

Intervention programs to strengthen living skills in children with neurodevelopmental disorders through educational play

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Abstract

Background: Neurodevelopmental disorders can have a significant impact on the cognitive and social-emotional development of children, making it a crucial health concern affecting over 3% of children globally.

Aims: The purpose of this paper is to conduct a thorough and systematic review of existing literature on neurodevelopmental disorders and the potential benefits of educational play in improving daily life skills.

Methods and procedures: Through extensive research on Scopus and PubMed, we discovered 209 relevant publications covering the years between 2011 and 2022.

Outcomes and results: 19 surveys highlighted the positive effects of educational play, with particular emphasis on sensory play.

Conclusions and implications: The systematic review revealed that educational play can enhance critical executive functions like self-regulation and concentration, ultimately promoting daily life skills and social interaction with peers. Moving forward, we anticipate further research to explore the potential impact of sensory play on cognitive and communication deficits in children with neurodevelopmental disorders.

Keywords: Neurodevelopmental disorders; Educational play; Play therapy; Sensory integration; Messy play; Skills

1. Introduction

Neurodevelopmental disorders refer to cognitive and behavioural challenges that emerge during the developmental period and can impede the acquisition and execution of specific intellectual, motor, language, or social skills, according to the WHO. These disorders disrupt fundamental neurodevelopmental processes, resulting in an inability to meet developmental milestones in areas such as cognitive, emotional, and motor abilities. Neurodevelopmental disorders are typically linked to disturbances in the coordinated events that facilitate brain development, and they are a significant health concern affecting over 3% of children globally, as reported by Gilissen (2014) and Parenti (2020). These disorders have varying causes and exhibit distinct patterns of cognitive function, communication, adaptive behaviour, and psychomotor skills, as described by Niemi (2018) and Tărlungeanu (2018). Studies have suggested that shared evolutionary molecular sequences of nodes could be responsible for the diverse clinical signs that characterize neurodevelopmental disorders, as noted by Cristino (2014) and Hormozdiari (2015). Consequently, comorbidity is often seen, such as co-occurring diagnoses of identity disorder, ASD, and epilepsy in individual patients, as reported by Bokhoven (2011) and Du (2018). Thankfully, effective treatment options are available, including psychosocial and

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psychomotor therapies, physical therapy, neurodevelopmental treatment, behavioural interventions, occupational therapy, speech therapy, and medication for certain diagnoses and age groups, according to the WHO.

The classification of neurodevelopmental disorders is carried out by the Neurodevelopmental Disorders section of the ICD-11 and the harmonized section of the DSM-V. These disorders are grouped into nine categories, namely: Disorders of mental development, Developmental speech or language disorders, autism spectrum disorder (ASD), Developmental learning disorder, Developmental motor coordination disorder, Attention deficit hyperactivity disorder (ADHD), Stereotypic movement disorder, Other specified neurodevelopmental disorders, and Neurodevelopmental disorders unspecified.

Educational play is a type of interaction that occurs between a specialized play instructor and an individual of any age, typically a child. The instructor provides carefully selected toys and creates a secure environment for the individual to explore their thoughts, feelings, and behaviours. This approach is designed to broaden their interactive zone of development and enhance their skills (Landreth, 2012). Educational game practice is not a standalone concept, but rather an umbrella term that encompasses various approaches with distinct historical roots.

It's crucial to comprehend that all aspects of educational play are based on neurobiological mechanisms and biological activity. The human brain is an organ that develops throughout a person's life, with a significant speed of development in the first years of infancy. The neuroplasticity of the brain, i.e. the ability of the nervous system to change structure and function in response to the environment, is a vital property for play therapy. During infancy, the brain exhibits considerable vigilance and can push neurons to regenerate anatomically and functionally, forming new synapses. Synaptogenesis, which is the formation of new synapses and occurs throughout a person's life, goes hand in hand with the rejection of inactive neurons, similar to pruning the dried branches of a tree. Myelination, the creation of protection around neurons to enable nerve signals to travel faster, is also a crucial process for brain development.

In this introductory part, finally, we emphasize the significance of all digital technologies in the field of education and in neurodevelopmental disorders training, which is highly effective and productive, facilitates and improves assessment, intervention, and educational procedures via mobile devices that bring educational activities everywhere [33-35], various ICTs applications that are the main supporters of education [36-49], and AI, STEM, Games and ROBOTICS that raise educational procedures to new performance levers [50-56]. Additionally, the development and integration of ICTs with theories and models of metacognition, mindfulness, meditation, and the cultivation of emotional intelligence [56-67], accelerates and improves more than educational practices and results, especially in neurodevelopmental disorders, treating domain and its practices like assessment and intervention.

2. Research Methodology

2.1. Purpose

The study aimed to identify relevant research studies that focused on this area, review and analyze them to identify the most effective approaches and strategies and propose recommendations for future research. The research methodology involved a systematic review of peer-reviewed literature from credible sources, including academic journals, conference proceedings, and relevant databases. The findings of the research provided valuable insights into the potential benefits of using educational games in enhancing the life skills of children with neurodevelopmental disorders, highlighting the need for further exploration and development in this area.

2.2. Research questions

After conducting a thorough review of both Greek and international literature, the following research inquiries were formulated and will be addressed in this work:

- In what ways does the educational game facilitate the growth of functional skills, such as autonomy and daily living, in children with neurodevelopmental disorders?
- In what ways does the educational game foster the development of cognitive skills among children with neurodevelopmental disorders?
- How does educational play contribute to the development of socio-emotional skills in children with neurodevelopmental disorders?

2.3. Sources

International experimental studies related to the subject were studied. In the first stage, articles were found and collected through an electronic search of the Scopus and Pubmed databases.

2.4. Keywords

“neurodevelopment disabilities” OR “neurodevelopment disorders” AND “intervention program” AND “educational game” OR “educational play” AND “Autism” OR “ASD” AND “Attention deficit hyperactivity disorder” OR “ADHD” AND “Sensory play” OR “Play therapy” OR “Drama therapy” OR “Music therapy” AND “Lego” AND “Sand play” AND “Aquatic play”.

2.4.1. Inclusion criteria

The studies considered for this research were conducted between 2011 and 2022. Only experimental studies that referred to specific intervention programs and systematic reviews to find primary research that referred to intervention programs were included. The age range of the children involved in the study was between 0 to 18 years old. The research had to have educational content and take place in clinical or school settings. The sample of children involved in the research should refer to diagnosed children who meet the criteria of a neurodevelopmental disorder, taking into account the existence of comorbidity. The literature review focused mainly on autism spectrum disorders (ASD) and attention deficit hyperactivity disorder (ADHD). These disorders were chosen due to their comorbidity with mental developmental disorders and motor coordination disorders, which can cause severe functional deficits in daily life skills and living conditions of people with subsequent cognitive and behavioural problems.

2.4.2. Exclusion criteria

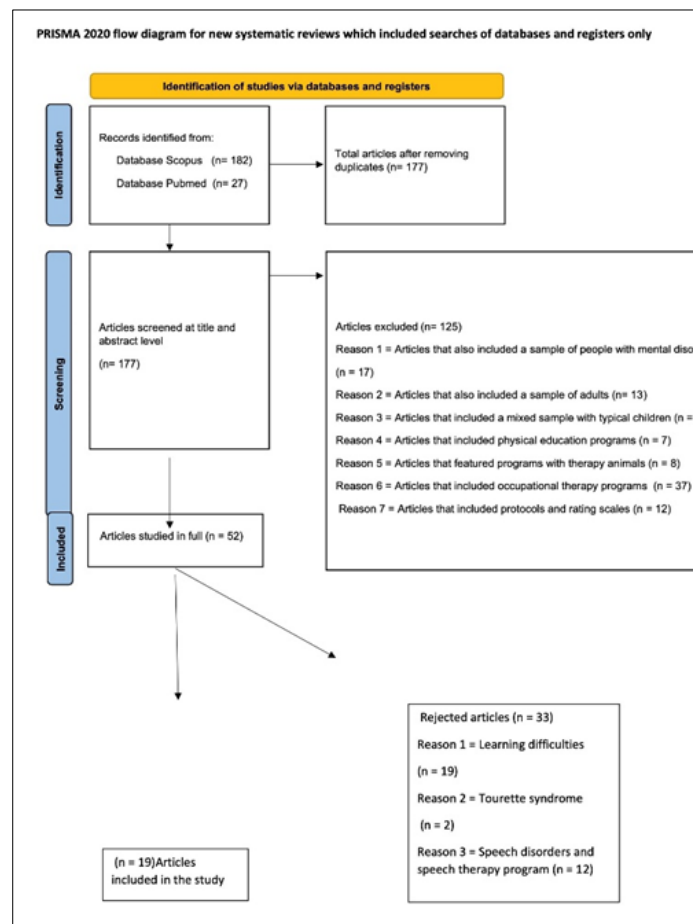


Figure 1 Data extraction flow chart

We chose to omit any studies that involved individuals with mental disorders, as well as those that included individuals with neurological syndromes such as Tourette's syndrome. Further, studies that centred on interventions for

individuals with learning disorders were also excluded. This was based on the fact that learning disorders typically do not result in functional difficulties in everyday life, and are instead confined to challenges with reading and writing within the academic setting.

3. Results

3.1. Olly: A tangible for togetherness. International Journal of Human-Computer Studies. Volume 153, September 2021, 1026

In 2021, Nonnis and Kinns conducted research at the Garden School, a specialized institution for children with autism aged 4-16 in North East London, UK. Their study aimed to explore the effectiveness of Olly, an audio textile user interface (TUI) for augmented reality applications, in helping minimally verbal children with autism between 5-10 years old to socialize and regulate their sensory experiences. Olly was placed in a ball with elastic bands to provide opportunities for socialization and sensory regulation. It was capable of translating user actions into computer interface input events. The study involved a group of five autistic children (4 boys and 1 girl) aged between 5-10 years who attended different classes at school. During the study, the children engaged in various forms of play while Olly was implemented in group sessions under the guidance of expert game trainers. The results showed that the program was effective in improving self-regulation, sociability, socialization, interaction, visual-motor coordination, and sensory processing.

3.2. Peers as clinicians: Examining the impact of Stay Play Talk on social communication in young preschoolers with autism. 2016

A study was conducted by Barber et al. in 2016 at the Universities of Alabama and Florida, USA, to evaluate the effectiveness of the "Stay, Play, Talk" program. The intervention program aimed to increase social interactions among young preschool children diagnosed with autism spectrum disorder (ASD) by using the social communication approach developed by English et al. in 1997. During the study, three typically developing peers aged between 3 to 5 years interacted with three 3- to 4-year-old children with ASD in 20-minute sessions over a six-to-eight-week period. The program was based on free social cooperative play and was implemented in dyadic sessions with expert play educators who encouraged the interlocutors. The results of the study indicated that there was a significant increase in social responses between each dyad above baseline, and the gains were maintained for two months after the intervention.

3.3. Long-term outcome of social skills intervention based on interactive LEGO play. 2006

Legoff and Sherman conducted a study in 2006 to assess the effectiveness of LEGO therapy compared to other intervention methods, and to explore whether the benefits extend to a broader range of skills, social development, and autistic behaviours. Over three years, 60 children with autism and 57 peers without social skills deficits met once a week for 90 minutes. The results confirmed the hypothesis that children who participated in LEGO building therapy displayed significant progress in various social skills, and showed a reduction in autistic-type social behaviours compared to the control group.

3.4. A mixed methods evaluation of the acceptability of therapy using LEGO bricks (LEGO-based therapy) in mainstream primary and secondary education. 2022

The study conducted by Barr et al. in 2022 aimed to assess the effectiveness of a group educational play and social skills program called LBT Lego for autistic children. The program was delivered in mainstream primary and secondary schools across three areas in the North of England. LBT involved a group construction game program, and schools were required to conduct 12 weekly 1-hour sessions. The study involved 98 schools, out of which 50 were assigned to undertake the LBT program. A total of 127 children and young people participated in LBT, and 81 facilitators delivered the sessions. According to most parents, their children enjoyed participating in LBT. Facilitators also observed improvements in communication and social skills among autistic children and youth during LBT sessions. Overall, LBT was considered a valuable program.

3.5. Moving Along and Beyond the Spectrum: Creative Group Therapy for Children with Autism. 2019

In 2019, Sharon Vaisvaser conducted a study at an autism research centre in Israel to improve the self-awareness and social interactions of children with autism through sensorimotor experiences. The study group consisted of three boys between the ages of 4.5 and 6 years old, who participated in 30 weekly 45-minute sessions held in a room within a kindergarten for children with autism. The sessions followed a four-phase structure which included an opening song, 20 minutes of drawing on paper, 20 minutes of free movement with elastic bands, and a closing song. The study presented a group therapy model that prioritized non-verbal creative methods for expression and communication. The incorporation of patterns in group play facilitated imitation and shared experiences among children, leading to the

development of a positive body image, a stronger sense of self, and improved cooperation skills. Furthermore, joint attention and coordination with peers were enhanced, allowing children to explore their surroundings and expand their range of movement. Non-verbal communication and eye contact were also improved through these activities. The enhancement of rhythm, internal organization, and developmental processes led to the strengthening of boundaries and separation. In addition, tactile contact, internal vestibular and proprioceptive sensations, and sensorimotor integration were all strengthened. The nature of the play was spontaneous, exploratory, and creative, and visual therapists used a group therapy model that promoted non-verbal communication and creative expression.

3.6. Brief Report: Theatre as Therapy for Children with Autism Spectrum Disorder. 2010.

In 2010, researchers at the University of California, Davis, led by Corbett, conducted a study to assess the effectiveness of the SENSE Theater program. This unique theatre intervention program is designed to enhance the social and emotional functioning of children with autism and other neurodevelopmental disorders. The study involved eight children with autism spectrum disorders, paired with eight typically developing children, ranging in age from 6 to 17 years old. SENSE participants were matched with typically developing actors, and the study found that the program led to moderate improvements in face recognition and theory of mind skills, enhanced social perception, and increased empathy, social referencing, and communication in both typically developing children and those with ASD who received social skills training. The social game was played in a group setting, with standard actors guiding the participants and following the rules of imitation and play.

3.7. Intelligent somatosensory interactive activities restore motor function to children with autism. 2022

Research conducted by Wang et al. in 2022 at Shanghai University's School of Physical Education aimed to investigate the effects of somatosensory interactive activities through artificial intelligence on children with autism. In the study, 18 children with autism were assigned to the experimental group that received the somatosensory play intervention, while 14 typical children were assigned to the control group and received the same intervention with the somatosensory interaction tool Kinect, an electronic motion detection tool. The study found that the muscle strength, balance, throwing, jumping and climbing abilities of children with autism improved, as well as their visual responses, stress reactions, verbal communication, interpersonal relationships, and learning motivation. The intervention was conducted through one-to-one interaction sessions with Microsoft's motion detection device

3.8. Activities of Daily Living, Playfulness and Sensory Processing in Children with Autism Spectrum Disorder: A Spanish Study. 2021

In a study conducted at the University of Burgos, Spain, González et al. aimed to differentiate between children with autism disorder and those with neurotypical development. The study involved two groups of children aged between 4-10 years, with 20 children diagnosed with autistic disorder and another 20 with neurotypical development. The findings revealed that children with autistic disorder required more assistance from caregivers and relied on more modifications in their environment, as well as support products. The study concluded that autistic disorder is associated with greater difficulties in daily living skills. The study utilized a sensory integration game that was carried out in the presence of caregivers and did not involve social interaction.

3.9. Effects of Aquatic Training in Children with Autism Spectrum Disorder. 2022

In 2022, Marzouki et al. conducted a study at the University of Jendouba in Tunisia to explore the effectiveness of two water-based interventions aimed at improving gross motor skills, emotion regulation, and stereotyped behaviours in autistic children. The research compared a game-based training protocol and the Halliwick technique to an active control intervention. The study included 22 autistic children who were randomly assigned to three groups. The two experimental groups participated in either a technical aquatic activity-Halliwick program or a game-based aquatic activity program, while the control group continued with their regular physical activity. Results showed that the experimental groups demonstrated significant improvements in functional behaviours, swimming skills, and motor emotional and functional skills. Conversely, the control group, who participated in other sports activities (excluding swimming), did not exhibit any improvement in gross motor skills.

3.10. Autistic preschoolers' engagement and language use in gross motor versus symbolic play settings. 2022

Binns et al. (2022) conducted a research study at York University in Toronto, Canada, intending to compare the number of expressions produced by preschool children with autism during symbolic and motor gross motor play. The study involved 70 autistic children aged between 25 and 57 months who interacted with a parent through play. Autistic children were given 25-minute access to symbolic, tactile, and gross motor toys. Gross motor play provided sensory-regulatory support that positively influenced social engagement.

3.11. Sensory Integration Training and Social Sports Games Integrated Intervention for the Occupational Therapy of Children with Autism. 2022

In 2022, a study was conducted by Wang et al. at Northeastern University in Shenyang Liaoning, China. The study focused on developing an interactive intervention program for preschool children with autism. The program combined sensory integration research design with educational gross motor play and consisted of 12 lessons. Each lesson had three preschool children who participated four times a week for 25 minutes each time. During the lessons, the children identified pictures and familiar objects before selecting a Lego-structured toy model to build. The program also included 12 lessons of rough motor play, taught over 24 sessions of 25 minutes each. The results of the research showed that sensory integration skills training and structured play reduced stereotypical behaviour in children with autism. Furthermore, the program was effective in improving the children's expressive language skills. The researchers themselves implemented the program.

3.12. Clinical efficacy of interactive group sandplay versus individual sandplay in the treatment of preschool children with autism spectrum disorder. 2019

A research study conducted by Wang et al. (2019) at the Child Health Center of the Provincial Maternity Hospital of Fujian Children's Hospital in Fuzhou, China aimed to investigate the effectiveness of intergroup and individual sandbox intervention for preschool children with autism spectrum disorder. The study involved 80 children with autism aged 4-6 years old, divided into two groups of 40 children each, namely the experimental and control groups. Additionally, 120 typically developing children joined the experimental group. During the intervention, the children in the experimental group participated in the group sand table, while those in the control group received individual sand table intervention. The study found that the intergroup sand table intervention was more effective in improving social, emotional, and stereotyped behaviors among children with autism than the individual sand table intervention.

3.13. Effects of Image-Sandplay Therapy on the Mental Health and Subjective Well-Being of Children with Autism. 2021

In 2021, researchers Guo and Li conducted a study at Changchun Women's and Children's Health Hospital to explore the impact of sand therapy on the mental health and well-being of children with autism. The participants were randomly assigned to either a control group (n=45) or an observation group (n=45). The observation group underwent 12 weeks of picture-sand therapy, consisting of 60-minute sessions once a week, while the control group received conventional rehabilitation therapy only. A dedicated sand play room was prepared for the therapy sessions. The child patients who received picture-sand therapy showed significant improvement in their interpersonal sensitivity, as well as a reduction in their paranoia, impulsivity, and aggressive behavior. They were able to express and release their inner conflicts, anxiety, and negative emotions, ultimately experiencing a strong sense of happiness. The program stimulated the imagination of the children and the sand play encouraged creativity, construction, and symbolism, while providing a sensory, social, and structured environment. The therapy was expertly guided by specialist therapists who built trust with the children and presented engaging projects to them.

3.14. International multicentre randomised controlled trial of improvisational music therapy for children with autism spectrum disorder: TIME-A study, 2017

In 2017, Crawford et al. conducted research funded by the National Institute for Health Research (NIHR) to explore the effects of improvisational music therapy on social emotion and responsiveness in children with autism. The study included 364 children between the ages of 4 and 7 who had been diagnosed with autism and were randomly assigned to either an intervention group or a control group between 2011 and 2015. A total of 314 children completed the study, with 165 in the intervention group and 149 in the control group. All parents and children received enhanced standard care, which included three 60-minute sessions of advice and support in addition to treatment as usual. The trial included two active treatment groups that were offered music therapy sessions at two different frequencies: once a week (low frequency) or three times a week (high frequency). The results of the study showed that improvisational music therapy delivered in groups by specialist therapists using a social game/drama play approach was able to positively influence the social behaviour of children with ASD when comorbid with intellectual disability.

3.15. Supporting coordination of children with ASD using neurological music therapy: A pilot randomized control trial comparing an elastic touch-display with tambourines. 2020

In 2020, a group of researchers at Chapman University's Fowler School of Engineering in Orange, California conducted a study to evaluate the effectiveness of neurological music therapy in enhancing the coordination and movement control of children with autism spectrum disorder (Cibrian et al., 2020). The study involved 22 children between the ages of 4-8 from a special school in the Northwest of Mexico, who underwent 8 sessions of therapy over 2 months. The researchers

utilized both a traditional tambourine and a modern technological intervention called an elastic touch screen to assess the impact of each method. The findings indicated that the therapy significantly improved coordination and movement control, with those who used the flexible touchscreen achieving higher scores.

3.16. Beyond Broadway: Analysis of Qualitative Characteristics of and Individual Responses to Creatively Able, a Music and Movement Intervention for autism. Children with Autism, 2019

The research conducted by Lakes et al. in 2019 at the University of California Irvine aimed to examine the qualitative characteristics and individual responses of children with autism spectrum disorder (ASD) to a music and movement intervention. The study included boys and girls aged between 7 and 12 years with a history of ASD diagnosis. The participants attended eight 45-minute sessions spread over four weeks. The results showed that during the sessions, the children with ASD were able to self-regulate to a level that would be expected from typically developing children of their age. The study also showed improvements in stereotypic movements and compulsive behaviours. The intervention was a sensory kinetic drama therapy game that was implemented in groups.

3.17. A practical study regarding the effect of adaptive roller-skating on the emotion regulation ability of autistic children, 2022

In a study conducted by Guan et al. in 2022 at the Center for Special Sports Intervention for Children in Hunan, China, the objective was to analyze how adaptive skating could affect the emotional regulation of autistic children. The study selected four children aged 6-7 years with moderate autism, severe sensory integration disorder, and basic motor skills. The program ran for four weeks, with three sessions per week each session lasting for 90 minutes, with a 10-minute break in between. The results of the study showed that adaptive skating was an effective way to regulate emotions in autistic children. After the intervention, all four autistic children demonstrated an improvement in their ability to regulate their emotions, with fear being the most notable. Moreover, the study found that stereotypic behavior was less common among the four children after the experiment.

3.18. Behavioral Outcome Effects of Serious Gaming as an Adjunct to Treatment for Children with Attention-Deficit/Hyperactivity Disorder: A Randomized Controlled Trial. 2016

Bul et al. (2016) conducted a research study aimed at investigating the effects of Plan-It Commander, an online adventure game, on the daily living skills of children diagnosed with attention-deficit/hyperactivity disorder (ADHD). The study was conducted at the Department of Clinical Psychology, University of Rotterdam, Netherlands. The research sample included 170 children between the ages of 8 and 12 who completed a 20-week trial. The results indicated that participation in the game significantly improved the time management, planning, organization, working memory, and time perception skills of the children. Furthermore, the study revealed an improvement in the children's short-term memory. The findings of this study suggest that Plan-It Commander has the potential to serve as an effective tool for improving the daily living skills of children with ADHD.

3.19. Improving Executive Functioning in Children with ADHD: Training Multiple Executive Functions within the Context of a Computer Game. A Randomized Double-Blind Placebo-Controlled Trial. 2015

In 2015, a study by DAVIS et al. was conducted at the Department of Developmental Psychology at the University of Amsterdam in the Netherlands. The research aimed to explore the short- and long-term effects of an educational video game intervention on children diagnosed with ADHD. The game, "Braingame Brian," focused on enhancing multiple executive functions, such as visuospatial coordination, inhibition, and cognitive flexibility. The study involved 89 children aged 8-12 years, who were randomly assigned to one of three groups: a fully active condition, a partially active condition, or a placebo version. The fully active condition included training for visuospatial coordination, inhibition, and cognitive flexibility, while the partially active condition focused on inhibition and cognitive flexibility. The placebo group received a fake training. The game, consisting of 25 training sessions, followed the journey of the main character, "Brian," a young inventor, as he created increasingly elaborate inventions and befriended inhabitants of the game world. During the course of the training period, the participants' compliance rate was consistently high. However, following the intervention, it was observed that only those individuals who were assigned to the full activity condition demonstrated a significant improvement in their visuospatial short-term memory measures. Notably, both the fully active and partially active groups showed a positive impact on their inhibition and cognitive flexibility measures.

4. Discussion

The objective of this study was to identify intervention programs that aid children with neurodevelopmental disorders in enhancing their everyday living abilities through the medium of educational play. After conducting a comprehensive review of international literature, several interventions were found to promote autonomy, cognitive, and socio-

emotional skills in these children. The results suggest that educational games can effectively enhance fundamental executive functions like self-regulation and attention concentration in individuals with neurodevelopmental disorders. Additionally, all the interventions utilizing educational games prioritized the development of social interaction with peers, which is an essential component of any educational program in the realm of neurodevelopmental disorders.

The Olly program, developed by Nonnis et al in 2021, offers activities that foster socialization and sensory integration. These are critical developmental areas for children with autism spectrum disorder (ASD). The program provides a secure and structured environment for children to enhance their social and sensory processing abilities. Another valuable program is Stay, Play, Talk (Barber et al, 2016), a free play program that promotes peer-to-peer interaction and has been shown to enhance social communication in young children with ASD.

The LEGO educational game (Legoff and Sherman, 2016) has also demonstrated effectiveness in improving social skills development in children with ASD. Over three years, children who played with LEGO exhibited significantly reduced autistic-type social behaviours compared to control groups. The LEGO educational curriculum can be easily adapted to school environments. Additionally, the LBT Lego program (Barr et al, 2022) is a group educational play program that helps children with ASD practice communication and social skills while building LEGO models in a structured environment with their peers under the guidance of a trained coordinator. Behaviour, communication, self-confidence, and social skills improved. However, the intervention context limited generalization.

Therapy groups that involve free movement, singing, and intense color stimuli have been shown to improve attention, motor coordination, and learning. These groups also allow for social imitation, strengthen eye contact, and improve communication (Vaisvasre, 2019). The Educational Musical Drama (Corbett, 2010) was designed to assist children with autism spectrum disorder (ASD) through a community-based approach. The program yielded significant results, including notable improvements in children's face recognition and theory of mind skills. These skills are often underdeveloped in children with ASD, impeding their social development. In addition to addressing these deficits, the program also helped children better comprehend social cues, cultivate empathy, and enhance their social communication abilities.

Research conducted by Wang et al. in 2022 found that somatosensory games using the Kinect tool can significantly improve the muscle strength, balance, and gross mobility of children with ASD. The study also observed improvements in visual responses, stress reactions, verbal communication, interpersonal relationships, and learning motivation in children with ASD.

Another study by Binns et al. in 2022 focused on the use of symbolic play in gross motor play settings, which provided some autistic children with significant sensory-regulatory support. This positively influenced their social engagement and helped reduce stereotyped behaviours through symbolic play.

In addition, structured play has been found to effectively contribute to the improvement of the language skills of children with ASD. These findings highlight the importance of using different play-based interventions, such as somatosensory games and symbolic play, to enhance the overall development of children with ASD.

Engaging in sand play can prove to be a valuable activity for children with ASD, as it aids in their sensory integration. A recent study conducted by Guo and Li in 2021 revealed that this game had a significant impact in curbing impulsive and aggressive behaviour, while also strengthening interpersonal relationships among the children. Moreover, music therapy has proven to be an effective tool in helping children with ASD communicate their emotions. According to a study by Crawford et al. in 2017, improvisational music therapy in particular has a positive effect on the social skills of children with ASD, especially those with intellectual disabilities.

The study conducted by Cibrian et al. in 2020 focused on the effectiveness of neurological music therapy in improving the motor coordination of children with ASD. Another program called "Creatively Able," designed by Lakes et al. in 2019 aims to support children with ASD. It combines music with rhythmic movement patterns and promotes collaboration with partners through social activities. The results have shown a reduction in stereotyped movements and compulsive behaviours. Guan et al. (2022) aimed at the emotional regulation of children with ASD through an adaptive skating educational game, which effectively regulated the emotions of children and reduced dysfunctional social behaviours. Marzouki et al. (2022) demonstrated an enhancement of functional behaviours and emotional expression through an intervention based on an educational play program in water. Additionally, Gonzalez et al. (2021) presented the positive contribution of free play as a means of promoting social participation, awareness, balance, and touch of the body.

Research has shown that electronic educational games such as "Brian" (Dovis et al. 2015) and Plan-It Commander (Bul et al. 2016) can be beneficial for students with Attention Deficit Hyperactivity Disorder (ADHD). "Brian" was found to significantly improve students' short-term memory, while Plan-It Commander enhanced their social skills, time management, and working memory. These findings suggest that educational games that focus on the sensory perception and processing of children with neurodevelopmental disorders can contribute to the development of daily living skills. By engaging the senses, the mind and body can work together to create cognitive schemas and social behaviours.

5. Conclusion

Concluding, we underline the positive impact of traditional playing as well as of all the digital technologies through play, on children with neurodevelopmental problems, They have positive impact on various mental abilities including: to significantly improve students' short-term memory, enhanced their social skills, time management, and working memory, reduction in stereotyped movements and compulsive behaviors, helping children with ASD communicate their emotions, improvements in visual responses, stress reactions, verbal communication, interpersonal relationships, and learning motivation, as well as many other improvements in every mental and emotional aspect.

Compliance with ethical standards

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Disclosure of conflict of interest

The Authors proclaim no conflict of interest.

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