Depósito legal ppi 201502ZU4662
Esta publicación científica en formato
digital es continuidad de la revista impresa
Depósito Legal: pp 197402ZU789
● ISSN: 1315-9518 ● ISSN-E: 2477-9431

Revista de Ciencias Sociales

Universidad del Zulia. Revista de la Facultad de Ciencias Económicas y Sociales
Vol. XXXI, Núm 3 JULIO-SEPTIEMBRE, 2025

Revista de Ciencias Sociales

Esta publicación científica en formato
digital es continuidad de la revista impresa
Depósito Legal: pp 197402ZU789
ISSN: 1315-9518

Revista de Ciencias Sociales (RCS)
Vol. XXXI, No. 3, Julio-Septiembre 2025. pp. 38-56
FCES - LUZ ● ISSN: 1315-9518 ● ISSN-E: 2477-9431

Como citar: Marín-González, F., Cuba-Romero, G. C., y Larios-Ariza, M. A. (2025). Artificial intelligence applied to the management of dyslexia cases in university settings: A systematic review. *Revista De Ciencias Sociales*, *XXXI*(3), 38-56.

Artificial intelligence applied to the management of dyslexia cases in university settings: A systematic review

Marín-González, Freddy[*]
Cuba-Romero, Gabriela Cristina[**]
Larios-Ariza, Michell Andrea[***]

Abstract

Dyslexia is a learning difficulty that affects reading and writing and has been studied in search of novel tools for detection and treatment. This article analyzes the applicability of Artificial Intelligence to the management of dyslexia cases in university settings, through a systematic review focused on the contributions of scientific literature on assessment/diagnosis and intervention processes. Through searches in Scopus and Web of Science, empirical studies were selected considering the Preferred Reporting Items for Systematic Reviews and Meta-Analyses for Protocols method. The results show that Artificial Intelligence is effective in the detection of dyslexia through eye movement analysis and neuroimaging, allowing early diagnosis. However, research has mainly focused on assessment and diagnosis, while its application in interventions requires further study. In conclusion, Artificial Intelligence has the potential to improve accessibility and personalization in the treatment of dyslexia, contributing to the transformation of university educational processes in students suffering from this condition.

Keywords: Dyslexia; artificial intelligence; education; university students; systematic review.

* Doctor en Ciencias Humanas. Postdoctorado en Ciencias Humanas. Magíster en Educación. Especialista en Planificación y Administración Educativa. Licenciado en Educación mención Biología y Química. Docente Investigador del Departamento de Humanidades en la Universidad de la Costa, Barranquilla, Atlántico, Colombia. E-mail: fmarin1@cuc.edu.co ORCID: https://orcid.org/0000-0002-3935-8806 Autor de Correspondencia.

** Psicólogo en Formación del Programa de Psicología en la Universidad de la Costa, Barranquilla, Atlántico, Colombia. E-mail: gcuba@cuc.edu.co ORCID: https://orcid.org/0009-0006-4259-6457

*** Psicólogo en Formación del Programa de Psicología en la Universidad de la Costa, Barranquilla, Atlántico, Colombia. E-mail: mlarios@cuc.edu.co ORCID: https://orcid.org/0009-0003-2907-816X

Recibido: 2025-03-16 • **Aceptado**: 2025-06-03

Inteligencia artificial aplicada a la gestión de casos de dislexia en entornos universitarios: Una revisión sistemática

Resumen

La dislexia es una dificultad de aprendizaje que afecta la lectura y la escritura, y se ha estudiado en busca de nuevas herramientas para su detección y tratamiento. Este artículo analiza la aplicabilidad de la Inteligencia Artificial al manejo de casos de dislexia en entornos universitarios mediante una revisión sistemática centrada en las contribuciones de la literatura científica sobre evaluación, diagnóstico e intervención. Mediante búsquedas en Scopus y Web of Science, se seleccionaron estudios empíricos considerando el método Preferred Reporting Items for Systematic Reviews and Meta-Analyses for Protocols. Los resultados muestran que la Inteligencia Artificial es eficaz en la detección de la dislexia mediante el análisis del movimiento ocular y la neuroimagen, lo que permite un diagnóstico precoz. Sin embargo, la investigación se ha centrado principalmente en la evaluación y el diagnóstico, mientras que su aplicación en intervenciones requiere más estudios. En conclusión, la Inteligencia Artificial tiene el potencial de mejorar la accesibilidad y la personalización en el tratamiento de la dislexia, contribuyendo a la transformación de los procesos educativos universitarios en estudiantes con esta condición.

Palabras clave: Dislexia; inteligencia artificial; educación; estudiantes universitarios; revisión sistemática.

Introduction

The acquisition of reading skills is not limited to academia, but is also a public health issue, as language and literacy are key determinants of health. These are linked to academic, social, and economic success through the increase of longevity chances and the decrease of the probability of experiencing poverty or suffering from certain diseases (World Health Organization [WHO], 2018; Johnston, 2019).

At its most basic level, learning to read allows students to achieve their school goals and advance to more complex skills typical of higher educational levels (Sanfilippo et al., 2020; Lohvansuu et al., 2021; Bravo et al., 2023; Burgos-Mendieta et al., 2024); however, some people face persistent difficulties in reading, such as inaccurate word reading or difficulties to comprehend the meaning of what is read, which are part of the diagnostic criteria for dyslexia (American Psychiatric Association [APA], 2013; Cancer & Antonietti, 2022; Larco, 2023; Serna, 2023).

Although there is no universal definition of dyslexia, it is considered a specific learning disability affecting reading and writing, characterized by problems in phonological processing, naming speed and working memory. This disorder is not related to intelligence or motivation, nor is it caused by sensory deficits (Diraä et al., 2009; Griffin & Pollak, 2009). Its origin is associated with genetic, neurodevelopmental and environmental factors, which also influence how it manifests itself depending on the language and writing system. In addition, the social and emotional context can affect its evolution. However, with early and appropriate instruction, people with dyslexia can overcome many of their difficulties and develop their educational potential (Helland, 2022; Wolf et al., 2024).

To address this condition, useful tools have emerged that include the application of new digital technologies (Alsswey et al., 2021; Al-Dokhny et al., 2022), such as assistive technologies, virtual reality tools, mobile applications, online learning environments,

digital games, among others (Rodríguez-Cano et al., 2021; Ausín et al., 2023). These innovations are beneficial for both clinical and educational fields, especially when facing the problem of late diagnoses that perpetuate difficulties to higher levels. These technologies accelerate the diagnostic process and allow timely interventions, providing support even in the face of the challenges of university education (Simón, 2020; Amador et al., 2021).

If dyslexia is not identified and treated early, it can have a significant impact on the sufferer's academic education. Difficulties in reading, writing, and comprehending texts can lead to overall poor performance, affect self-esteem, generate demotivation, and cause problems keeping up with the class (Zuppardo et al., 2020). Consequently, the person with dyslexia may develop avoidance strategies to get rid of frustration, leading to school failure and even dropout (Gutiérrez-Fresneda et al., 2022).

This situation may constitute an obstacle for obtaining a professional degree, since at this educational level the demands in terms of reading comprehension, analysis and writing of complex texts are much higher (Quisnancela, 2022), in fact, the most common difficulties in university students with dyslexia are associated with grammatical problems, word changes during reading, writing problems and troubles with relating paragraphs (Serna, 2023); Consequently, it is necessary to investigate how the mediation of technology through the inclusion of innovative and automated resources contributes to generation of new opportunities for students from basic to higher educational levels (Rubio, 2022).

Considering these references, new technologies, particularly Information and Communication Technologies (ICT) have proven to be fundamental for dyslexia care in educational contexts by facilitating improvements in fluency, accuracy, writing and reading comprehension, in addition to fostering enthusiasm and problem-solving skills in students (Macas-Macas & Guevara-Vizcaíno, 2020; Guaña-Moya et al., 2023; Peñalver-Higuera et al., 2024).

A complementary breakthrough is Artificial Intelligence (AI), which consists of systems designed to mimic human cognitive capabilities, learn from experience and make decisions autonomously, thus improving efficiency in various processes. Although there is no standard universal definition, AI focuses on the ability of computer systems to adapt to new situations and optimize the pace of work (Duan et al., 2019; Aishwarya et al., 2022).

Although this technological advance seems recent, its creation and application to the study of dyslexia dates back decades, being mainly used in assessment and diagnosis. AI techniques can be useful for automatic scoring of evaluative results and, therefore, they provide the advantage of not making prior assumptions about the nature of the data obtained and eliminate the natural bias associated with data processing or scoring performed by humans (Palacios et al., 2010; Modak et al., 2019).

In addition, it has been applied as a multivariate classification technique in clinical neuroimaging studies to detect and classify individuals with and without dyslexia (Tamboer et al., 2016). At the intervention level, it is important to highlight the use of machine learning applications to treat dyslexia, which provides leveling opportunities for students with this disorder, ensuring their inclusion in academic settings such as universities (Jothi et al., 2018).

From this perspective, potential of artificial intelligence in the different processes carried out in dyslexia cases is remarkable, as AI allows more accurate assessments given its ability to analyze large volumes of information, make earlier diagnoses, develop personalized interventions, continuously monitor student performance, or simply enrich educational processes for students with dyslexia (Barua et al., 2022; Yang, 2022).

These technologies can serve as a support to evaluate and identify signs of dyslexia in students in a fast, adequate and effective way, allowing the implementation of curricular management processes according to principles of adaptation, progression and

contextualization according to the needs, expectations and intentions of the integral formation process. In this sense, didactic and pedagogical mediation strategies based on AI are conceived and valued to facilitate the learning and successful participation of students with dyslexia in university educational environments (Chalco-Torres et al., 2023; Gracheva & Shalileh, 2023).

For this reason, the aim of this article is to analyze the applicability of artificial intelligence to the management of dyslexia cases in university settings, based on scientific literature, through a systematic review focused on assessment, diagnosis, and intervention processes. The purpose of this is to provide a comprehensive view of how AI is transforming the study of dyslexia, including the detection phase, understanding it as a preventive measure for the progression of academic difficulties in reading and writing in children at basic educational levels (Carrillo et al., 2011; Ausín et al., 2023).

The above implies a minor compromise of higher academic skills in the future. However, it also highlights that advances in dyslexia detection seek to streamline this process so that students at more advanced levels with reading difficulties can access faster and more efficient evaluative phases that give them greater knowledge about their condition, thus facilitating the choice of intervention objectives and the implementation of the intervention, for which AI would also be very useful (Platas-García et al., 2023).

By understanding both the benefits of AI in the study of dyslexia and the areas that require further attention and research, this paper will serve as a valuable resource for educators, researchers, and practitioners in both the social sciences (education) and health sciences who seek to integrate advanced technologies into their practices and design inclusive and adaptive curricula, thereby improving the accessibility and effectiveness of educational processes to support university students with dyslexia.

1. Theoretical foundation

1.1. Historical evolution of the study of dyslexia

The term “dyslexia” first appeared in the late 19th century to refer to difficulties with words presented by numerous adult patients. However, later studies described cases of what was called “word blindness” in gifted children, characterized by a discrepancy between intellectual abilities and reading and writing skills, which led to further investigations into its causes (Wolf et al., 2024).

Over time, explanatory models of dyslexia have emerged with the intention of deepening the understanding of the underlying descriptors of this difficulty. According to Helland (2022), works such as the “The equilibrium model of dyslexia” describe that beginning reading is managed primarily from the right hemisphere of the brain, but shifts to the left hemisphere as the child learns to read, so that when this process does not occur properly, reading difficulties may arise. On the other hand, the “Morton and Frith causal model” posits that dyslexia is a multifactorial disorder, influenced by both biological and environmental factors. This model emphasizes the importance of considering different levels of analysis, from genetic to social, to fully understand dyslexia.

Another crucial milestone corresponds to the inclusion of techniques such as electroencephalogram (EEG) and magnetic resonance imaging (MRI), which allow observation of brain structure and function. In addition, magnetoencephalography (MEG) demonstrated impaired directional connectivity in dyslexia, from the right auditory cortex to Broca’s area, supporting the hypothesis that a deficit in the phonological perceptual mechanism hinders phonological manipulation (Helland, 2022).

According to the British Dyslexia Association (2025), these findings led to the development of intervention approaches,

which indicate that people with dyslexia respond better to visual or kinesthetic learning strategies, which activate the right side of the brain, such as pictures, diagrams, interactive methods and tactile learning. This is due to dyslexia's resistance to conventional teaching methods, although their effects can be mitigated with targeted interventions that include the use of information technology and specialized support.

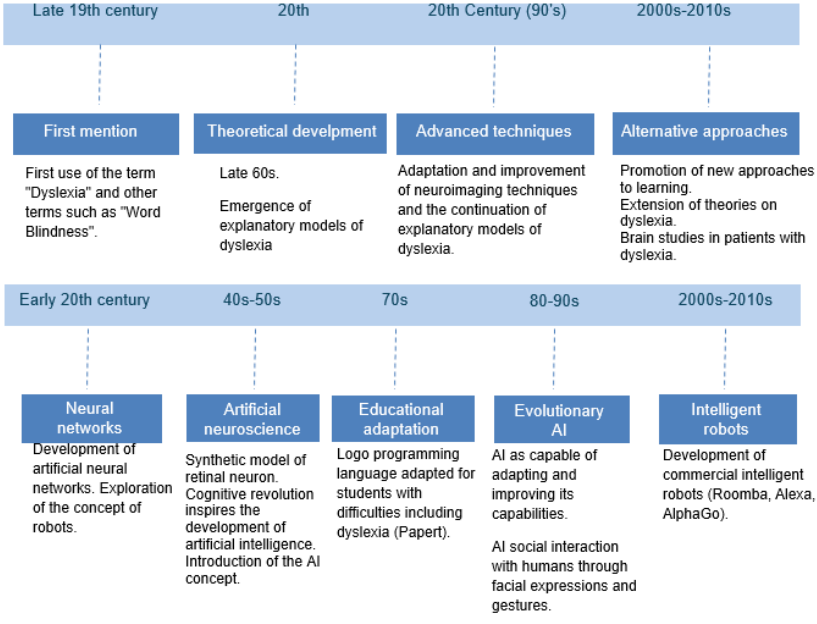
In this regard, we can understand dyslexia as a specific learning disorder characterized by a difference between the individual's intellectual potential and the implementation of their reading and writing skills, caused by alterations in neurodevelopment, which in turn can be influenced directly or indirectly by socio-environmental phenomena. These irregularities produce reading and writing dynamics that may not be very compatible with traditional teaching strategies, so the challenge for education professionals lies in the need to incorporate new techniques for literacy learning based on contemporary tools (including technological ones) supported by scientific evidence obtained through neuroimaging studies.

1.2. Historical evolution of artificial intelligence

The beginnings of AI can be traced back to the 19th century with Boolean algebra. Later, during World War II, Alan Turing used it to crack the Enigma code, creating the Bombe machine and developing the concept of computational intelligence. In 1943, Warren McCulloch and Walter Pitts modeled a retinal neuron, laying the foundation for neural networks and digital brain modeling (Haiech, 2020).

Subsequently, the so-called "cognitive revolution" led to interdisciplinary work among researchers to build new models of human cognition. The models would allow progress in the development of artificial intelligence technologies, resulting in an increased interest in problem solving, text comprehension and natural language processing (Doroudi, 2023). Similarly, the concept of computational intelligence was concretized in a publication by Alan Turing in 1950; while the term artificial intelligence and the intellectual paradigm associated with it were proposed in 1956 (Haiech, 2020).

In the 1970s, Seymour Papert created the Logo programming language, adopted for students with various disabilities (e.g., physical disabilities, dyslexia, and autism) to learn basic communication skills. The 1980s and 1990s were characterized by the robust demonstration of AI's ability to adapt, improve its problem-solving capabilities over time, and interact with humans through different ways, including facial expressions and gestures, a time from which the foundation is laid for the development of different classes of commercial intelligent robots on the 2000s and 2010s (Doroudi, 2023). Figure I below shows graphically the most important milestones in the historical evolution of the variables under study.



Source: Own elaboration, 2025.

Figure I: **Historical evolution of the studied variables (dyslexia and artificial Intelligence)**

In this sense, it is understood that during the emerging development of AI, its focus was purely directed to the computer science area, which is evidenced by the emergence of concepts such as computational intelligence. However, after the collaboration of professionals from different fields due to the cognitive revolution, the interest was redirected towards knowledge that can be applied to everyday human interaction dynamics, to the point of intervening on various alterations and disabilities that affect the course of this type of interactions.

1.3. Role of social sciences and new technologies in the study of dyslexia

The study of dyslexia, although it is usually carried out in an interdisciplinary way, is strongly approached by the social sciences, such as education and educational psychology. Psychology and education are areas that converge and complement each other to ensure the continuity of scientific advances in each of these disciplines, since educational psychology has provided teaching with scientifically valid methodological tools and resources, distancing it from traditional or intuitive approaches, and has also made it possible to investigate and understand learning processes in a systematic way (Beltrán & Pérez, 2011).

On the other hand, the teaching-learning process has directly influenced the modification of the psychologist's role, replacing the medical and test application approach with one based on systemic, ecological and collaborative intervention, whereby psychologists, in this case, educational psychologists, now work more closely with teachers, parents and other professionals to develop strategies and programs that help students learn more

effectively (Marín, 2020; Suárez-Rojas et al., 2024).

This change has emerged as this discipline has evolved, which also involves the adaptation of undergraduate and graduate educational programs to be able to train educational psychologists with the necessary skills to perform their work and address special educational needs, such as those of students with dyslexia, through direct or indirect intervention approaches focused on the student or group, broad intervention at the school level, intervention in the provincial or regional education system, or through the implementation of research practices (Carrasco et al., 2019).

The integration of new technologies from an interdisciplinary perspective has transformed education and educational psychology by enabling digitization and access to multimedia educational resources. These technologies offer unprecedented flexibility and adaptability to restructure educational processes and facilitate more flexible and personalized learning. In addition, they foster interaction and collaboration between students and teachers, since they allow the creation, modification and distribution of information, opening new possibilities for more effective teaching methods (Marín-González et al., 2020; Vega-Rodríguez & Botero-Suaza, 2021).

2. Methodology

This article presents a systematic review oriented to the applicability of artificial intelligence (AI) to the management of dyslexia cases in university settings, considering the assessment, diagnosis and intervention processes. The search was conducted in July 2024 following the strategies TITLE-ABS-KEY(“dyslexia” OR “reading difficulties”) AND TITLE-ABS-KEY(“artificial intelligence” OR “machine learning” OR “neural networks” OR “natural language processing”) for the Scopus database and TS=(“dyslexia” OR “reading difficulties”) AND TS=(“artificial intelligence” OR “machine learning” OR “neural networks” OR “natural language processing”) for Web of Science.

Although both search strategies are composed of the same keywords, they are presented in isolation, since the advanced search option was used for both databases; the main reason why this type of search was applied is because it allows obtaining more precise and specific results in terms of the study variables. From a complementary perspective, with the documents obtained, a co-occurrence analysis of the keywords was carried out using the VosViewer software, with the aim of visualizing the relationships between the different terms and identifying the most important topics and subtopics within the fields addressed.

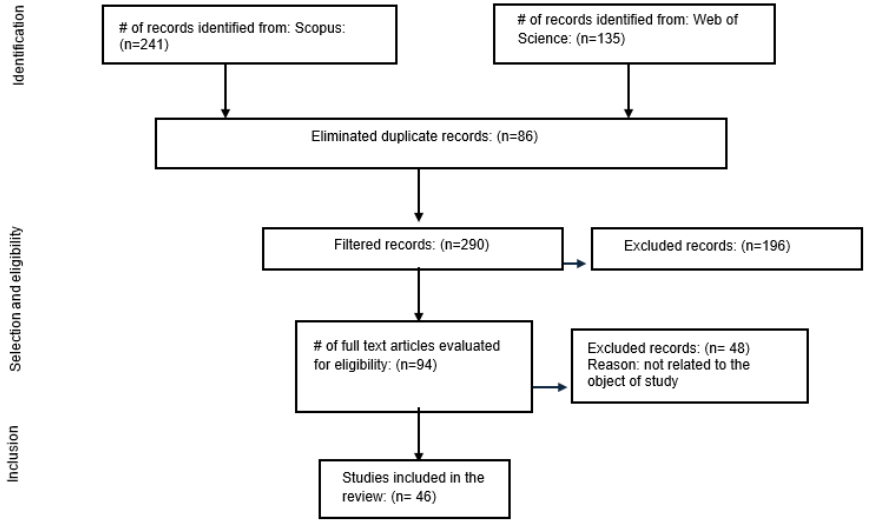
The 2020 statement of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses for Protocols (PRISMA) method was taken as a reference. This facilitates the collection, analysis and summary of existing studies on a specific topic, ensuring the reliability of the results. In addition, it is composed of a 27 items checklist and a flowchart that visually represents the four phases of the review process (identification, selection, eligibility and inclusion (Page et al., 2021).

The inclusion criteria used for the selection of documents included in this review are: a) empirical research articles indexed in Scopus or Web of Science b) referred to the application of AI modalities (machine learning, neural networks...) to dyslexia assessment, diagnosis or intervention. The exclusion criteria defined were: review articles, books, book chapters, editorials and conference reviews. Finally, the content review and selection of the papers presented in the results was carried out based on the inclusion and exclusion criteria defined in consensus by the researchers.

3. Results and discussion

The articles were collected in four stages.

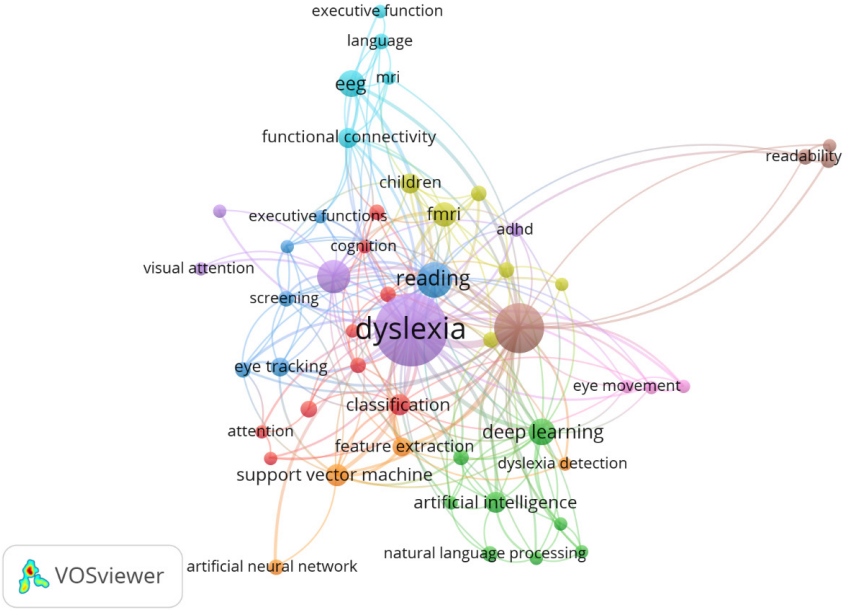
First, the Web of Science (WoS) and Scopus databases were consulted using the advanced search option, identifying a total of 376 articles (135 from Web of Science and 241 from Scopus). Subsequently, duplicate articles (86 articles) were eliminated, leaving a total of 290 articles. In the third stage, the articles were examined in terms of their title, keywords and abstract, and the exclusion criteria were applied, followed by an exhaustive review of the full-text articles and application of the inclusion criteria, leaving a total of 94 articles for eligibility, of which 48 were excluded because they did not refer to the object of study. Finally, in the last stage, 46 articles were obtained for the systematic review presented in an integrated manner in this section. The development of each of these stages is presented in Figure II.



Source: Own elaboration, 2025.

Figure II: **PRISMA flow chart**

The keyword co-occurrence analysis of the consulted papers shows that terms grouped in clusters such as "dyslexia", "reading", "screening", "classification" and "feature extraction" reflect a growing interest in studying dyslexia and reading processes, including the identification of biomarkers and the development of assessment tools, using methods such as neuroimaging and eye movement monitoring, represented by terms such as "EEG", "fMRI", "eye tracking" and "eye movement". In addition, terms such as "deep learning", "support vector machine", "artificial intelligence", "artificial neural network", and "natural language processing" indicate a growing focus on the application of artificial intelligence to detect and diagnose dyslexia, as well as to develop data-driven interventions. This information is illustrated in Figure III.



Source: Own elaboration, 2025 through VosViewer.

Figure III: **Co-occurrence of keywords**

As for the results of the review carried out, different predominant themes can be appreciated in the research on the application of artificial intelligence to the study of dyslexia, mainly in terms of assessment and diagnosis, revealing significant advances that can directly benefit the student population with signs of dyslexia, including those who belong to university sectors.

Initially, a large amount of information was observed oriented to eye movements as predictive indicators of both dyslexia and its different levels of severity, of which different characteristics were studied such as the speed at which the gaze points move, this being one of the factors that have been most taken into account in this type of studies (Appadurai & Bhargavi, 2021; Vajs et al., 2023; Jothi et al., 2023).

In addition to the above, features with a high predictive level are based on the time of onset of the first eye fixation, the total number of fixations, the total number of saccades (when the eyes move rapidly to fixate the image), the average duration of the fixation saccade, the length and speed of the saccade, and the ratio of saccades to fixations (Appadurai & Bhargavi, 2021; Vajs et al., 2023). This is because the eye movements of people with dyslexia differ from those of ordinary readers.

Those with dyslexia tend to hold their fixations longer, experience prolonged reading times, and make a greater number of fixations compared to readers without this condition (Modak et al., 2019; Nerušil et al., 2021; Vajs et al., 2022), which represents useful information for university teachers, because, although it does not replace a formal diagnosis by a health professional, it constitutes a warning sign that would be part of the repertoire of basic knowledge in dyslexia detection.

These studies have shown how all these features can be integrated together with different AI modalities such as machine

learning, within which neural networks and deep learning are also found for dyslexia detection, complemented with classification and regression models used in predictive tasks such as Hybrid Kernel SVM-PSO and XGBoost (Jothi & Bhargavi, 2019; Sekhar et al., 2023; Liu et al., 2024). These techniques are implemented through text reading (including in different languages) and non-reading activities (Nilsson et al., 2016).

The research shows that data on eye movements performed in the exercise of reading texts and analyzed through machine learning, allow predicting dyslexia with high accuracy. It also highlights the relevance of using activities that are not directly related to reading to achieve a more accurate assessment (El Hmimdi et al., 2021; El Hmimdi et al., 2022; Vajs et al., 2023).

On the other hand, one of the research lines that has gained strength within the subject studied is the application of artificial intelligence (AI) to the evaluation of brain activity to predict and detect dyslexia (García et al., 2014; Tamboer et al., 2016), specifically through the use of neuroimaging techniques such as functional magnetic resonance imaging (fMRI), which is used to measure brain activity in real time, and other methods such as electroencephalogram (EEG), used to measure brain electrical activity (Jothi et al., 2018; Formoso et al., 2021; Parmar & Paunwala, 2023).

These techniques have found significant differences in specific areas of the temporal, frontal, left occipital, inferior parietal, and prefrontal brain regions of the right anterior hemisphere (Cui et al., 2016; Perera et al., 2018; Martínez-Murcia et al., 2020). In addition, disparities and relevant features are observed in the EEG alpha band, as well as increased theta wave activity of the left hemisphere of the brain; this is substantiated from results evidencing that adults with dyslexia show unique patterns of brain wave activation during the performance of literacy tasks (Mat et al., 2020; Tomaz et al., 2021; Beyer et al., 2022; Seshadri et al., 2023).

The aforementioned AI applications within this context also correspond to the use of machine learning, specifically deep learning, deep and shallow neural networks (Christoforou et al., 2023a; 2023b; Seshadri et al., 2023), which have shown high levels of accuracy, sensitivity and specificity when classifying individuals with dyslexia; however, other studies highlight the importance of continuing research and development of automated systems to address the challenges of predicting and detecting this specific learning disorder (Christodoulides et al., 2022).

In this regard, learning in its different modalities, within which set-based machine learning and supervised machine learning are also included, has been of great help mainly in the assessment and diagnosis of dyslexia (Vezzoli et al., 2018; Yong et al., 2019; Ahmad et al., 2022), through the use of reading and non-reading tasks, combined with the aforementioned resources, as well as for the automatic classification of text reading difficulty, the identification of reading fluency, the creation of online game tests, the generation of profiles of evaluated people and the establishment of correlations between different types of learning difficulties to verify possible relationships between them (Dutt et al., 2022; Kaisar & Chowdhury, 2022; Zabkar et al., 2023; Cavalli et al., 2024).

The advantages of these AI applications include leveraging accurate prediction, the ease of determining key impairments for each evaluee, the potential for greater accessibility and effectiveness of these methods compared to traditional ones, the increased generalizability across large and diverse datasets, and the opportunity to improve the current assessment/diagnostic system through globalization of these approaches (Kaisar & Chowdhury, 2022; Erbeli et al., 2023; Kothapalli et al., 2023; El Hmimdi et al., 2024).

In summary, the assessment and diagnostic processes have benefited from different AI modalities by allowing them to act as a support to accelerate the analysis processes of different indicators of dyslexia, such as eye movements, brain areas and brain wave activation patterns, and some aspects

related to the student's performance in reading tasks (difficulty, fluency, among others).

In addition, AI has also been able to elaborate comparative results between individuals with and without dyslexia in a faster and more efficient way, so that all of the above, taken together, represents a significant advance to optimize the processes carried out in the detection phase, which would mitigate the phenomenon of late diagnoses and the negative consequences that derive from it, mainly in students in higher grades who lose the possibility of receiving timely treatment due to the absence of a diagnostic category that allows effectively understanding such difficulties.

In the context of intervention, research has been mostly focused on the university population (Mpia et al., 2013; Pedroli et al., 2017), which encompasses the implementation of techniques such as assistive learning technologies, virtual reality, tools to personalize the learning experience for students with dyslexia, and recommendation algorithms for the aforementioned resources (Alsobhi & Alyoubi, 2019; Zingoni et al., 2021; Wang et al., 2022; Morciano et al., 2024).

These intervention modalities provide several advantages such as generation of increased brain activity associated with learning, improved cognitive skills and academic performance, recommendations tailored to each student's experience, improved and assisted text comprehension, correlation of dyslexia type with preferred learning style, increased ability to apply what is learned in practical contexts, increased satisfaction with the learning process, real-time feedback, and significant improvement in phonological awareness, reading aloud, and writing (Nandhini & Balasundaram, 2013; Alsobhi & Alyoubi, 2019; Wang et al., 2022; Corona-González et al., 2024).

In general terms, although the literature about AI based interventions is scarce, its focus on the personalization of the learning processes of reading and writing skills is highlighted, which includes the recommendation and provision of reinforcement strategies, as well as the proportion of assistance to complete activities related to text comprehension, ensuring the improvement of the student's academic performance, but also of their intellectual faculties, evidencing intervention from the transcendental aspects to the superficial ones.

Finally, the congruence between what was developed in the scientometric process and the analysis of the consulted content is highlighted, since the figure provided by VosViewer (see Figure III), summarizes important elements argued to a greater degree in the theoretical construction of the review results, represented by keywords such as "MRI", "fMRI" and "EEG", corresponding to brain activity assessment techniques, articulated with different AI modalities such as machine and deep learning, and neural networks, useful also for the creation of classification algorithms; this evidenced in keywords such as "deep learning", "artificial neural network", "classification" and "support vector machine". Keywords related to dyslexia detection, including through eye movements, are also identified, represented through "dyslexia detection", "eye tracking" and "eye movement".

Conclusions

As discussed throughout this paper, there is evidence of the effectiveness of various AI applications to the study of dyslexia, specifically in assessment, diagnosis and intervention processes, however, it is notable the predominance of research focused on the evaluative and diagnostic area, which reflects the need of deeper understanding of the intervention area.

To address this gap, it is suggested that future work could be oriented towards research lines focused mainly on interventions supported by the use of AI in its different modalities, given its benefits in terms of improving the cognitive skills involved in the learning processes of reading capacities,

well as in terms of the possibility of carrying out tailored, personalized and assistive interventions with real-time feedback for students with dyslexia, specifically in higher education.

In this regard, the usefulness of the findings of this research in the university training field is highlighted, since the knowledge of tools that integrate AI with other resources such as evaluation methods of brain activity and eye movement recording techniques, allows identifying alternatives that provide an early diagnosis in students who show difficulties in reading and in whom the presence of dyslexia is suspected. However, despite the valuable contributions obtained from the two most relevant academic repositories, a possible limitation of this study is that using a larger number of databases could have resulted in a broader sample of relevant results.

Despite the above, it has been possible to conclude that with an early assessment, it is possible to manage the necessary curricular adaptations to counteract signs and symptoms of dyslexia, and even these modifications may include AI-designed tools to streamline the intervention process, given its ability to recommend specific strategies to address each case and positively enrich the learning experience of each student, Therefore, these advances may be key to level reading skills between students with and without dyslexia, increase motivation for learning and academic performance in students with dyslexia, reduce their risk of academic dropout, as well as provide opportunities to ensure the inclusion of this population in university and work environments.

Bibliographic references

Ahmad, N., Rehman, M. B., El Hassan, H. M., Ahmad, I., & Rashid, M. (2022). An efficient machine learning-based feature optimization model for the detection of dyslexia. *Computational Intelligence and Neuroscience*, 8491753. https://doi.org/10.1155/2022/8491753

Aishwarya, G. L., Satyanarayana, V., Singh, M. K., & Kumar, S. (2022). Contemporary evolution of artificial intelligence (AI): An overview and applications. *Advanced Production and Industrial Engineering*, 130-136. https://doi.org/10.3233/ATDE220731

Al-Dokhny, A. A., Bukhamseen, A. M., & Drwish, A. M. (2022). Influence of assistive technology applications on dyslexic students: The case of Saudi Arabia during the COVID-19 pandemic. *Education and Information Technologies*, *27*(9), 12213-12249. https://doi.org/10.1007/s10639-022-11090-9

Alsobhi, A. Y., & Alyoubi, K. H. (2019). Adaptation algorithms for selecting personalised learning experience based on learning style and dyslexia type. *Data Technologies and Applications*, *53*(2), 189-200. https://doi.org/10.1108/DTA-10-2018-0092

Alsswey, A., El-Qirem, F. A., & Al Tarawneh, M. H. (2021). Dyslexic Arabic students in the Arab countries: A systematic review of assistive technology progress and recommendations. *International Journal of Early Childhood Special Education*, *13*(1), 114-120. https://www.int-jecse.net/media/article_pdfs/114-120.pdf

Amador, G., Clouder, L., Karakus, M., Uribe, I., Cinotti, A., Ferreyra, M. V., & Rojo, P. (2021). Neurodiversidad en la Educación Superior: La experiencia de los estudiantes. *Revista de la Educación Superior*, *50*(200), 129-151. http://resu.anuies.mx/ojs/index.php/resu/article/view/1893

American Psychiatric Association (2013). *Diagnostic and statistical manual of mental disorders: DSM-5*.

Editorial Médica Panamericana. https://doi.org/10.1176/appi.books.9780890425596

Appadurai, J. P., & Bhargavi, R. (2021). Eye movement feature set and predictive model for dyslexia: Feature set and predictive model for dyslexia. *International Journal of Cognitive Informatics and Natural Intelligence (IJCINI)*, *15*(4), 1-22. https://doi.org/10.4018/IJCINI.20211001.oa28

Ausín, V., Rodríguez, S., Delgado, V., & Bogdan, R. (2023). Evaluación de una APP de realidad aumentada en niños/as con dislexia: Estudio piloto. *Pixel-Bit. Revista de Medios y Educación, 66*, 87-111. https://doi.org/10.12795/pixelbit.95632

Barua, P. D., Vicnesh, J., Gururajan, R., Oh, S. L., Palmer, E., Azizan, M. M., Kadri, N. A., & Acharya, U. R. (2022). Artificial intelligence enabled personalised assistive tools to enhance education of children with neurodevelopmental disorders-A review. *International Journal of Environmental Research and Public Health*, *19*(3), 1192. https://doi.org/10.3390/ijerph19031192

Beltrán, J. A., & Pérez, L. (2011). Más de un siglo de psicología educativa. Valoración general y perspectivas de futuro. *Papeles del Psicólogo, 32*(3), 204-231. https://www.papelesdelpsicologo.es/pdf/1981.pdf

Beyer, M., Liebig, J., Sylvester, T., Braun, M., Heekeren, H. R., Froehlich, E., Jacobs, A. M., & Ziegler, J. C. (2022). Structural gray matter features and behavioral preliterate skills predict future literacy - A machine learning approach. *Frontiers in Neuroscience*, *16*, 920150. https://doi.org/10.3389/fnins.2022.920150

Bravo, R. N., Vargas, K. V., Manzano, M., & Lazo, C. S. (2023). Alfabetismo en el Siglo XXI: Análisis de competencias de lectura y escritura en Ecuador. *Revista de Ciencias Sociales (Ve), XXIX*(E-8), 183-196. https://doi.org/10.31876/rcs.v29i.40946

British Dyslexia Association (2025). About dyslexia. *British Dyslexia Association.* https://www.bdadyslexia.org.uk/dyslexia/about-dyslexia/what-is-dyslexia

Burgos-Mendieta, D. J., Castro-Castillo, G. J., Mendoza-Carrera, J. E., & Ibarra-Freire, M. C. (2024). Hábitos de lectoescritura en entornos educativos digitales en Ecuador. *Revista de Ciencias Sociales (Ve), XXX*(3), 349-364. https://doi.org/10.31876/rcs.v30i3.42670

Cancer, A., & Antonietti, A. (2022). Music-based and auditory-based interventions for reading difficulties: A literature review. *Heliyon, 8*(4), e09293. https://doi.org/10.1016/j.heliyon.2022.e09293

Carrasco, C., Balytar, M. J., Bastidas, N., López, J., Morales, M., & López, V. (2019). Identidad profesional de una psicóloga educacional: Un estudio de caso en Chile. *Pensando Psicología*, *15*(25), 1-27. https://doi.org/10.16925/2382-3984.2019.01.01

Carrillo, M. S., Alegría, J., Miranda, P., & Sánchez, N. (2011). Evaluación de la dislexia en la escuela primaria: Prevalencia en español. *Escritos de Psicología*, *4*(2), 35-44. https://doi.org/10.24310/espsiescpsi.v4i2.13317

Cavalli, E., Brèthes, H., Lefèvre, E., El Ahmadi, A., Duncan, L. G., Bianco, M., Melmi, J.-B., Denis-Noël, A., & Colé, P. (2024). Screening for dyslexia in university students: A standardized procedure based on conditional inference trees. *Archives of Clinical Neuropsychology, 39*(5), 557-574. https://doi.org/10.1093/arclin/acad103

Chalco-Torres, L. E., Galarza-Mora, W. G., & Gálvez-Palomeque, P. A. (2023). Optimizando la enseñanza en educación superior: Una revisión de estrategias para la inclusión de estudiantes con necesidades educativas especiales. *MQRInvestigar, 7*(3), 4300-4316. https://doi.org/10.56048/MQR20225.7.3.2023.4300-4316

Christodoulides, P., Miltiadous, A., Tzimourta, K. D., Peschos, D., Ntritsos, G., Zakopoulou, V., Giannakeas, N., Astrakas, L. G., Tsipouras, M. G., Tsamis, K. I., Glavas, E., & Tzallas, A. T. (2022). Classification of EEG signals from young adults with dyslexia combining a Brain Computer Interface device and an Interactive Linguistic Software Tool. *Biomedical Signal Processing and Control, 76*, 103646. https://doi.org/10.1016/j.bspc.2022.103646

Christoforou, C., Theodorou, M., Fella, A., & Papadopoulos, T. C. (2023a). RAN-related neural-congruency: A machine learning approach toward the study of the neural underpinnings of naming speed. *Frontiers in Psychology, 14*, 1076501. https://doi.org/10.3389/fpsyg.2023.1076501

Christoforou, C., Theodorou, M., Fella, A., & Papadopoulos, T. C. (2023b). Phonological ability and neural congruency: Phonological loop or more? *Clinical Neurophysiology, 156*, 228-241. https://doi.org/10.1016/j.clinph.2023.10.015

Corona-González, C. E., Ramos-Flores, M., Alonso-Valerdi, L. M., Ibarra-Zarate, D. I., & Issa-García, V. (2024). Psychophysiological evaluation of the Smartick method in children with reading and mathematical difficulties. *Frontiers in Human Neuroscience*, *18*, 1287544. https://doi.org/10.3389/fnhum.2024.1287544

Cui, Z., Xia, Z., Su, M., Shu, H., & Gong, G. (2016). Disrupted white matter connectivity underlying developmental dyslexia: A machine learning approach. *Human Brain Mapping*, *37*(4), 1443-1458. https://doi.org/10.1002/hbm.23112

Diraä, N., Engelen, J., Ghesquière, P., & Neyens, K. (November 9-10, 2009). The use of ICT to support students with dyslexia. In A. Holzinger & K. Miesenberger (Eds.), *HCI and Usability for e-Inclusion: 5th Symposium of the Workgroup Human-Computer Interaction and Usability Engineering of the Austrian Computer Society, USAB 2009,* (pp. 457-462), Linz, Austria. Springer Berlin Heidelberg.

Doroudi, S. (2023). The intertwined histories of artificial intelligence and education. *International Journal of Artificial Intelligence in Education*, *33*(4), 885-928. https://doi.org/10.1007/s40593-022-00313-2

Duan, Y., Edwards, J. S., & Dwivedi, Y. K. (2019). Artificial intelligence for decision making in the era of Big Data–evolution, challenges and research agenda. *International Journal of Information Management*, *48*, 63-71. https://doi.org/10.1016/j.ijinfomgt.2019.01.021

Dutt, S., Ahuja, N. J., & Kumar, M. (2022). An intelligent tutoring system architecture based on fuzzy neural network (FNN) for special education of learning disabled learners. *Education and Information Technologies*, *27*(2), 2613-2633. https://doi.org/10.1007/s10639-021-10713-x

El Hmimdi, A. E., Kapoula, Z., & Garnot, V. S. F. (2024). Deep learning-based detection of learning disorders on a large scale dataset of eye movement records. *BioMedInformatics*, *4*(1),

519-541. https://doi.org/10.3390/biomedinformatics4010029

El Hmimdi, A. E., Ward, L. M., Palpanas, T., Garnot, V. S. F., & Kapoula, Z. (2022). Predicting dyslexia in adolescents from eye movements during free painting viewing. *Brain Sciences*, *12*(8), 1031. https://doi.org/10.3390/brainsci12081031

El Hmimdi, A. E., Ward, L. M., Palpanas, T., & Kapoula, Z. (2021). Predicting dyslexia and reading speed in adolescents from eye movements in reading and non-reading tasks: A Machine Learning approach. *Brain Sciences*, *11*(10), 1337. https://doi.org/10.3390/brainsci11101337

Erbeli, F., He, K., Cheek, C., Rice, M., & Qian, X. (2023). Exploring the machine learning paradigm in determining risk for reading disability. *Scientific Studies of Reading, 27*(1), 5-20. https://doi.org/10.1080/10888438.2022.2115914

Formoso, M. A., Ortiz, A., Martínez-Murcia, F. J., Gallego, N., & Luque, J. L. (2021). Detecting phase-synchrony connectivity anomalies in EEG signals. Application to dyslexia diagnosis. *Sensors, 21*(21), 7061. https://doi.org/10.3390/s21217061

García, Y., García, B., Saralegui, I., & Fernandez-Ruanova, B. (2014). Automatic classification of dyslexic children by applying machine learning to fMRI images. *Bio-Medical Materials and Engineering, 24*(6), 2995-3002. https://doi.org/10.3233/BME-141120

Gracheva, M. A., & Shalileh, S. (2023). Dyslexia diagnostics based on eye movements and artificial intelligence methods: A review. *Clinical Psychology and Special Education, 12*(3), 1-29. https://doi.org/10.17759/cpse.2023120301

Griffin, E., & Pollak, D. (2009). Student experiences of neurodiversity in higher education: Insights from the BRAINHE project. *Dyslexia, 15*(1), 23-41. https://doi.org/10.1002/dys.383

Guaña-Moya, J., Arteaga-Alcívar, Y., Ilbay-Guaña, E., & Morales, M. B. (2023). Uso de las Tecnologías de la Información y Comunicación para mejorar el aprendizaje de los niños con dislexia. *RECIMUNDO, 7*(1), 507-514. https://doi.org/10.26820/recimundo/7.(1).enero.2023.507-514

Gutiérrez-Fresneda, R., Díez, A., Pozo-Rico, T., Ramos-Fernández, E., & Verdú-Llorca, V. (2022). Saberes sobre la dislexia y su importancia en el aprendizaje por parte de los estudiantes de mención en pedagogía terapéutica. En R. Satorre (Ed.), *El profesorado, eje fundamental de la transformación de la docencia universitaria* (pp. 5-14). Octaedro.

Haiech, J. (2020). Parcourir l'histoire de l'intelligence artificielle, pour mieux la définir et la comprendre. *Médecine Sciences*, *36*(10), 919-923. https://doi.org/10.1051/medsci/2020145

Helland, T. (2022). Trends in dyslexia research during the period 1950 to 2020-theories, definitions, and publications. *Brain Sciences*, *12*(10), 1323. https://doi.org/10.3390/brainsci12101323

Johnston, R. B. (2019). *Poor education predicts poor health—A challenge unmet by American medicine*. National Academy of Medicine.

Jothi, A., Bhargavi, R., & Deepa, B. V. (2023). Prediction of dyslexia severity levels from fixation and saccadic eye movement using machine learning. *Biomedical Signal Processing and Control, 79*(Part-1), 104094. https://doi.org/10.1016/j.bspc.2022.104094

Jothi, A., Bhargavi, R., & Ramesh, R. (2018). Prediction of dyslexia using support vector machine in distributed environment. *International Journal of Engineering & Technology, 7*(4), 2795. https://doi.org/10.14419/ijet.v7i4.17222

Jothi, A., & Bhargavi, R. (2019). Prediction of dyslexia from eye movements using machine learning. *IETE Journal of Research, 68*(2), 814-823. https://doi.org/10.1080/03772063.2019.1622461

Kaisar, S., & Chowdhury, A. (2022). Integrating oversampling and ensemble-based machine learning techniques for an imbalanced dataset in dyslexia screening tests. *ICT Express, 8*(4), 563-568. https://doi.org/10.1016/j.icte.2022.02.011

Kothapalli, P. K. V., Rathikarani, V., & Nookala, G. K. M. (2023). A constructive model for dyslexia and ADHD prediction using feature learning and boosting approaches. *International Journal of Intelligent Systems and Applications in Engineering, 12*(2s), 639-649. https://www.ijisae.org/index.php/IJISAE/article/view/3685

Larco, J. M. (2023). Retraso en el desarrollo del lenguaje en niños de nivel inicial en Ecuador. *Revista de Ciencias Sociales (Ve), XXIX*(E-8), 197-210. https://doi.org/10.31876/rcs.v29i.40947

Liu, F., Wang, H., Zhao, X., & Yu, D. (2024). Small-world properties of eye-movement time series assisted in identifying children at high risk for dyslexia. *Biomedical Signal Processing and Control, 93*, 106148. https://doi.org/10.1016/j.bspc.2024.106148

Lohvansuu, K., Torppa, M., Ahonen, T., Eklund, K., Hämäläinen, J. A., Leppänen, P. H. T., & Lyytinen, H. (2021). Unveiling the mysteries of dyslexia-lessons learned from the prospective Jyväskylä Longitudinal Study of dyslexia. *Brain Sciences, 11*(4), 427. https://doi.org/10.3390/brainsci11040427

Macas-Macas, A. D. R., & Guevara-Vizcaíno, C. F. (2020). Uso de herramientas digitales para mejorar la dislexia en estudiantes de Educación Básica. *Dominio de las Ciencias, 6*(3), 197-218. https://dominiodelasciencias.com/ojs/index.php/es/article/view/1281

Marín, F. (2020). Editorial. Resignificar la praxis educativa en tiempos de incertidumbre: Un desafío para las organizaciones sociales. *Revista de Ciencias Sociales (Ve), XXVI*(E-2), 9-13. https://doi.org/10.31876/rcs.v26i0.34140

Marín-González, F., Grimaldo-Guerrero, J., Mendoza-Becerra, M., & Senior-Naveda, A. (2020). Mapeo del conocimiento para la enseñanza interdisciplinaria en ingeniería. *Formación Universitaria, 13*(6), 85-94. http://dx.doi.org/10.4067/S0718-50062020000600085

Martínez-Murcia, F. J., Ortiz, A., Gorriz, J. M., Ramirez, J., Lopez-Abarejo, P. J., Lopez-Zamora, M., & Luque, J. L. (2020). EEG connectivity analysis using denoising autoencoders for the detection of dyslexia. *International Journal of Neural Systems, 30*(7), 2050037. https://doi.org/10.1142/S0129065720500379

Mat, N. I., Abdul, A. W., & Kamaruddin, N. (2020). Detecting learning disabilities based on neuro-physiological interface of affect (NPIoA). *Indonesian Journal of Electrical Engineering and Computer Science, 19*(1), 163-170. http://doi.org/10.11591/ijeecs.v19.i1.pp164-171

Modak, M., Ghotane, K., Siddhanth, V., Kelkar, N., Iyer, A., & Prachi, G.

(2019). Detection of dyslexia using eye tracking measures. *International Journal of Innovative Technology and Exploring Engineering, 8*(9S2), 58-61. https://doi.org/10.35940/ijitee.I1011.0789S219

Morciano, G., Alcalde, J. M., Zingoni, A., Yeguas, E., Taborri, J., & Calabrò, G. (2024). Use of recommendation models to provide support to dyslexic students. *Expert Systems with Applications, 249*(Part-C), 123738. https://doi.org/10.1016/j.eswa.2024.123738

Mpia, D., Ojo, S., & Osunmakinde, I. O. (2013). An intelligent integrative assistive system for dyslexic learners. *Journal of Assistive Technologies, 7*(3), 172-187. https://doi.org/10.1108/JAT-11-2012-0036

Nandhini, K., & Balasundaram, S. R. (2013). Improving readability through extractive summarization for learners with reading difficulties. *Egyptian Informatics Journal, 14(*3), 195-204. https://doi.org/10.1016/j.eij.2013.09.001

Nerušil, B., Polec, J., Škunda, J., & Kačur, J. (2021). Eye tracking based dyslexia detection using a holistic approach. *Scientific Reports, 11*(1), 15687. https://doi.org/10.1038/s41598-021-95275-1

Nilsson, M., Öqvist, G., Ygge, J., Pansell, T., Rydberg, A., & Jacobson, C. (2016). Screening for dyslexia using eye tracking during reading. *PloS One, 11*(12), e0165508. https://doi.org/10.1371/journal.pone.0165508

Page, M. J., Moher, D., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., …McKenzie, J. E. (2021). PRISMA 2020 explanation and elaboration: Updated guidance and exemplars for reporting systematic reviews. *The BMJ, 372*, 160. https://doi.org/10.1136/BMJ.N160

Palacios, A. M., Sánchez, L., & Couso, I. (2010). Diagnosis of dyslexia with low quality data with genetic fuzzy systems. *International Journal of Approximate Reasoning, 51*(8), 993-1009. https://doi.org/10.1016/j.ijar.2010.07.008

Parmar, S., & Paunwala, C. (2023). Early detection of dyslexia based on EEG with novel predictor extraction and selection. *Discover Artificial Intelligence, 3*, 33. https://doi.org/10.1007/s44163-023-00082-4

Pedroli, E., Padula, P., Guala, A., Meardi, M. T., Riva, G., & Albani, G. (2017). A psychometric tool for a virtual reality rehabilitation approach for dyslexia. *Computational and Mathematical Methods in Medicine,* 7048676. https://doi.org/10.1155/2017/7048676

Peñalver-Higuera, M. J., Guerra-Castellanos, Y. B., Rodríguez, L. R., & Lopez, R. D. P. (2024). Transformando la educación con Inteligencia Artificial: Hacia un aprendizaje personalizado en la Era 4.0. *Revista de Ciencias Sociales (Ve), XXX*(4), 416-430. https://doi.org/10.31876/rcs.v30i4.43040

Perera, H., Shiratuddin, M. F., Wong, K. W., & Fullarton, K. (2018). EEG signal analysis of writing and typing between adults with dyslexia and normal controls. *International Journal of Interactive Multimedia and Artificial Intelligence, 5*(1), 62-67. https://doi.org/10.9781/ijimai.2018.04.005

Platas-García, A., Sánchez, M., & Mayett, R. L. (2023). Dislexia y autoeficacia académica en estudiantes universitarios mexicanos. *Cuestiones*

Pedagógicas, 2(32), 105-120. https://doi.org/10.12795/CP.2023.i32.v2.06

Quisnancela, A. M. (2022). *Gamificación como estrategia didáctica para estudiantes con dislexia de EGB superior, en la Escuela de Educación Básica "Fe y Alegría" de la Ciudad de Riobamba* [Tesis de maestría, Universidad Nacional de Chimborazo]. http://dspace.unach.edu.ec/bitstream/51000/9783/1/Quisnancela%20Q.%2C%20Ana%20%282022%29%20Gamificacion%20como%20estrategias%20didacticas%20para%20estudiantes%20con%20dislexia.pdf

Rodríguez-Cano, S., Delgado-Benito, V., Ausín-Villaverde, V., & Muñoz-Martín, L. (2021). Design of a virtual reality software to promote the learning of students with dyslexia. *Sustainability, 13*(15), 8425. https://doi.org/10.3390/su13158425

Rubio, J. (2022). *Evaluación de la Calidad de Materiales Didácticos Digitales para alumnado con Dislexia en Educación Primaria* [Tesis de pregrado, Universidad de Oviedo]. https://digibuo.uniovi.es/dspace/handle/10651/64313

Sanfilippo, J., Ness, M., Petscher, Y., Rappaport, L., Zuckerman, B., & Gaab, N. (2020). Reintroducing dyslexia: Early identification and implications for pediatric practice. *Pediatrics, 146*(1), e20193046. https://doi.org/10.1542/peds.2019-3046

Sekhar, S., Chandrashekar, S., & Siddesh, G. M. (2023). Eye movement interpretation for detecting dyslexia using machine learning techniques. International Journal of Computing and Digital Systems, 13(1), 787-794. http://dx.doi.org/10.12785/ijcds/130162

Serna, M. A. (2023). Dislexia en la etapa universitaria: Una mirada desde la lingüística clínica. *Revista Médica de Risaralda, 29*(1), 9-18. https://doi.org/10.22517/25395203.25236

Seshadri, N. P. G., Agrawal, S., Singh, B. K., Geethanjali, B., Mahesh, V., & Pachori, R. B. (2023). EEG based classification of children with learning disabilities using shallow and deep neural network. *Biomedical Signal Processing and Control*, *82*, 104553. https://doi.org/10.1016/j.bspc.2022.104553

Simón, Á. (18-20 de agosto de 2020). *Acompañamiento a un estudiante con dislexia, de la Tecnicatura Universitaria en Programación de la FRGP*. Expoingeniería 1era Feria Virtual de Proyectos Tecnológicos, Buenos Aires, Argentina.

Suárez-Rojas, M.-S., Hernández-Ballestas, M.-A., & Orozco-Gutiérrez, M. (2024). Metacomprensión y desarrollo cognitivo en la autorregulación del aprendizaje del adolescente. *Cultura Educación y Sociedad, 15*(1), e0424675. https://doi.org/10.17981/cultedusoc.15.1.2024.4675

Tamboer, P., Vorst, H. C. M., Ghebreab, S., & Scholte, H. S. (2016). Machine learning and dyslexia: Classification of individual structural neuro-imaging scans of students with and without dyslexia. *NeuroImage. Clinical, 11*, 508-514. https://doi.org/10.1016/j.nicl.2016.03.014

Tomaz, L., Bianchini, N., Ruiz, D. D., Meneguzzi, F., & Buchweitz, A. (2021). Visual explanation for identification of the brain bases for developmental dyslexia on fMRI data. *Frontiers in Computational Neuroscience, 15,* 594659. https://doi.org/10.3389/fncom.2021.594659

Vajs, I., Ković, V., Papić, T., Savić, A. M., & Janković, M. M. (2022).

Spatiotemporal eye-tracking feature set for improved recognition of dyslexic reading patterns in children. *Sensors, 22*(13), 4900. https://doi.org/10.3390/s22134900

Vajs, I., Papić, T., Ković, V., Savić, A. M., & Janković, M. M. (2023). Accessible dyslexia detection with real-time reading feedback through robust interpretable eye-tracking features. *Brain Sciences, 13*(3), 405. https://doi.org/10.3390/brainsci13030405

Vega-Rodríguez, L. Y., & Botero-Suaza, L. E. (2021). Formación profesional inmersa en la transformación digital con el fin de mejorar la calidad en la educación. *Cultura Educación Sociedad, 12*(1), 37-46. https://doi.org/10.17981/culteducsoc.12.1.2021.03

Vezzoli, Y., Folgieri, R., Vanutelli, M. E., & Lucchiari, C. (2018). How many tests do you need to diagnose Learning Disabilities? *Neuropsychological Trends,* (23), 67-81. https://doi.org/10.7358/neur-2018-023-lucc

Wang, M., Muthu, B., & Sivaparthipan, C. B. (2022). Smart assistance to dyslexia students using artificial intelligence based augmentative alternative communication. *International Journal of Speech Technology, 25*(2), 343-353. https://doi.org/10.1007/s10772-021-09921-0

Wolf, M., Gotlieb, R. J. M., Kim, S. A., Pedroza, V., Rhinehart, L. V., Gorno, M. L., & Sears, S. (2024). Towards a dynamic, comprehensive conceptualization of dyslexia. *Annals of Dyslexia, 74,* 303-324. https://doi.org/10.1007/s11881-023-00297-1

World Health Organization - WHO (2018). Social determinants of health. *WHO*. https://www.who.int/health-topics/social-determinants-of-health#tab=tab_1

Yang, H. (2022). Effect of story structure instruction based on visual analysis on reading comprehension intervention for dyslexic students. *Computational Intelligence and Neuroscience,* 9479709. https://doi.org/10.1155/2022/9479709

Yong, C., Dekuan, X., & Xueqiang, L. (2019). Automatically grading text difficulty with multiple features. *Data Analysis and Knowledge Discovery, 3*(7), 103-112. https://doi.org/10.11925/infotech.2096-3467.2018.1089

Zabkar, J., Urankar, T., Javornik, K., & Košak, M. (2023). Identifying reading fluency in pupils with and without dyslexia using a machine learning model on texts assessed with a readability application. *Center for Educational Policy Studies Journal, 13*(4), 233-256. https://doi.org/10.26529/cepsj.1367

Zingoni, A., Taborri, J., Panetti, V., Bonechi, S., Aparicio-Martínez, P., Pinzi, S., & Calabrò, G. (2021). Investigating issues and needs of dyslexic students at university: Proof of concept of an artificial intelligence and virtual reality-based supporting platform and preliminary results. *Applied Sciences, 11*(10), 4624. https://doi.org/10.3390/app11104624

Zuppardo, L., Rodríguez, A., Pirrone, C., & Serrano, F. (2020). Las repercusiones de la dislexia en la autoestima, en el comportamiento socioemocional y en la ansiedad en escolares. *Psicología Educativa, 26*(2), 175-183. https://doi.org/10.5093/psed2020a4