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The role of Educational Robotics in the learning of children with special educational needs: Down syndrome, ADHD, Autism, Dyslexia

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Abstract

The purpose of this literature review is to investigate the role of Educational Robotics (ER) in the educational process of children with Special Educational Needs (SEN). Specifically, we aim to highlight, through a review of the existing literature, whether the development of educational programs based on the principles of Educational Robotics has the potential to enhance various aspects of the learning process of individuals belonging to the category of special educational needs (SEN). These aspects include engaging and actively involving students in the learning process, diagnosing SEN, improving their performance in relation to expected learning outcomes and enhancing their academic skills, assessing the learning process and, by extension, supporting the learning of these individuals in general.

For the review, known research databases including IEEE Xplore, Science Direct, Springer Link, ProQuest, MDPI, Pubmed and the Google Scholar search engine were used. As a result, we arrived at a total of 33 articles using the defined keywords.

Keywords: Educational Robotics; Special Education; Autism; Dyslexia; Down Syndrome; ADHD; STEM; STEAM

1. Introduction

The evolution of technology in recent years has been rapid. Recognizing its advantages, we have integrated it into our lives and into educational programs of any level and category. Educational Robotics, with its technology, offers many possibilities to schools and is changing the learning environment and the learning process. It focuses on critical thinking, computational and problem-solving skills in all subjects, from Mathematics to History (1). Children are equipped with skills important for their future social and professional lives, such as collaboration, project management, critical and innovative thinking skills (2,3).

Educational Robotics has been integrated as a new methodology in the teaching and learning process, offering meaningful and flexible experiences that engage students in monitoring the behavior of specific prototypes using their own programming languages, graphical or textual (3). It is also a valuable tool that offers learning through building and/or programming robots in a fun way. The many tools that have been developed for the ER make it an attractive learning environment that stimulates the interest and curiosity of students. Despite its widespread application, there are still areas where the methodology requires further development (3).

However, knowing the great importance of learning environments as a mediating agent of knowledge, it is important to demonstrate the clear development of ER as a field of research and its use as a pedagogical practice. Despite the scientific

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articles found focused on ER, there are still few works related to its use as a resource for students with SEN. Addressing the latter through robotics is a very new field that researchers have not devoted much attention to (3).

The purpose of this literature review is to explore how Educational Robotics has contributed to the learning process of children with SEN. The chapters of this article discuss the term "Special Educational Needs" and highlight the role of Educational Robotics in Down Syndrome, ADHD, Autism and Dyslexia.

Concluding the introduction, we emphasize the significance of all digital technologies in the field of education and in special needs training, which is highly effective and productive and facilitates and improves assessment, intervention, and educational procedures via mobile devices that bring educational activities everywhere [34], various ICTs applications that are the main supporters of education [35-38], and AI, STEM, Games and ROBOTICS that raise educational procedures to new performance levers [39-49]. Additionally, the development and integration of ICTs with theories and models of metacognition, mindfulness, meditation, and the cultivation of emotional intelligence [50-57], accelerates and improves more the educational practices and results, especially in special needs, treating domain and its practices like assessment and intervention.

2. Literature review

2.1. Special Educational Needs

The term "Special Educational Needs" refers to children with learning difficulties or disabilities who have more difficulty in the educational process than other children of the same age group.

These children belong to a population group with frequent executive function impairments and possible behavioral, self-regulatory, socio-cognitive and neurofunctional disorders (4). The educational process of children with SEN is quite differentiated at all levels. Children need to be approached individually, even if they have the same learning difficulty or disability (5).

Effortful Control (EC) or Self-Regulation is the ability to regulate emotions, behavior and cognition. It can contribute to adaptive and adverse outcomes of various domains for children, adolescents and adults. For example, when a person focuses on neutral or positive thoughts and removes negative ones, they experience fewer negative emotions and are less likely to experience anger, anxiety and depression (6). Effective control enhances the individual's adaptation to intense situations and inhibits reactions that are likely to lead to difficulties. In children without SEN, high EC indicates adequate self-regulation, leading to a possible enhancement of social skills (7).

According to research, children with SEN have low effective control, positive emotions and sociability, particularly those with severe disabilities. Likely, activities that seem interesting to other children may not have the same impact on children with severe disabilities, especially if they are not fully aware of the process. Therefore, it seems important that teachers contribute to promoting positive anticipation, acceptance and support for children so that they feel they belong to a group. Teachers need to create situations of positive affect, with pleasant emotions, to identify children's strengths, in an environment that adapts to each child's temperament (7).

2.1.1. Types of Special Educational Needs

The term Special Educational Needs is a broad term, which includes several sub-terms that have been mentioned over the years. Two generalized sub-terms used are 'learning difficulties' and 'learning disabilities', as cognitive difficulties are called (8).

According to the World Health Organization (WHO), “10% of the world's population has any disability” (7).

Learning disability is classified as a neurodevelopmental disorder that occurs before the age of 18 and is characterized by limited intellectual functioning and social skills. People with a learning disability may have difficulty in writing, reading, reading, forming words, etc. The term includes Down Syndrome, Autism Spectrum Disorder (ASD) and Cerebral Palsy (8).

Down Syndrome is caused by genetic factors, due to the presence of an extra chromosome. It is characterized by a specific face, delayed development and susceptibility to exogenous diseases.

The neural mechanisms of ASD (autism spectrum disorder) are unknown. All that is known is that it causes a range of conditions. It is characterized by repetitive behaviors, speech delay and challenges in social interactions. 2% of the population in developed countries is on the Autism Spectrum.

Cerebral palsy is the most common physical disability of childhood and is characterized by a set of permanent disorders affecting the development of movement, posture and language. The individual's quality of life can be improved with occupational and speech therapy, focusing on movement functionality and cognitive skills (8).

Learning disabilities do not affect a person's level of intelligence and people can actively participate in social activities, unlike learning disabilities. They include attention deficit hyperactivity disorder (ADHD), Dyslexia, Dyscalculia and Dysgraphia.

Attention Deficit Hyperactivity Disorder, also known as ADHD, is caused by a combination of phenotypic, genetic and environmental factors. Individuals with ADHD have difficulty maintaining attention and many times can be hyperactive.

Dyslexia are characterized by difficulty in word formation and memory, in the reading process, which can lead to low self-esteem, depression and anxiety. It is caused by limited brain development.

Dyscalculia is characterized by a persistent inability to learn and understand numbers and deductive mathematical operations.

Dysgraphia is a Developmental Coordination Disorder (DCD), which occurs at a very young age and is characterized by a deficit in the production of written language. It is estimated that 5% to 20% of children worldwide suffer from dysgraphia or some other type of writing deficit, exacerbating personal, professional and social activities (8).

The Equality Act (2010) states that "children who have learning difficulties or disabilities of any kind are entitled to receive holistic special educational needs support" (8).

2.2. Special Educational Needs and Educational Robotics

Children in special education need individualized educational strategies that meet their specific mental, physical and social needs (4).

Educational Robotics (ER) approaches every child's learning by motivating them to engage in the design and assembly of robots and their programming, based on different learning theories and involving them in the STEM concept (4,9). It can be carried out through educational programs, activities, resources and pedagogical philosophy, platforms, using robotic packages (10). Over the years, there have been several studies that demonstrate the help that robots offer to these children to mitigate their daily problems, through robot therapy, play, interaction with robots, etc. Through such activities, behavioral improvement has been noted, both at an individual and social level, and consequently an improvement in mental well-being and school performance (8).

Students have to think before they act and eventually control their robot, stimulating reasoning and programming skills, with positive effects on their physical and mental empowerment and self-esteem. In the end, the robot itself provides feedback on the planned actions and enables students to evaluate their performance and mistakes (11,12).

Much research data demonstrates and notes the contribution of Educational Robotics to creativity, critical thinking, logical reasoning, socialization, teamwork and collaboration, problem solving, autonomy and independence, initiative taking, suspension and information focus skills, cognitive flexibility, improved working memory and even visual-motor skills in children with SEN (4)(13)(9). All of these in turn play an important role in social inclusion and thus in increasing achievement, interaction with the environment and more effective learning (9,10,13).

Robotic devices that have been used for research are the Bee-bot, LEGO WeDo, KIBO, LEGO Mindstorms and the WeDo 2.0 Core Set (4,9,12).

For Educational Robotics to be effective, children need to be exposed to challenging activities and variable tasks, to respond to schedules and repetitive practices, to engage holistically with their social, cognitive and emotional aspects. The activities organized must be adapted to the children and their weaknesses, with the main focus on improving their learning difficulties or disabilities. ER can be easily used by teachers for this purpose, thanks to its adaptability, increasing children's motivation and interest (4,12).

Teachers using new technologies and ER, adapted and structured according to children's characteristics, can support and help children with SEN to integrate into new curricula (9). However, to achieve this, some barriers in the education system, such as the absence of the necessary equipment, especially after it has been damaged, and the training of teachers on the necessary tools (12).

The literature review then discusses the contribution of Educational Robotics to some of the SEN.

2.2.1. Educational Robotics and Down Syndrome

The adaptability of Educational Robotics facilitates the inclusion of children with Special Educational Needs, such as Down Syndrome, in the learning process.

The syndrome is caused by the presence of an extra chromosome, known as trisomy 21, and can be diagnosed even during pregnancy with special tests. It is the most common chromosomal abnormality with a rate of about 12% (10,14). Children with Down syndrome have many characteristics in common with each other, cognitively, behaviorally and visually/externally. Specifically, external features include a flat face with slanted almond-shaped eyes, thick eyelids, thin and dry lips, straight, short and thin hair, short and wide limbs with thick fingers and reduced muscle tone. Their usual cognitive and behavioral characteristics are low IQ (IQ 35- 70, mild to moderate mental retardation), speech delays, slow muscle response and joint problems, anxiety in reprogramming situations resulting in inattention, short-term auditory memory, poor narrative ability, telegraphic speech, impaired use of language features such as conjunctions and molecules. They can provide clarification when asked, but are unable to initiate conversations or enrich a topic. However, they are distinguished for their high performance of social skills. The degree of cognitive and behavioral difficulties varies in each child (10,15).

It seems, therefore, that due to their neurological dysfunctions, they have deficits in language skills, in performing daily activities and others. It is therefore necessary to have individualized educational techniques, based on each child's neurodevelopmental needs, that support and meet their learning needs, learning style and incorporate, adapt tools appropriate for their full intellectual development. Use tools that increase their active participation, motivation and concentration in the learning process (14).

The research that has been done includes activities with ready-to-use Educational Robotics kits, ready-to-use Bee-bot robots or robots built by the children themselves, following the teachers' instructions and Educational Robotics Labs (ER- Lab). All studies, although few, demonstrate the importance of ER in the learning process of children with Down Syndrome, improving their cognitive functions, for example, visual-spatial memory, increasing their performance and motivation and equipping them with new useful knowledge, such as basic programming skills (10,11).

Another area in which ER can be involved with positive results for children with Down Syndrome is occupational therapy. Occupational therapy trains children, aiming to maximize their functional performance in daily life. It focuses on cognitive, sensory, motor and communication skills, controlling potential developmental delay. The combination of occupational therapy with supportive curricula and Roamer robots can bring encouraging results.

In a similar study, it is reported that such educational programs increase the interactivity of children with Down Syndrome, as demonstrated by assessment indicators. Furthermore, it highlights the importance of teamwork since children who participated in group work developed more motivation, effective competitiveness, knowledge production and meaningful conversation (15).

All the studies that have been done demonstrate the positive effect of ER on children with Down's syndrome. However, the combination of different tools including ER can positively contribute to the learning process and better cope with the different needs of children (10).

2.2.2. Educational Robotics, ADHD and ASD

ADHD, Autism and their co-existence are a complex and important issue of concern to the scientific community, educators, parents and the people who experience these conditions (16,17). As we gain a better understanding of the nature of ADHD and Autism, we recognize that their co-existence can have a significant impact on the daily lives of people who experience them (18).

The sometimes co-existence of these two disorders can be challenging for both the individuals experiencing them and their parents, guardians and teachers. Dealing with their co-existence requires an integrated and multidimensional approach (16). It is therefore important to emphasize the need for access to appropriate health and education services.

People with Autism and ADHD should have access to specialist therapies and support from specialist professionals such as psychologists, speech and language therapists and specialist teachers (18). Access to these services can help individuals to develop and improve their skills and better cope with the challenges they face.

In summary, the co-existence of ADHD and Autism requires an integrated and multi-dimensional approach that includes access to appropriate health and education services, information and education for parents and teachers, and support from the wider community (19). In this way, we can create an environment that fosters the success and well-being of individuals facing these challenges.

A recent study published by Italian researchers examined teachers' views on the implementation of ER for students with special needs, demonstrating its value in the education of this group of students

(20). In Italy, teachers participating in the study identified ER as a powerful tool to promote various skills in students with special needs, especially for those with ASD, ADHD and learning difficulties. The research highlights the need for further training, exposure and support for teachers in the implementation of ER and the need for tailored design of ER activities according to the disability involved (20).

A survey was conducted to investigate whether there is reliable evidence in the literature that robot activities improve the skills and performance of children with special needs. The majority of experiences showed improvements in participants' performance and skills, social constriction and participation, communication/interaction with classmates during robotics sessions. Some studies have reported conflicting results, calling for the need for careful design of the goal and associated activities of each experience (21). Research on the use of robotic systems, in speech and language therapy for children with learning disabilities, has shown significant improvements in participants' speech and language skills. This suggests that interactions with robots may be a constructive way to help children improve their communication skills. This is particularly important for children with special needs, as enhancing communication and social participation can have a positive impact and lead to more integrated development (21).

It is equally important to integrate and embed ER in schools and for children to acquire knowledge through the fun learning of ER (22). It was observed in one study that students, at first, were reluctant to participate in the activities, but soon became engrossed in the project and excited to participate in all stages, especially during the assembly, programming and interaction with a Lego® Mindstorms prototype. The study seems to have used the Lego® Mindstorms prototype set as a tool to conduct the activities. This may have contributed to the students' enthusiasm as these devices offer a fun and accessible experience in robotics. Therefore, this study highlighted the effectiveness of fun learning through educational robotics in integrating and encouraging the participation of students with learning disabilities (22).

Despite the challenges and contradictions presented in some studies, general trends suggest that the application of Educational Robotics can have a positive impact on the education and development of children with Autism and ADHD (19,21).

2.2.3. Robotics and ADHD

ADHD refers to a range of disorders that affect social interactions, behaviors and social skills, but to a lesser extent than autism (23). However, it is equally important that teachers are made aware of how to manage individuals with ADHD and use Educational Robotics to improve their educational processes and beyond (24,25).

A recent study highlights the evolution of the development and application of robotics and other emerging technologies in relation to the treatment of attention deficit hyperactivity disorder (ADHD) and their feasibility (26). Robotics has enabled the change and improvement of many support processes for vulnerable individuals in a variety of settings. In recent years, its use has been directed towards supporting therapeutic interventions for neurodevelopmental disorders, including ADHD. A review of the literature highlights how advances in robotics have evolved in various ADHD treatment and management scenarios, their collaboration with other emerging technologies, outcomes, limitations, and research challenges for the future development of robotics in the field of supporting children with ADHD (26). Despite favorable technical outcomes, robotic technologies supporting ADHD treatments require significant improvements in terms of scaling, human-machine interaction, and treatment and processing the information obtained to apply it effectively to real treatments. The effective application of robotic technologies in the treatment of ADHD requires efficient collection, processing and utilization of the data generated during therapeutic procedures. This includes the development of tools and techniques to automatically identify patient responses and provide corresponding processed information to the therapist (26).

The impact of STEAM training using robotics on the executive function of students with attention deficit hyperactivity disorder (ADHD) is also important, as well as the impact of the method on developmental exploration. Educational Robotics (ER) is primarily recognized for its effects in scientific academic areas such as science, technology, engineering, arts, and mathematics (STEAM). According to research, ER can also impact cognitive development by increasing critical thinking and planning skills. Executive Function (EF) refers to a complex set of cognitive control processes required for adaptive daily functioning. EFs are a better predictor of mental progress, health, wealth and quality of life across the lifespan than IQ or socioeconomic status and can be divided into three core abilities, working memory, inhibition and shifting ability, which work together to support higher order processes such as planning and problem solving required to stay on track, resist impulses and lack of concentration, and to pursue longer-term positive (rather than more immediate) outcomes. The current study also sought to validate the effectiveness of ER on EF in children with ADHD (25).

The design, development, implementation and evaluation of a Robotic Assistant (RA-Robotic Assistant), called "Atent@", is being investigated as a tool to support homework activities for children with attention deficit hyperactivity disorder (ADHD) (24). By interacting with children, the RA helps to correct poor habits and inappropriate behavior caused by the disorder. Its functions and capabilities were designed by therapists, applying Artificial Intelligence (AI) algorithms to process information and make real-time decisions to help children focus on their tasks. The RA interacts with smart objects placed in the home that are related to the activity being monitored (desk and chair). This solution allows therapists to receive more accurate information about work sessions within the home. At the same time, through the RA, remote interaction with the child is allowed to provide new instructions and support during the sessions. The RA is a significant development of a previous version. All improvements brought to the project by modifications to the technical and quality features are explained. In addition, the experiment and its results are presented to demonstrate clinical feasibility. This work shows that the RA can not only make observations with a high degree of accuracy like an expert (Teacher or Therapist), but also, positively influence the task performance of children with and without ADHD (24).

2.2.4. Robotics and ASD

Autism is a neuro-emotional disorder that affects social interaction, communication, interests and behavior. People with Autism may have difficulties with social interaction and communication, limited interests and repetitive behavior (23). It is important that these children have access to appropriate health and education services. There should be information and training for teachers to support and assist them. Educational Robotics can be very helpful for both parties (19).

This study analyses the impact of an ER intervention using LegoWedo 2.0® on the social status of students with Autism in behavioral education settings in primary education. Before and after the intervention, sociometric methods and instruments related to students' social status were used. Subsequently, students were categorized according to their social status, with the analysis of research data revealing interesting results about the effect of this ER intervention on the social status of students with Autism in behavioral education settings (27). From the comparison of the data, we concluded that many students with Autism after the intervention were in the social status of "average popularity" or "talkable/approachable", whereas the changes were not as evident for students with typical development (27). Post-intervention data analysis showed improvement in social status for many of the students with Autism. This improvement can be attributed to the interest the students showed in the activities, the collaborative behavior they demonstrated, and the skills they demonstrated when assembling/building and programming the robotic modules. However, this improvement in social status and positive preferences was limited to the relatively small sample and therefore, we cannot get a complete picture of the whole school environment. Current pedagogical and teaching research emphasizes the need for schools where students with different Special Educational Needs or Disabilities learn together with all other students (27). The goal of 'Inclusion' is to provide every child with the opportunity to participate, explore and become part of the learning process in different and creative ways using differentiated content, goals and resources. This study is among the first to examine the impact of activities using the specific Educational Robotic Device (LegoWedo 2.0®) on the social domain of students with Autism in educational inclusion contexts. Pre-intervention results showed that students with Autism demonstrated low social status ("Feeling of Rejection" or "Neglect"), results that are consistent with existing studies addressing the issue of social acceptance and social status of children with Disabilities or Special Educational Needs. In the social diagrams, after the ER intervention, it appeared that the social status of many of the students with ASD improved. These results raise the important issue of the social status of children with Autism and SEN in embedded contexts and ways in which this status can be improved, suggesting the positive impact of this particular educational intervention on the social status of the group of pupils with ASD in embedded contexts of mainstream classrooms (27).

Another published study examined the application of (ER) as a motivational tool for students between the ages of six and seven diagnosed with autism spectrum disorder (ASD). The aim was to observe the positive effects ER provides in terms of concentration, social interaction and rule compliance. The results suggest that ER can be used as a motivational tool to promote students' participation in the above activities (28).

Finally, a recent study examines the participation of students with autism spectrum disorder in Educational Robotics (ER) and how it can promote their successful inclusion in behavioral or special education settings. ER provides an appropriate educational environment for engaging students with Autism through which they can tap into their key strengths and interests. According to the results, research on the participation of children with ASD is limited and has mainly focused on ER activities, failing to adequately explore other dimensions that influence the successful participation and inclusion of students with ASD in educational robotics (19).

2.2.5. Educational Robotics and Dyslexia

In this literature review, we seek to examine the role of Educational Robotics in relation to the different aspects of learning for people with Dyslexia.

Dyslexia is the most common learning disability and affects between 5-12% of all students. It is a neurodevelopmental disorder that has the highest prevalence among different types of learning disorders. Children with dyslexia usually experience difficulties in reading. Of course, the range of problems extends to writing and mathematics and may be due to a combination of deficits in phonological processing at the level of the auditory and visual systems (29-31). In addition, according to other definitions, dyslexia and other learning disabilities affect the brain's ability to receive, process, analyze or store information. Also known as Specific Dyslexia, it is a common disorder in reading and language and is not associated with any form of intelligence deficit in general, educational opportunities or reduced motivation. Finally, it affects 5-10% of literate speakers and 1 in 10 children are dyslexic (31).

Studies have shown that robots can help students develop problem-solving skills and learn computer programming, math and science. However, few studies have examined the use of robots in the learning of children with dyslexia. Unfortunately, without early remedial intervention, the dyslexic child may face barriers to lifelong learning and a fear of learning that may limit their career development as an adult. The European Dyslexia Association estimates that approximately 10% of the population suffers from this learning disability (29). The question that arises from the above is: Do robots used for educational purposes have the potential to intervene in the teaching process to improve the learning of individuals with dyslexia?

Due to the youth's preference for technology, robots have been validated by researchers in the field of education as useful tools in STEM Education. In addition, children with learning disabilities, such as dyslexic children need a new approach to the learning process. Because it has been proven that dyslexic children learn best through observation, demonstration, diagrams, hands-on practice and engagement in experiments, we wish to explore the possibility that Robotics can support this learning process. Teachers who have used this technology in the classroom state that students are more focused and motivated by their own creations. There is greater receptivity to the information presented. Robotics is seen by many as offering significant new benefits to education at all levels. Cognitive research has confirmed that students learn more if they interact with educational materials. Thus, students learn from designing, assembling, and operating their own robots (29,31).

Although previous research has shown that educational environments and their staff seem to take the use of technology and robotics in educational contexts seriously, a more recent study has shown opposite results in terms of their successful integration. Currently, many schools and industries are trying to adopt Educational Robotics without committing to its continuity as a useful educational tool in learning and training processes, which, for example, would be permanently implemented in any school educational project. Previous research in this area has indicated a reluctance of teachers to integrate ER into their daily activities, even once a week (3).

Following the analysis of the potential of robots in the education of people with Dyslexia, it appears that Social Robots have already started to be widely used in this field. Today, with the emergence of educational technologies, various tools are being used to help children with Special Educational Needs, including computer games, Virtual Reality, Social Robotics.

An example of this is the Taban robot, which was developed specifically for children with dyslexia and functions as an educational assistant. To conduct this study, an Android application was designed and developed to facilitate the interaction between the child and the robot via a tablet. Specifically, a modern game for the Android operating system and Social Robotics technologies were combined to provide a new protocol: a new tablet game in collaboration with the autonomous social robot Taban, which provides visual, verbal and physical feedback to the child, to improve literacy and reading skills of children with Dyslexia (30). The main aim of this research, therefore, was to introduce a serious robot game as an innovative method of education for children with Dyslexia based on their special educational needs. Another question that arises from the above is the following: How can the integration of game elements and technologies such as robots contribute to improving the learning of children with Dyslexia?

Game-based strategies have demonstrated positive effects on students' motivation and the multiple learning benefits they receive. Gamification is the process by which we take elements from games and integrate them into educational environments to increase motivation, reinforce behaviors or promote behavioral change. However, although technology can support the design and development of gamified activities in education, gamification can also be done without it. Under these circumstances, research is still lacking to demonstrate the advantages and disadvantages of gamification in technological and non-technological learning environments, as well as its effectiveness and impact on student motivation and long-term engagement (32).

Based on the study mentioned above, the first applications of the Taban robot in the education of children with dyslexia have yielded encouraging results in terms of the use of technology and gamification in the educational process. During the study, it was observed that dyslexic children showed high levels of alertness, mastery and enjoyment. The results showed that there was increased participation in the robot games and at the same time the children were happy, excited and felt in control during the game. Furthermore, the results showed that this game may have the potential to be used to detect children with dyslexia and to identify them through measuring their performance in this robot board game. In summary, the desktop robot game protocol presented in this study shows high potential for supporting these children and could serve as a valuable tool to support teachers in their conventional teaching methods (30).

Despite initial concerns, the above study demonstrates that Educational Robotics has been recognized as a powerful tool for transforming practices in Education, especially in helping to attract students to STEAM (Science, Technology, Engineering, Engineering, Arts and Mathematics) careers. It is anticipated that the A (for Arts) will bring personal expression and compassion to more technologically oriented careers, creating a way of explaining what students are learning. In this context, ER is a powerful tool for creating materials that span all five disciplines and invites students to contribute by actively participating. There are many ways to ensure this innovative project development process in Educational Robotics environments, aimed at discovering new pathways and performing learning challenges (3).

Another question that arises from the above is: how to think about these new pathways so that they are suited to an educational community facing learning difficulties? According to a study conducted by Eurydice, children with learning difficulties are completely omitted from educational activities based on STEAM and Robotics Education principles. This is also true for children with Dyslexia who have problems with comprehension of written information, either in a print or online course (29). Given the above context, there is a need to understand how Educational Robotics can contribute and be conducted to encourage and promote practices that are meaningful for students with learning difficulties, such as Dyslexia, which we study in this chapter of the literature review.

According to a survey conducted; to answer the above question, we can gather those who are not interested in learning a subject because of a reason not related to a disorder or deficit and those who have a disorder such as Dyslexia. It is clear that the collaborative work that develops in ER allows for the development of different skills, especially when a group of people with different aptitudes and interests is created. Some with a greater aptitude for the assembly process, others in the field of programming, but with the same purpose of solving the problem proposed in class. In this way, students begin to work in groups, fostering relationships and developing skills through each workshop. Thus, in this article, the researchers addressed the use of Robotics in context either as a primary tool or as a support tool to improve learning skills in children with learning disabilities. The researchers proposed ER lessons with LEGO kits for children aged 12 to 16 years. Instead of following typical academic tasks, the children worked in small groups using LEGO robots during school activities. Results showed an increase in academic achievement for those children who attended the lessons compared to a passive control group. This finding supports the hypothesis that ER can provide an active learning environment where children can build their academic knowledge, always with the teacher as a facilitator (3).

The above research findings of the above studies mentioned so far, show that Educational Robotics as a learning tool has the potential to function as a means of detecting students with Dyslexia, to promote the active involvement and participation of children in the learning process, but also to increase the academic, emotional and problem-solving skills of students. However, there is a significant amount of research focused on Educational Robotics, but little work related to the use of ER as a resource for students with Dyslexia (3,33).

More recent research has shown that the use of ER in learning for people with dyslexia has the potential, in addition to enhancing participation in the learning process and improving various skills, to act as an assistant to the teachers themselves, providing more personalized assistance to students based on their needs while the teacher is engaged with other students. The research sought to address the question of whether students with Dyslexia could benefit from a robot assisted learning support system. Reinforcement Learning is another aspect of Robotics that could be used to support students with Dyslexia. Reinforcement learning is a machine learning technique based on rewarding desirable behaviors and/or "punishing" undesirable ones. Subsequently, secondary analysis conducted for this research signals that support systems for people with learning disabilities could be improved with the novel concept of a dyslexic humanoid robot. Currently, statistics show that people with learning disabilities may find it difficult to disclose that they have learning disabilities. A dyslexic humanoid robot could add a personal approach to help them disclose this information and feel supported. In general, robots seem to have the potential to be used as a reinforcement learning agent, able to perceive and interpret their environment, take action, and learn through trial and error (33).

In conclusion, in recent years there has been great progress in research on Dyslexia. The number of people with Dyslexia is increasing. The problem is that the current support system for people with dyslexia is insufficient. Current support could be improved as a more personalized learning approach is currently lacking to cater to the 6 different types of Dyslexia, which are Phonological, Superficial, Visual, Primary Dyslexia, Secondary/Developmental and Traumatic Dyslexia. Support could be improved, as highlighted through the above studies, through the use of technology such as Robotics. Robots could provide personalized support needed to cover the six different types of Dyslexia, detect such students and help through educational interventions to improve academic and emotional skills, promote active participation and engagement in the learning process and finally help with self-esteem and social inclusion of individuals.

3. Conclusion

The studies analyzed presented many encouraging results, highlighting the positive impact of robotic activities on the development of children with Special Educational Needs, on many levels . Future research and applications should focus on developing more systematic programs and analyzing the long-term effects of Educational Robotics on this vulnerable group of children.

With advances in technology and ongoing research, Educational Robotics can be another powerful resource for improving the quality of life and education of children with SEN. At the same time, assessing the impact of the robot on the self-esteem and social inclusion of children with SEN can be a critical parameter for the development of tailored educational programs.

Taking into account all the above research findings, some suggestions for future research are given. First, envisioning a modern educational reality that serves the needs of every student, it is important to study the development of educational programs that encourage the use of robotics in education and train teachers to effectively integrate it into the teaching process. Furthermore, it is of major importance to study the long-term impact of the use of robotics on children's academic achievement and skill development, as well as to analyze the factors that influence the acceptance and effectiveness of its use in education. In addition, research on the development of advanced educational robotic systems that are individually tailored to the needs of children with different educational profiles can promote personalized learning and effective education.

In conclusion, these proposals could contribute to the expansion of research on the use of robotics in the education of children with special educational needs and, together with the existing data, offer new research perspectives in the field.

Compliance with ethical standards

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Disclosure of conflict of interest

The Authors proclaim no conflict of interest.

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