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The use of ICT for the early detection of dyslexia in education

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Abstract: ICTs are tools that can support people with dyslexia especially during their education. ICT can contribute to effectively deal with the deficits they present in order to improve their performance and this is proven by more and more research data. Activity also exists in the field of dyslexia detection with the creation of software in this direction. Such softwares have also been designed for the Greek student population but further research is needed in order to enhance their effectiveness.

Keywords: ICT, dyslexia, education, detection.

1. Introduction

Dyslexia is one of the most common learning disabilities. It is a disorder that involves a severe impairment in the ability to read, which affects and disrupts a person's language development and functioning. Dyslexia can be described as a language learning disability, as the severity of reading, writing and spelling deficits varies between different languages and cultures (Elbeheri et al., 2006). It affects approximately 7-10% of the population in most languages and cultures (Peterson & Pennington, 2012).

Studies now focus, among other things, on the potential benefits of using Information and Communication Technology (ICT) in education by trying to develop interactive experiences that can motivate and help students (Vouglanis, 2020; Vouglanis & Driga, 2023). In particular, designed applications can stimulate students' interest. ICT can also help students with learning disabilities to integrate and progress in the mainstream school environment. The use of multimedia is also believed to help dyslexic students (Rahman et al., 2012). Multimedia applications not only enable but also support the bimodal presentation of information through visual and audio channels. Thus, information processing is accelerated and mnemonic recall is facilitated (Kazakou et al., 2011).

2. Dyslexia

Dyslexia is a neurodevelopmental disorder characterized by deficits in the ability to learn or use specific academic skills. Dyslexia is a cross-cultural and chronic condition that typically persists into adulthood (APA, 2013). The prevalence of dyslexia is controversial, ranging from 5-15% worldwide (Vlachos et al., 2013; Peterson & Pennington, 2015) with a significant male predominance with sex ratios ranging from 1.5:1 to 3.1: 1. These large discrepancies are due to methodological differences between studies and mainly due to the use of many terms in the past to describe dyslexia (Rutter et al., 2004; Hawke et al., 2009; Vlachos et al., 2013).

Despite decades of intensive research, the underlying biological and cognitive causes of dyslexia currently remain unknown. Dyslexia has no single underlying cause. The etiology of dyslexia is complex and involves the interaction of genetic, epigenetic and environmental factors in its etiology (Hendren et al., 2018; Gorker et al., 2017). The estimated heritability of dyslexia is approximately 50-70% (Hawke et al., 2009; Peterson & Pennington, 2015). The relative risk of dyslexia is 4-8 times higher in first-degree relatives of people with these learning disabilities compared to those without dyslexia.

Dyslexia is highly comorbid with other developmental and psychiatric disorders. The most common comorbid disorders are specific language disorder, attention deficit hyperactivity disorder, autism spectrum disorders, anxiety and depressive disorders (Hendren et al., 2018; Ramus et al., 2013; Talli et al., 2016; Sciberras et al., 2014; (Mayes & Calhoun, 2006; Scerri et al., 2011).

3. ICT and support for dyslexic students

In education, ICT refers to the development of information and communication technologies. It includes the adoption of general information and communication technologies in the learning process. Recent research (Drigas et al., 2015; Zikl et al., 2015; Madeira et al., 2015) agrees that ICT is likely to be a useful tool for users with dyslexia. It can help and enhance the learning process as well as create a developmentally appropriate learning environment according to the needs of the students.

Some applications of ICT in education have been made to support dyslexic students. Such examples include the use of web pages as instructional stimuli (Johnson & Hegarty, 2003), text-based adaptations in contemporary learning activities, and browser extension to help dyslexic users adapt web content to be easier to read. readability and more accessible (Woodfine et al., 2008), text editing and adapting the visual aspects of the text using specific fonts to the needs of users, allowing them to try different fonts and graphic settings and choose the most effective option, so that improve their

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reading performance (Zikl et al., 2015) and eBook reader for Android designed, in an accessible way according to the needs of dyslexic users (Rello et al., 2012).

Other research has focused on mobile learning and computer games as an alternative learning tool to help students with special needs (Skiada et al., 2014; Ismaili & Ibrahimi, 2016; Shaw et al., 2005). According to Rose et al. (2002) and Kalyvioti & Mikropoulos (2014), virtual environments and virtual reality applications can be used as powerful and sensitive clinical tools for adults and children with neurocognitive and neuropsychological impairments.

There are many applications that have been developed in this field. Skiada et al. (2015) proposed interface design options for creating a tablet game for children with learning disabilities. EasyLexia 2.0 was developed from software tested on mobile phones, and consists of spelling, memory and math problem activities for children with dyslexia.

In studies that described the use of software and e-readers (Schneps et al., 2013), the effectiveness of technological tools in promoting better reading performance in dyslexics was verified. In a scientific article (Berninger et al., 2015), the effectiveness of pedagogical activities on iPads was investigated, increasing the applicability for children with other specific learning disabilities, such as dysgraphia, which is a specific writing disorder. The results of the application of two technological instruments - Abracadabra (ABRA) and e-Pearl - have described benefits in letter-sound recognition, phonological awareness and reading comprehension, also showing positive results in the case of children with reduced attention and low reading performance. Children systematically exposed to the programs showed learning gains in written language and better performance in metacognitive reading skills (Lysenko & Abrami, 2014).

A study conducted with children with literacy difficulties, including dyslexia, showed positive results from using tablets to support reading and writing activities at school (Conway & Amberson, 2011). The results of using software with phonological and multisensory resources, such as letter-sound matching and listening strategies, were presented in a study with children with and without dyslexia, showing significant benefits in the spelling performance of dyslexic children (Kast et al., 2011).

An intervention study described the use of a pedagogical application, APADYT, aimed at supporting the pedagogical work of parents and teachers of children with special educational needs, such as dyslexia, dysgraphia, dyscalculia, attention-deficit and/or hyperactivity disorder (ADHD) and cross laterality (Rubio et al., 2014). A study on the use of e-readers with children with dyslexia concluded that for some dyslexics the e-reader as a technological tool facilitates reading and

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comprehension compared to reading on paper. In e-readers it is possible to have larger font size, fewer words per line, longer line spacing and control of screen brightness (Schneps et al., 2013).

On the other hand, in a study on the use of virtual learning environments, with dyslexic undergraduates, some preference for printed text was detected through interviews. Some dyslexics preferred to read the text on paper because it was easier to note the important passages. In addition, in writing they felt that the keyboard reduced the typing speed. Others, however, relied on the word processor to offer spell-checking tools and verify grammatical errors, as they would not be able to spot the errors as well. Text-to-speech was commented on by some respondents as a useful tool for catching errors in a text written by them (Habib et al., 2012).

The use of virtual reality technologies was described in a study that aimed to assess the working memory of dyslexic graduate students. He concluded that virtual reality can be an effective technology assessment tool, even for use in early memory tests in children (Kalyvioti & Mikropoulos, 2012). When it comes to speech therapy with remedial and phonological intervention goals, the performance of dyslexic children who underwent the intervention program related to the use of computer in terms of reading skills was highlighted, providing an increase in the reading and spelling levels of dyslexic children (Reid et al ., 2013). The effect of letter font choice on reading material for children with special learning difficulties was described in a study of 150 children. The results presented reveal the benefits of an appropriate font choice in terms of reading speed and errors (Zikl et al., 2015).

A literature review on supporting dyslexic students – based on research in eight online databases – highlighted that it is important to recognize the individual needs of students so that technical solutions can be adapted (Bjorklund, 2021). The relationship between virtual environment and dyslexia was described in a literature review and it was verified that the scientific articles published so far present benefits and orientations for parents, teachers and professionals related to dyslexic people (Kalyvioti & Mikropoulos, 2014).

4. ICT and detection of dyslexia

In an intervention study conducted with dyslexic children, phonological and morphological activities were linked to computer use, with positive effects on reading speed and spelling skills when used early. It has also been pointed out that the use of ICT can be useful in the early intervention of children with risk characteristics for learning difficulties (van der Leij, 2013).

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In a study regarding assessment for children with dyslexia, in addition to describing the functions of multimedia tools in the construction of technological products for dyslexic children, a concern was observed to identify the impression that children and teachers have about the use of ICT in learning to read and write (Rahman et al., 2012).

The most widely used ICT screening test for dyslexia is the Cognitive Profile System (CoPS) (Singleton et al., 2000) developed in the UK. The CoPS consists of 8 subtests that assess working memory, auditory and color discrimination, and phonological awareness in 4- to 8-year-old children. The test has several versions and is adapted to several languages such as Italian, Swedish and Norwegian (Singleton et al., 2000; Brookes et al., 2011).

In Greece, the literature on the evaluation of ICT for dyslexia is insufficient. There are two ICT screening tests, VLEMA and Lambda. BLEMA is designed to assess dyslexia in children attending 3rd and 4th grade. The Lambda in its first released version was designed to assess dyslexia for students in grades 2 through 4 and in its second version for students in grades 5 through 6. The validity and reliability of both tests are limited due to their many methodological limitations (Protopapas & Skaloumbakas, 2007).

5. Conclusions

Finally we underline the importance of the digital technologies in education domain and language comprehension that is very productive and successful, facilitates and improves the assessment, the intervention and the educational procedures via Mobiles which brings educational activities everywhere [48-57], various ICTs applications which are the core supporters of education [58-94], AI, STEM & ROBOTICS which raise educational procedures into new levers of performance [95-115], and games which transforms the education in a very friendly and enjoyable interaction [116-119]. Additionally, the enhancement and combination of ICTs with theories and models of metacognition, mindfulness, meditation, and emotional intelligence cultivation [120-166] as well as with environmental factors and nutrition [44-47], accelerates and improves more over the educational practices and results, especially in the language comprehension domain and its practices like assessment and intervention.

Undoubtedly, ICT assessment tools, developmentally adapted and validated are feasible, can be used en masse in schools, filling the aforementioned lack of ICT assessment. For the Greek education system, where many schools are isolated and access to diagnostic centers is complicated and time-consuming, the use of ICT tools would be beneficial. Despite the many advantages of ICT

screening tools, their results should be interpreted with caution and in the light that they identify children at risk for dyslexia in the population who need further assessment.

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