

## The use of ICT in the education of students with dyslexia

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### Abstract

With the use of ICT, in general in special education and in particular in dyslexia, there are tangible results that allow the development of the student. New technologies, therefore, give the possibility to create a digital environment that will enhance the use of the senses on the part of the student, which is not always easy in the case of conventional education for the student diagnosed with dyslexia.

**Keywords:** ICT; Dyslexia; Special education; Learning disabilities

### 1. Introduction

Specific learning disabilities refer to difficulties in decoding reading and understanding the written word, dyspelling, dysgraphia, dyspraxia and sometimes difficulty in math calculations. Dyslexia is classified as one of the specific learning disabilities. In particular, dyslexia is classified as a specific form of learning disability that negatively affects the processing and retention of information, which can affect a person's literacy, skills and ability to learn (Polychroni, 2011). Dyslexia has been characterized as an unexpected learning disability in individuals who possess the necessary intelligence and motivation to learn general literacy (Shaywitz & Shaywitz, 2003). Specifically, it is characterized as a neurodevelopmental disorder of reading and spelling skills that manifests itself independently of the individual's general intellectual abilities and educational opportunities and affects approximately 7-10% of the world's population (Snowling, 2013). As a result, it is beneficial to view dyslexia as an alternative learning style rather than a disability (Powell et al., 2004).

The true nature of dyslexia has puzzled researchers and other professionals for almost 120 years (Nicholson & Fawcett, 2008) as there is no definitive definition or underlying causes of dyslexia. Pretty much everyone knows and can understand what dyslexia is and what it stands for, but in reality no one is ready to give a clear and documented definition of it. Therefore, giving a single definition may be impossible (Rawson, 1981). Indeed, there are many definitions of dyslexia in use today by professionals and educators. Although these definitions have some similarities, trying to understand the variety of these definitions can be confusing for parents and teachers (Reid, 2016).

A widely recognized and representative definition used by the International Dyslexia Association emphasizes the neurobiological origins of the condition, but also takes into account the associated secondary underlying causes that can lead to it (Lyon et al., 2003). The main difficulties are thought to be related to deficits in phonological coding as they manifest in slow and inaccurate reading and spelling. Secondary difficulties, poor reading comprehension and limited vocabulary, may be more pronounced in language learning (Lyon et al., 2003). Also, dyslexia is often associated with conditions such as numeracy difficulties (Landerl & Moll, 2010), poor coordination or clumsiness motor skills, and poor time management organization (Reid, 2016).

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Although dyslexia is primarily defined as a reading disorder, it is also characterized by phonological deficits, manifested in assessments of phonological awareness, phonological short-term judgement, and rapid retrieval of phonological forms (Noordenbos & Serniclaes, 2015). Indeed, deficits in phonological skills are found in the majority of children, adolescents and adults with dyslexia (Ramus et al., 2003). In fact, the accentuation of phonological deficits among individuals with dyslexia is so striking that the disorder has been described as arising from an underlying phonological deficit (e.g. Ramus et al., 2003; Vellutino et al., 2004); thus replacing visual disturbances as the apparent essence of the problem. A phonological deficit is thought to manifest most clearly in tasks tapping phonological awareness, rapid automated naming, and verbal short-term memory (Vellutino et al., 2004).

In conclusion, we can say that dyslexia is characterized by difficulties in accurate and rapid word reading and spelling despite adequate instruction and the absence of general cognitive or sensory deficits (Lyon et al., 2003; Peterson & Pennington, 2015). The literacy skills associated with dyslexia involve reading and spelling at the word level. In terms of the underlying cognitive abilities associated with these word-level literacy skills, there is consensus that phonological abilities play an important role in an individual's education (Ramus et al., 2003). Finally, it is important to mention that the definition of dyslexia is particularly vague in adulthood because the primary indicators of literacy weakness are not as evident as in childhood due to compensatory strategies that have developed over time (Garratt et al., 2011).

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## 2. Characteristics of dyslexic students

As far as students are concerned, dyslexia has been observed as a specific learning difficulty of the spoken and written language that appears mainly in reading and spelling and most of the time is strongly presented during the learning process. A dyslexic child early shows symptoms, which are related to writing, spelling of words, reading, memory, phonological difficulty, lack of coordination and organization and difficulty in taking in information (Peer, 2003). Furthermore, students with dyslexia experience difficulties in word recognition accuracy and fluency, as well as their spelling, regardless of their intelligence or other sensory abilities or receiving clear instructions (Shaywitz & Shaywitz, 2003).

Physiologically, dyslexia is a language disorder with processing systems in the brain. Although reading and speaking depend on the phoneme, which is processed in the brain, speaking is natural while reading is not (Shaywitz & Shaywitz, 2003). Difficulty in reading is usually one of the most obvious problems, students who experience this type of difficulty show corresponding challenges in perception and memory, as well as in the ability to establish relationships between letters and the sounds that accompany them especially in conditions time pressure (Lesaux & Siegel, 2003). In particular, when it comes to reading, understanding and remembering a text, dyslexic students face many difficulties as they confuse words, read slowly, do not focus on the lines and cannot easily memorize the information of a text as they have problems handling its meaning. Thus, most of the time they read mechanically without being able to assimilate the meaning of a text. In essence, dyslexic people when reading a written text initially expect to understand its concepts and understand its various symbols. These people cannot easily form an overall picture of the text and extract useful information from it. They thus have difficulty identifying the main ideas of a text and recognizing their meaning. In addition, they do not pay attention to the heading, and in general to the organization of the text and often continue reading, even when they have not fully understood the meaning of the text (Porpodas, 1997).

Furthermore, dyslexia occurs heterogeneously with many other learning disorders that are often related not only to reading difficulties, but also to attention, memory, coordination, and lateral and auditory information processing. Also, a variety of dyslexic characteristics cause difficulty not only in reading, writing and spelling, but also in oral expression. These degrees of difficulty vary and are influenced by the student's intelligence and educational opportunities. Students with dyslexia have difficulties with word recognition accuracy and fluency, as well as spelling, regardless of their intelligence or other sensory abilities or receiving clear instructions (Miles, 2008; Riddick et al., 1999).

Secondary educational consequences of dyslexia may include difficulties in comprehension and written expression. These difficulties are unexpected for the student's age, educational level, or cognitive abilities. In addition, there is usually a family history of similar difficulties (Shaywitz & Shaywitz, 2003). The main reading and spelling features of dyslexia are:

- Difficulty reading single words.
- Difficulty decoding words.
- Slow, inaccurate or labored oral reading.
- Difficulty learning to spell (Shaywitz & Shaywitz, 2003).

### 3. Dyslexia in education

A child with dyslexia is defined as one with normal intelligence, without sensory problems and a serious psychiatric disorder who, under normal educational conditions, is unable to master the written word in the first grades of primary school (Pennington, 2006). As a result of their cognitive difficulty, dyslexic students may need to compensate for their weaknesses by using alternative ways of learning both in and out of the classroom. Dyslexic students usually have difficulty processing symbolic information. This can limit the dyslexic student's ability to learn in a society that primarily processes information and, more importantly, is educated that way.

Consequently, it is the responsibility of the institution to offer a set of enabling arrangements to ensure that the dyslexic student can demonstrate his or her strengths rather than relying on traditional teaching methods that leave the dyslexic student in a vulnerable position. Current social structures of education and assessment, however, continue to promote a traditional learning style, and these are the traditional teaching methods that present problems for the dyslexic student in the course of education (Polychroni, 2011).

The everyday context of teaching and learning constantly exposes students to social events and actions that are strictly related to metacognitive and affective functions. Learning as a higher cognitive function includes socio-emotional processes such as self-efficacy, self-esteem, empathy and also the acquisition of values. Dyslexic children tend to perceive these values through a lens of low self-efficacy and low self-esteem. This can be the cause of negative and disappointing situations during their educational course, as lower level options compared to their real potential and with a clear social impact. On the contrary, with every success in school, the perception of achieving goals and the consciousness of self-efficacy and self-esteem are strengthened. These functions facilitate learning and influence school success.

Finally, as Reid (2016) mentions, dyslexia-friendly schools must adopt an open and flexible approach that will encourage communication between all involved (teachers, parents, specialists, students). Their tactics and alternative methods are believed to help students gain the self-esteem that has been lost through the traditional methods of the education system, which seems to still have many problems to deal with.

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### 4. Assistive technology for students with dyslexia

Recently, there has been an increase in the use of ICT in the field of special education (Manola et al., 2023; Vouglanis et al., 2022; 2023). Through various research it has been shown that the use of ICT plays an important role in supporting students, especially those with special learning difficulties (Hermans et al., 2008). Typically, students with dyslexia have low self-esteem and low expectations for their academic opportunities. ICT is a key tool to support dyslexic students as it can facilitate learning and reduce difficulties in identifying or confusing words and meaning (Harden et al., 2018). Also, the use of ICT has strong positive effects on learning, it tends to increase the student's confidence, motivation and self-esteem. Specially designed applications can stimulate students' interest and act as supports (Alexander-Passe, 2006). The use of ICT has a valuable role in providing opportunities for users to participate more fully in education. It tends to improve and develop interactive experiences that can motivate users more (Benmarrakchi et al., 2016).

The use of ICT can have positive effects on students with learning difficulties such as dyslexia. Confirmation is that ICT facilitates access to the educational process, increasing motivation, strengthening healthy competition, self-confidence and self-esteem of learners (Skiada et al., 2014). The use of ICT in the teaching and learning process can make the student more independent and autonomous, giving him control over the learning process and reducing the need for the presence of the teacher. However, it is certainly known that computers are not magical tools and that by themselves they cannot change the learning process. Research data emphasize the essential role that educational technology can play in creating a supportive learning environment, in the light of Cognitive Science (Salomon, 1988).

Today's technological era has produced a number of very good computer programs and tools to help people with dyslexia:

- Listening and speaking
- Reading and spelling
- Writing and general organization (Harden et al., 2018).

Students with dyslexia face great difficulties in mastering reading. And even when they master reading with much effort, their relationship with books is not the best (Miller et al., 1994). Research on the effectiveness of computers in teaching

reading shows that computers can be an important and effective aid in this area as well (Nicolson et al., 2000; Miller et al., 1994). Reading difficulties can be overcome through the multi-focal education approach which is an effective approach to teaching students with dyslexia. It involves the simultaneous use of three senses, namely visual, auditory and kinesthetic touch, so as to enhance memory and written learning. This study predicts that digital technology positively affects the learning process of students with dyslexia. An increase in motivation and achievement can be observed (Peer, 2003).

Equally, however, speech difficulties make it difficult for dyslexic students as they not only marginalize the student but also deny him the right to express his point of view. The initial goal of every teacher should be to give him a "voice". Technology can provide solutions in this area as well. The use of new technologies can also provide opportunities for interaction and the creation of friendly relationships, especially for students with emotional and behavioral disorders (Cooper et al., 2002), as well as for students with learning difficulties such as dyslexia.

As Raptis & Rapti (2001) argue, in recent years there has been a lot of research on helping children with diagnosed dyslexia to overcome their problems and several programs have been implemented. It has been shown that the visual and auditory stimuli offered by the computer, the clear and orderly display of the text, the various types of software for correcting mistakes and referring to grammar rules, grammar exercises and word processing help these children a lot. That is why the various rehabilitation centers for dyslexic children rely heavily on the properties of the computer (Singleton, 2004).

In another research project carried out in Arabia and specifically in Morocco by Benmarrakchi et al. (2016) an adaptive mobile learning reconstruction system specially designed for students with dyslexia is proposed. The aim of the present study was to investigate the benefits of using ICT in special education and to show the relationship between dyslexia and learning styles. Based on the results of the analysis of differences in learning styles, an adaptive mobile learning is suggested to support and promote learning for students with dyslexia. The aim of the study was to examine the relationship between dyslexia and learning style and to suggest a different learning style.

The preliminary results of the research showed that ICT is a useful tool for supporting dyslexic students and has a valuable role in providing opportunities for students with dyslexia to participate more fully in education. In this case, they can benefit from the variety of visual, auditory and tactile information. New technologies can also be used as an adaptive learning support tool to enhance the learning process by reducing recognition difficulties or confusion between words and meaning. They can also encourage learners' imagination and creativity. The results of this research show that multimedia learning supports the idea that students learn better and more deeply when multimedia contents are designed in ways that are consistent with supporting cognitive processes and managing the necessary processing (Benmarrakchi et al., 2016).

The positive and useful contributions that digital technologies provide to the field of education should be highlighted as a final point. Mobile devices (50-53), a range of ICT apps (54-73), AI & STEM ROBOTICS (74-78), and games (79-81) are some examples of the technologies that enable and improve educational processes including evaluation, intervention, and learning. Additionally, the use of ICTs in conjunction with theories and models of metacognition, mindfulness, meditation, and the development of emotional intelligence [82-108], accelerates and improves educational practices and outcomes, in specific learning disabilities and especially for children with dyslexia.

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## 5. Conclusion

More specifically ICT tools enable the dynamism of learning, in terms of not only the appropriation of content while developing students' basic competencies, but also when creating attractive spaces that invite interaction and information exchange. These technological resources make it possible to adapt the teaching-learning process to the characteristics, interests and needs of the student, promoting their active participation to help achieve the academic goals and achievement goals they had predetermined by the teacher, while facilitating individual, collaborative and interactive work in the classroom.

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## Compliance with ethical standards

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