying the use of technology in education. It also analysed typical technology-based interventions effective for supporting reading and reading instruction of students with learning disabilities. It is recommended that to use assistive technological devices effectively for reading instruction, teachers of students with learning disabilities should understand learners' differences, identify student specific barriers that occur during reading instruction and assessment that can be remedied through technology and adopt appropriate assistive technological tools to remove barriers in reading. Students with learning disabilities should be given proper orientation towards the use of assistive technological devices for reading to enable

them adopt the devices and advocate for the use of specific technologies.

Keywords: Assistive technological devices, Reading and reading instruction, Students with learning disabilities, Support

Introduction

Many students with learning disabilities experience mild to severe difficulties in different academic areas (such as reading, spelling, handwriting, oral and written language and mathematics) and in cognitive, affective, social and other non-verbal skills. Despite possessing at least an average intelligence, a student with learning disabilities often experiences a distinct discrepancy between his ability and achievement that cannot be explained primarily by problems with vision, hearing, health, social-emotional issues or lack of ability or opportunity. In its statement in the National Policy on Education (NPE), the Federal Government of Nigeria (FGN, 2013) identified ten categories of special need persons one of which are persons with learning disabilities (LD). Lerner and Kline (2006) stated that persons identified with learning disabilities comprise over 50% of the special education population. This accounts for the reason why issues concerning the provision of quality education to persons with LD are increasingly taking centre stage in the plans of many leading governments of the world such as the United States of America (USA) (Individuals with Disabilities Education Act (IDEA), 2004) and Canada (Learning Disabilities Association of Canada, 2017).

Thus, the Learning Disabilities Association of Canada (LDAC) (2017) put forward a definition of LD which was adopted by the LDAC in 2002 and re-endorsed in 2015 that:

Learning disabilities refer to a number of disorders which may affect the acquisition, organization, retention, understanding or use of verbal or nonverbal information. These disorders affect learning in individuals who otherwise demonstrate at least average abilities essential for thinking and/or reasoning. As such, learning disabilities are distinct from global intellectual deficiency. Learning disabilities result from impairments in one or more processes related to perceiving, thinking, remembering or learning. These include, but are not limited to: language processing;

phonological processing; visual spatial processing; processing speed; memory and attention; and executive functions (for example, planning and decision-making). Learning disabilities range in severity and may interfere with the acquisition and use of one or more of the following: oral language (for example, listening, speaking, understanding; reading (for example, decoding, phonetic knowledge, word recognition, comprehension); written language (for example, spelling and written expression); and mathematics (for example, computation, problem solving).

Lerner and Kline (2006) explained that considerable studies confirm that the majority of students with LD have difficulty with the reading component of the language system. Identifiable areas of reading difficulties among secondary school students with LD include problem with phonemic awareness, phonics, fluency, vocabulary and text comprehension (Lerner (2000) cited in Lazarus (2010). Considering the debilitating effects of reading problems among secondary school students with LD, educators are in search of ways of assisting students with LD to overcome or at least, compensate for their reading problems. One way to achieve this goal is through the use of assistive technological devices for reading and reading instruction.

Assistive Technological Devices for Reading and Reading Instruction

An assistive technology device refers to "any item, piece of equipment, or product system, whether commercially acquired off the shelf, modified, or customized, that is used to increase, maintain or improve the functional capabilities of a child with a disability" (IDEA, 2004; 34 C.F.R. § 300.6). With respect to this definition, Israel, Marino, Delisio and Serianni (2014) explained that it has remained virtually unchanged over the past 20 years and allows flexibility for individual education programme (IEP) teams in determining the types of assistive technologies that best meet the needs of students with disabilities. According to Johnston and Ryan (2005), the use of technology makes things easier for most people without disabilities but for people with disabilities technology makes things possible. To this end, the FGN (2013) included three assistive technological devices that are useful to students with LD namely: computer technology, internet facilities and

audio-visual equipment in the list of assistive technological devices in the NPE.

Assistive technological devices for reading range from low-technology, low-cost devices to high-technology, more expensive devices. Raskind (2006) in Virgile and Polloway (2008) observed that students can learn to differentiate between words by using low-tech devices such as inexpensive colour highlighters. The Wisconsin Assistive Technology Initiative (WATI, 2009) presented a continuum of considerations for assistive technology for reading as follows: standard text, book adapted for access, low-technology modifications to text, handheld device to read individual words, use of pictures/symbols with text, electronic text, modified electronic text, text reader, scanner with optical character recognition and text reader with study skill support. Stanberry and Raskind (2009) stressed that each type of assistive technology device available to help individuals who struggle with reading works a little differently, and all of those devices help by presenting text as speech. Thus, they facilitate decoding, fluency and comprehension.

Different kinds of computer devices and software programmes can be utilised by students with LD to learn and practice reading skills effectively. For instance, smaller reading passages copied and pasted into Microsoft word can be easily enhanced to aid comprehension using standard formatting features within the programme. Mangal (2007) posited that computer technology can facilitate self and/or individualised instruction as well as group instruction among students with LD. Lerner and Kline (2006) maintained that computer programmes are motivating, they help students with LD who struggle with automaticity in reading develop automaticity and they offer time to think about reading passages. When students use assistive technological devices, they get to improve their reading speed and rate, learn vocabulary and thereby overcome their reading difficulties.

An example of a computer programme for teaching reading is the Scholastic's READ 180. This technology-based reading intervention programme provides individualised instruction on the basis of each student's ability level and specific needs. To use the programme, Belson (2003) explained that the student begins each lesson by viewing a video that provides background knowledge. The student then reads

the text, with *clickable* vocabulary words. It is a programme specifically designed for those in grades 4-12.

Laptop computers and tablet devices such as iPad, iPhone and iPod are portable and lightweight. They have many features that make them quite useful in teaching and learning of reading. Apple Incorporated (2013) explained that Apple tablet devices have standard features that can enhance literacy and learning for special needs persons. Also, these devices have voice functions to identify objects for individuals with visual impairment or reading difficulties, as well as software and applications for reading to help students with learning disabilities. Apple tablet devices are also designed to provide a zooming effect for users with low vision and those with reading problems. Tablet devices also have a facility that changes colour to photo-negative. This function can help people with low vision and also people with dyslexia and dyscalculia. Pentop computers such as LiveScribe smart pens are cheaper than high-tech devices like iPads but can provide text-to-speech, strategy feedback, and other organisational functions. They serve as self-regulated reading aides and may be a useful tool for students with reading disabilities (Schmitt, McCallum, Hennessey, Lovelace & Hawkins, 2012).

Audio tape and tape recorders also help students with LD to rectify many of the language learning difficulties particularly related to pronunciation, proper intonation and way of speaking (Mangal, 2007). Students with LD can listen to audio-taped texts and answers to chapter or workbook questions rather than read the texts. MP3 downloads provide opportunities for students with LD to listen to a variety of texts. Raskind (2006) in Virgile and Polloway (2008) affirmed that a student who struggles with reading but who has good listening skills might benefit from listening to books on tape. A student can learn to read the sounds of the letters in the alphabet by listening to a listening device. Hence, decoding, word recognition and reading comprehension are improved.

Video-disc, a useful assistive technological device for reading, provides high quality visual and auditory presentation to all students including those with LD. Students with LD can watch useful and interesting academic as well as social presentations on the video discs in the form of continuous motion pictures and simultaneously listen to

the carefully prepared narration for providing useful instruction (Mangal, 2007). With electronic reference materials such as encyclopedias on CD-ROM, students with LD can explore and obtain information by browsing through topics or searching for specific information.
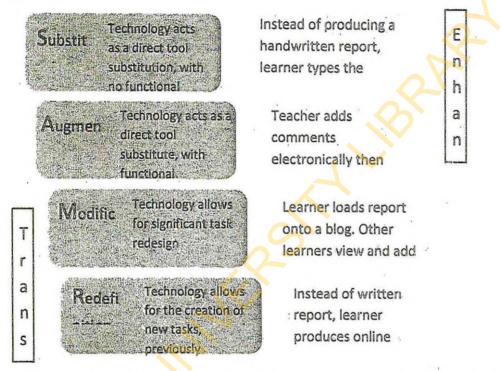
The Internet is equally useful to students with LD. The Web is made up of interconnected pages or sites, each containing textual and graphic information on specific topics. Users can link up to pages that interest them. Electronic storybooks offer high-interest stories, and words can be highlighted or read aloud by the computer (Lerner & Kline, 2006). The use of the internet provides instructional supports to students with learning disabilities in a flexible manner.

Moreover, students with LD also benefit from reading instruction by employing speech synthesizer/screen reader software and optical character recognition (OCR)/scanner. Speech synthesizers/screen readers software are systems that can display and read aloud text on a computer screen, including text that has been typed by the user, scanned in from printed pages like books or text appearing on the Internet. Similarly, optical character recognition allows a user to scan printed material into a computer or handheld unit. The scanned text is then read aloud via a speech synthesis/screen reading system. OCR is available as stand-alone units, computer software, and as portable, pocket-sized devices (Stanberry & Raskind, 2009).

Theoretical Framework

This study is anchored on the SAMR (Substitution, Augmentation, Modification, and Redefinition) model developed by Dr. Reuben Puentedura. Chell and Dowling (2013) linked the second phase in the history of educational and learning technology to the SAMR model of classifying the use of technology. They pointed out that the model categorizes the application of technologies into two. That is, as either possessing a transformative function (that is, one that transforms the subject of education and delivers a brand new topic to the curriculum), or enhancement function (that is, the use of technology to enhance the teaching of traditional subjects and vocational skills during lesson periods). The model shows the stages that adopters of educational

technology often follow as they integrate their teaching and learning with technology.

Figure 1: An illustration of the SAMR model of technology driven education

Substit	Technology acts as a direct tool substitution, with no functional	Instead of producing a handwritten report, learner types the
Augmen	Technology acts as a direct tool substitute, with functional	Teacher adds comments electronically then
Modific	Technology allows for significant task redesign	Learner loads report onto a blog. Other learners view and add
Redefi	Technology allows for the creation of new tasks, previously	Instead of written report, learner produces online

Source: Cambridge International Examinations (2015). Digital technologies in the classroom. *Education Brief 5*

According to Figure 1, the enhancement functions of assistive technologies are divided into two groups: the substitution and augmentation of mechanical tasks into digital tasks. For instance, to complete a reading assignment, students with learning disabilities can be taught to use a word processor instead of a typewriter, or hot metal publishing processes. With assistive technological devices, tasks that were once mechanical such as the shredding or filing of documents, can be augmented by using digital equivalents; such as the electronic waste bins, spell checking functions, grammar checking functions, cut and paste functions and file folders on word processing systems.

Similarly, the transformative functions of assistive technologies are further grouped into two: the modification and redefinition of

mechanical tasks into new digital ones. For example, word processors have within them, diverse tools that modify mechanical, physical ways of working to cognitive digital processes. Examples of these processes include the ability to save different versions of files, to e-mail directly from a document and to change a paper based document into a webpage. Likewise, bypassing the use of old fashioned technologies like keyboards, students with learning disabilities can now complete their reading tasks through the use of digital devices, such as voice inputs, swiping and tapping touch screens. Besides, assistive technological devices enable students with reading disabilities to record mainstream classes and access extra data that they may need in mainstream classes and even have access to specialist media such as electronic books through the web. In lieu of the foregoing, a review of studies on the use of assistive technological devices for students with learning disabilities is provided in the section that follows.

Technology-based interventions and reading instruction of students with learning disabilities

Studies such as those conducted by Edyburn (2000) and Welch (2010) have showed that the use of screen readers and other forms of electronic text to assist students performing below grade level in reading is effective. In a study by Hasselbring and Goin (2004), it was reported that the use of text-reader software among students with LD in Kentucky, USA, removed the stigma and failure they experienced during their entire school career. For many students in Kentucky schools, the use of text-reader software called Read & Write Gold software enabled them to read grade-level passage without depending on a teacher or another reader. They also used Read & Write Gold when taking the state assessment. Also, Stetter and Hughes (2010) observed that computer assisted instruction enables students with learning disabilities to receive immediate and dynamic feedback while they engage in computerised drill and practice. Thus, computer assisted instruction is beneficial to students with learning disabilities as it helps them to learn to read.

Furthermore, Shippen, Morton, Flynt, Houchins and Smitterman (2012) reported that computer-aided reading instruction allows for dynamic manipulation of the reading difficulty levels based on student performance data. Walcott, Marett and Hessel (2014) found that a

computer–assisted approach to learning was significantly more effective at providing intervention to inattentive readers as compared to their counterparts. Kennedy, Deshler, and Lloyd (2013) conducted a study that examined the effects of multimedia vocabulary instruction through content acquisition podcasts (CAPs) on students' vocabulary learning through four conditions. The study revealed that students with learning disabilities who used CAPs through explicit instruction and with keyword mnemonic strategy instruction significantly outperformed other students with learning disabilities who used multimedia vocabulary instruction without these components. They concluded that explicit instruction must be tied to information technology use for students with learning disabilities in order for them to fully benefit from these technologies.

Similarly, a study was conducted by Fitzgerald, Miller, Higgins, Pierce, and Tandy (2012) using a multiple baseline design across five participants. The study investigated the use of online modules to teach students with disabilities the Word Identification Strategy developed by Lenz and colleagues (2007) as cited in Fitzgerald et al. (2012). They found that all five participants in the study improved both their oral comprehension and reading comprehension. These technologies allow teachers and students to customize content delivery. More so, Liman, Adebisi, Jerry and Adewale (2015) studied the efficacy of assistive technology on the educational programme of children with LD in inclusive classrooms, in Plateau State Nigeria. Forty teachers of students with LD from three schools in Jos Metropolis participated in the study. The findings revealed that assistive technological devices used for remediation, intervention and for instructional purposes improved the educational programme of students with LD in an inclusive setting.

The Scholastic's READ 180 produced unexceptional effects on the reading skills of struggling readers compared to that of traditional face-to-face instruction when used in a quantitative study (Higley, 2016). In addition, Kim, Capotosto, Hartry and Fitzgerald (2011) and Papalewis (2004) successfully utilised the READ 180 and System 44 remedial programmes and reported statistically significant student literacy results. Perhaps, the efficiency of READ 180 lies in the fact that the software remedies the problem of a deficit in background knowledge

common among students with that poor reading ability. Higley (2016) reported that findings from studies on the efficacy of computer-assisted learning on reading interventions showed that struggling readers obtained higher reading scores using computer-assisted technology than compared to struggling readers who did not have the same technology access. Against this background, this paper therefore, suggests that when utilised appropriately, assistive technological devices have the potential to yield improved reading outcomes for students with LD.

Teachers' guide on the use of assistive technological devices for students with LD

The following are things teachers of students with LD must do in order to support reading and reading instruction through the use of assistive technological tools.

1.   Determine the instructional needs in terms of reading of students with learning disabilities. This is because being sensitive to the needs of the students will enable the teacher to provide adequate assistive technological tools that will address the specific reading needs of students with learning disabilities. The teacher should find out through some forms of assessment (may be formal or informal), the specific area(s) of difficulty of the student(s) in reading. For example, some students may have difficulties in decoding or sounding out words, reading sight words. Others may experience expressive or receptive language difficulties or difficulties with comprehension.

2.   Match assistive technological tools to the needs of the students. Different assistive technological tools are needed to support reading instruction tailored to each of reading need of students with learning disabilities. Once the needs have been identified, the teacher will focus on how to support student's reading using appropriate assistive technological tools. For instance, if a student requires improvement on his/her phonological awareness skills, appropriate assistive technology such as audio-taped text, and/or computerised drill and practice should be used to address this need.

3.   Have a good understanding of different technological tools that are effective in enhancing reading achievement of students with learning disabilities. The reason is because as a teacher of students with learning disabilities, it is his/her responsibility to integrate technologies

into his/her daily classroom routines. He or she needs to understand how the assistive technological devices work and how they can be incorporated within his/her teaching to support the students. The teacher should know the characteristics of emerging technologies. Since there are many of them, having a sound understanding of the available technological devices will give the teacher the opportunity of making right decisions about the selection, purchase, usage, evaluation and maintenance of assistive technological devices for reading and reading instruction.

4.   Select appropriate traditional or specialised and/or commercially available technologies. Teachers can select appropriate devices for reading instruction from a wide range of assistive technological devices available. Some commercial products can also be used to meet the reading needs of students with LD. What is important is that the right technology should be selected and used correctly. Before selecting the device, the teacher should evaluate the accessibility features of the technologies available in his/her classroom/school and use those that meet the needs of his/her students in reading.

5.   Allow students with learning disabilities to actively decide the kind of technological support they want. This requires some consideration in terms of students' motivation and reaction to particular adaptation, cost of assistive technology and training for usage of the device. For example, computerized devices can be distracting, expensive or immobile (restricted to a computer laboratory). Conversely, if students are involved in the process of selecting the computer devices for their reading assignments, they will be motivated and determined to use the technologies for the purposes they are meant for, rather than use them for the wrong purposes at a specified time. Consequently, students' complaints in terms of insufficient fund to purchase the technology, the failure of school management to provide technologies and stigmatizing effect about devices will be reduced if students are involved in the decision-making process.

6.   Get familiar with technology-based interventions. Teachers should learn about evidence based interventions that are effective for reading instruction. Coupled with teachers' understanding of learners'

differences, it will be easier to customize assistive technological devices to suit the unique reading needs of individual students with LD.

7.   Accompany assistive technological devices with explicit instruction and guided practice. The teacher should provide explicit instruction and guided practice on assistive technologies. Students with learning disabilities will benefit fully from technologies and reading instruction if teachers explicitly teach them how to use different technologies to support their reading and learning in general. If the students are not taught, they may get distracted with the diverse functions of assistive technological devices and unable to use technology effectively. The teacher should describe how to use assistive technological devices, model the use of assistive technological devices, allow students to engage in guided and independent practice and give them correctional feedback. Once students can use the devices independently, they can be allowed to use them during reading lessons and when completing homework assignments. For instance, students with LD should be taught how to use laptop computers and other computer devices like pentop computers, video discs, tablets, software programmes and the internet.

8.   Integrate assistive technological devices for reading with student career goals and transition plans. By so doing, the students themselves will realise that they actually need to use technology for life and will embrace it.

9.   Evaluate the use of assistive technological devices for reading among students with LD to monitor progress and ensure modification of instruction based on students' needs.

Conclusion

This paper has provided insight into the use of assistive technological devices in reading and reading instruction of students with LD. Assistive technological devices such as different computer devices, programmes and software, audio taped texts, the Internet among others, were identified as useful instructional support tools that teachers and students with learning disabilities can explore and utilize. In addition, focusing on the SAMR model of technology driven education, the paper concluded that teachers should explore both the transformative and enhancement functions of assistive technological devices for

reading instruction. Emphasis was also placed on the use of evidence-based reading interventions that involve the use of assistive technological devices for students with LD. Against this backdrop, it can be concluded that the use of assistive technological tools for reading instruction will be quite beneficial to students with LD and is capable of leading to enhanced reading performance and overall improved academic achievement of students with LD.

Recommendations

On the basis of the foregoing discussion, the following recommendations were made:

1.   Teachers should understand learners' differences, identify student specific barriers that occur during reading instruction and assessment that can be remedied through technology and adopt appropriate assistive technological devices to remove barriers in reading.

2.   Teachers should obtain the necessary training from assistive technology specialists so as to be able to use them effectively to improve reading and reading instruction.

3.   Teachers should collaborate with assistive technology specialists, other school staff, parents and students with learning disabilities to ensure successful support of reading instruction.

4.   Proper orientation should be provided to the students to enable them to develop and show willingness to use assistive technological devices for reading tasks and assignments.

5.   Students with learning disabilities should be taught how to advocate for the use of specific technologies.

6.   Parents of students with learning disabilities should provide the necessary assistive technological devices for their wards and also familiarize themselves on how to use them. They should encourage the use of assistive technological devices at home for assignments.

7.   Administrators such as head of schools and principals should provide the necessary assistive technological devices for students with LD and ensure that the devices are incorporated in teaching reading and other content subjects in the school.

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