HOW MUCH DOES PARENTAL INVOLVEMENT MATTER WHEN AUTISM SPECTRUM DISORDER (ASD) CHILDREN USE ARTIFICIAL INTELLIGENCE (AI) IN THE LEARNING PROCESS?

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Absztrakt

MENNYIT SZÁMÍT A SZÜLŐI BEVONÓDÁS, AMIKOR AZ AUTIZMUS SPEKTRUMZAVARRAL ÉLŐ (ASD) GYERMEKEK MESTERSÉGES INTELLI-GENCIÁT (MI-T) HASZNÁLNAK A TANULÁSI FOLYAMATBAN?

A tanulmány célja, hogy bemutassa a szülői hozzáállást a mesterséges intelligencia (MI) autizmus spektrumzavarral (ASD) szenvedő gyermekek esetében történő használatával kapcsolatban. A statisztikák azt mutatják, hogy az ASD-gyerekek száma növekszik az előző évekhez képest, és ez a kérdés az ASD-s gyermekek legjobb tanítási és fejlesztési stratégiáival foglalkozó számos tanulmány fókuszpontjává vált. A manapság egyre elterjedtebb mesterséges intelligencia-technológia fejlesztése az egyik legújabb módszer az ASD-s gyerekek fejlődésének és tanulási folyamatának segítésében. A jelen tanulmányban alkalmazott módszer egy olyan szakirodalmi áttekintés, amely a szülők szerepét vizsgálja az ASD-vel élő gyermekek oktatásában, számos mesterséges intelligencia-technológiai fókuszon keresztül, mint például a nyelvtechnológia, a játékok, a robotika és a virtuális valóság. A cikk az EPSTEIN-t referenciamodellként is használja a szülőknek az ASD-vel élő gyermekek tanulási folyamatába és fejlődésébe való bevonására az MI használatával. Ennek a modellnek az a célja, hogy a szülői hozzájárulások bevonásával kiszélesítse az iskolai tanterv hatókörét. Jelentős esélyt jelent az iskolák számára is, hogy javítsák jelenlegi tantervüket azáltal, hogy bevonják a szülőket az oktatási folyamatba. Korábbi tanulmányok eredményei azt mutatják, hogy a szülők részvétele az AI-technológia ASD-s gyermekek számára történő alkalmazásában nagyon pozitív, és nagy hatással van gyermekeik fejlődésére. A korábbi vizsgálatok alapján

megállapítható, hogy az ASD-s gyermekek szociális, érzelmi és viselkedési fejlődését nagymértékben befolyásolja szüleik bevonása. Emellett az AI-technológiát várhatóan tanítási eszközként fogják használni a tanulók teljesítményének, önbecsülésének és viselkedésének javítására.

Kulcsszavak: szülői részvétel, mesterséges intelligencia, technológiák, autizmus, ASD

Diszciplína: informatika, pedagógia

Abstract

This study's objective was to demonstrate the connection(s) between parental participation in employing artificial intelligence (AI) for children with autism spectrum disorder (ASD). Statistics indicate that the number of ASD children is increasing compared to previous years and this issue has become the focal point for numerous studies into the best teaching and developmental strategies for ASD children. The development of AI technology which is becoming more prevalent nowadays is seen as one of the latest methods in helping the development and learning process of ASD children. The method taken in this study is a review of the literature that examines the role of parents in the education of children with ASD through several AI technology focuses such as language technology, games playing, robotics and also virtual reality. The article will also use EPSTEIN as a reference model to discuss the involvement of parents in the learning process and development of ASD children through the use of AI. The objective of this model is to broaden the scope of the school curriculum by including parental contributions. It also presents a significant chance for schools to enhance their current curricula by involving parents in the educational process.The results of previous studies show that parents' involvement in using AI technology for ASD children is very positive and has a great influence on their children's development. Based on this previous study, it can be concluded that the social, emotional and behavioral development of ASD children is greatly influenced by the involvement of their parents. Additionally, it is anticipated that AI technology would be used as a teaching tool to raise student achievement, self-esteem, and behavior.

Keywords: parental involvement, artificial intelligence, technologies, autism, ASD

Disciplines: informatics, pedagogy

A pervasive neurodevelopmental illness called autism spectrum disorder (ASD) is connected to developmental disabilities brought on by variations in the brain. ASD can be identified by persistent traits that are typical of social interaction and communication in a variety of contexts, such as repetition, preoccupation, poor communication, behavioral patterns, or activities. Despite the wide variation in how ASD symptoms manifest, many children with ASD require ongoing daily care notably from close family such as parents. Parents of children with ASD often have to make difficult decisions about their children's needs and care, such as selecting the best educational environment or making sure their child has access to appropriate technologies that enhance their child's learning development.

Parental involvement is seen as an important aspect in the learning development of ASD children. Previous research has demonstrated that parents' involvement in their ASD children's development can aid these exceptional children with delayed linguistic abilities (Yan et al., 2022), distracted or hyperactive behavior (Sin & Cheng, 2022), seizure or epilepsy disorder (Fombonne et al., 2022), deferred motor skills (Gajic et al., 2021), odd dietary and sleeping patterns (Bullivant & Woods, 2020), atypical emotional or mental states (Tajik-Parvinchi et al., 2020) and also delayed cognitive or educational abilities (Fenning & Butter, 2019).

This article will examine the benefits of parental involvement in using AI techno-logies that affect autistic children's engagement with types of AI such as speech recognition software, intelligent tutoring system, machine learning, and also virtual learning application. The use of various types of AI in the education of autistic children will look at how these would influence the final socio-behavioral results. The use of AI technology to the learning process is not new, and during the past 25 years, it has undergone tremendous advancements in the field of education (Roll & Wylie, 2016).

AI technology is also seen as an effective alternative in helping the learning of children with autism (Porayska-Pomsta et al., 2018). Many software and tools have been developed to aid autistic children in their educational endeavors, such as the Speech Blubs program created by Mitja Mavsar. This idea was created to help children with autism to encourage them to speak fluently and improve pronunciation by watching and repeating after several times. Nielsen (2021) asserts that since its establishment in 2017, Speech Blubs has effectively assisted millions of children with speech problems throughout the world, including non-verbal children with autism and Down syndrome. A humanoid robot with a wide range of facial expressions has been introduced in the US by RoboKind to help autistic children receive therapy for understanding human emotions. Milo, the robot that has been created by Acapela Group acts as a speech technology that can be used to voice any textual information with genuine voices

that convey meaning and intention. By converting written input into speech, more than 100 synthetic voices in 30 languages are prepared to give any content a voice, delivering a natural and enjoyable audio output (Acapela Group, 2015).

Meanwhile, a 58 cm tall bipedal robot called NAO was unveiled in 2008 by a robotics company known as Aldebaran based in France, China, and the USA. The goal of NAO is to fill the void between isolation and increased social and intellectual engagement for children on the autistic spectrum (IEEE Spectrum, 2022).

Autistic Spectrum Disorder (ASD)

Autistic Spectrum Disorder (ASD) or also known as Autism refers to a broad range of conditions characterized by challenges with social skills, repetitive behaviors, speech and nonverbal communication (Autism Speaks, 2021). Autism comes from the Greek word 'autos' which means self. It describes a person who exists in their own universe.

From a medical perspective, autism is a neurological condition that affects a person's ability to develop social interaction, social communication, and repetitive behavior, as well as their limited interest in certain things (Kund et al. 2022).

Autism is a spectrum disorder that makes children with autism regardless of genders, races, ethnicities, and economic backgrounds, have obstacles in one of aspects including the process of learning how to think, how to communicate, and also in solving a problem. This coincides

with the definition given by the American Psychiatric Association that ASD is a complicated developmental syndrome characterized by ongoing difficulties with social interaction, narrow interests, and repetitive conduct (Copeland, 2018).

ASD is a neurodevelopmental disease characterized by repetitive and limited activities and interests, as well as social communication difficulties, according to Bentenuto et al., (2023).

Some people with autism may require a great deal of assistance in their everyday life, while others may only need a little help or even be completely independent in some circumstances.

Martín-Gutiérrez et al., (2022) stated that ASD is one of the most common neuro-developmental disorders where children with ASD will affect three main aspects in their lives, namely communication, social interaction, and impulse control. Children with ASD may experience communication difficulties as they learn language and struggle to comprehend what others are saying to them.

Additionally, they frequently struggle with nonverbal cues including eye contact, facial expressions, and hand gestures (Ghazal et al., 2023). When it comes to social engagement, autistic kids frequently prefer to play alone and have a hard time making new friends (The National Autistic Society, 2023). Additionally, these children frequently lack empathy for other people's sentiments (Shanok et al., 2019) and respond to queries in an unconnected way (Wallace et al., 2022).

Autism is one of the categories of disorders known as Pervasive Developmental Disorders where another disorder in this category is Asperger's Syndrome which is a condition in which the affected child's speech and cognitive abilities can be normal (Al Mosawi, 2020).

The primary etiology of autism is still unclear as of this writing. However, studies have shown that a combination of genetic, biochemical, and environmental variables contribute to autism. According to the most recent research, a variety of hereditary variables may complicatedly enhance the risk of developing autism. It has been determined that having some specific genetic disorders, such as Tuberous Sclerosis and Fragile X Syndrome, increases one's likelihood of being diagnosed with autism (Bozhilova et al., 2023). In addition, there is some evidence of hereditary and genetic links to autism in a family where a child is likely to get autism if they have a sibling with autism (Sacrey et al., 2018). A study conducted by Lung et al., (2018) stated that a large percentage of autistic children are delivered to moms who are older than 40 at the time of childbirth. Pregnancy-related use of some drugs, including thalidomide and valproic acid, has also been linked to a higher risk of autism (Puig-Lagunes, 2021).

A different theory claims that autism develops when a pregnant woman is exposed to pollutants, particularly metals, or to unhealthy behaviors like smoking, drinking alcohol, or abusing drugs (Etemadi-Aleagha & Akhgari, 2022).

The World Health Organization (2019) estimated that there are 1:160 people in the population who have ASD. Meanwhile, according to a recent study published in Autism Speaks (2022), 1 in 100 children or 100 out of every 10,000 children worldwide have an ASD diagnosis. This figure also records that the number of males with autism is higher than females with a ratio of 4:1 (McCrossin, 2022). In terms of treating autism, the primary symptoms are still untreatable at this present. Children who have autism must live with it for the rest of their life. Nevertheless, there are therapeutic approaches that can assist improve the quality of life for those with autism such as special education (Sassu & Volkmar, 2023), speech and language therapy (Christopoulou et al., 2022), occupational therapy (Domínguez-Lucio et al., 2022), sensory stimulation therapy (Fernández-Lechuga et al., 2021), and also medicines (Hofer et al., 2019).

Artificial Intelligence (AI) Technology in Education

Various treatments to help children and adults with ASD have been mentioned in the paragraph above. In line with the advancement of technology nowadays, children with ASD can go through a learning process that can help their development through the use of artificial

technology (AI). Humans have been using machines to augment our capabilities for a long time and the use of AI in education is not something new.

AI can be defined as the replication of human intelligence functions by machines, particularly computer systems with the specific applications of AI include expert systems, natural language processing, speech recognition and machine vision (Burns, 2022). AI is a field that combines computer science and robust datasets to enable problem-solving and there are many current real-world uses for AI systems, including speech recognition, recommendation engines, computer vision, and automated stock trading (IBM, 2022).

The Turing Test, which was introduced by Alan Turing, a British mathematician, is a method of inquiry in artificial intelligence (AI) for determining whether or not a computer is capable of thinking like a human being (St. George, 2023). AI is the capacity of a digital computer or computer-controlled robot to carry out tasks that are typically performed by intelligent beings. The phrase is widely used in reference to the effort to create AI systems that possess human-like cognitive abilities like the capacity for reasoning, meaning-finding, generalization, and experience-based learning (Copeland, 2022),

The beginning of AI in education may be traced back to 1763, when mathematician Thomas Bayes created the decision-making method known as Bayesian inference. This method is used to educate machines (and people) on how to make judgments based on pattern recognition and probabilistic predictions. Furthermore, the "analytical engine," a device made to conduct mathematical calculations, was created by Charles Babbage in 1837. To complete this task, the machine needs instructions from a program.

The first program to utilize his prototype is written by his coworker Ada Lovelace. The development of several technologies that support the global education system accelerated the growth of AI since the beginning of the Y2K era. Kismet, a robot head developed by Dr. Cynthia Breazeal, was successfully launched at the Massachusetts Institute of Technology in 2002. With the help of different facial expressions, vocalizations, and movements, Kismet was developed with the aim of identifying and recreating emotions and the movements of the ears, eyebrows, eyelids, lips, jaw, and head are used to form facial expressions (Masabanda et al., 2023).

The development of numerous AI technologies that can aid in the learning process and inadvertently entice students to learn more about a certain subject demonstrates the continued evolution of AI in the field of education (Demeter & Mező, 2023). Face recognition technology, which uses AI to verify and authenticate students' identities by detecting, recording, and comparing faces to photos from a database, is one of the AI advancements that have a big positive impact on education. This technology, commonly referred to as machine learning, makes

predictions about the future based on historical data or algorithms (Alam, 2022).

Furthermore, AI in education can be observed in translation technology, which can assist teachers and students in understanding one another on several levels. Google Translate, Microsoft Translator, and Linguee are a few instances of AI technology that facilitates translation. Students can comprehend the ideas professors are explaining to them by interpreting more than just words (Hasyim et al., 2021).

In addition, virtual reality technology has also become an important learning tool in today's modern world. VR is an immersive technology that allows students to interact in a computer-generated world of imagery and sounds. Studies from Papanastasiou et al., (2019) show that the use of VR in education can help to enhance student memory and information retention while also enhancing comprehension of difficult conceptual concepts (Raja & Priya, 2021).

Parental Involvement from Epstein Model

It is unavoidable that parents play a role in their autistic children's development. The life of ASD children continues at home and with their families, thus today's educational programs designed to involve parents of children with autism at all stages of development can only be successful with genuine and continuous cooperation

from teachers and parents. Numerous earlier studies have demonstrated the crucial role parents play in ensuring that their children receive prompt expert guidance when children exhibit symptoms of autism. Parents also investigate the most effective therapies for their autistic children, including speech therapy (Aliffia et al., 2023), special education schools (Hurwitz et al., 2022) and motor skills training (Zoccante et al., 2021).

Furthermore, parents also play a role in ensuring consistency of approach in therapy to ensure there is a positive development in terms of social and behavioral aspects of children with autism (Kehinde et al., 2022).

The Epstein's model that was built by Dr. Joyce Epstein from Johns Hopkins University has outlined six types that refer to parent involvement which aims to assist teachers to create school and family collaboration programs (Nathans et al., 2022). Epstein's Framework of six types of involvement involves

1) parenting - to assist all families in creating living spaces that encourage children' academic success,

2) communicating - to create efficient ways to communicate with parents and teachers on educational initiatives and student development such as parents-teachers meeting and newsletter,

3) volunteering - by providing parent room or family center for volunteer work, meetings, and resources for families,

4) learning at home - to educate parents on how to assist their children with

homework and other curriculum-related decisions and activities at home,

5) decision-making-by developing parent leaders, representatives, or parent organizations, as well as involving families in educational decisions,

6) community collaboration which to inform students and families about programs and services related to community health, culture, recreation, social support, and other topics.

A study on the EPSTEIN model in reference to parental involvement was conducted by Salac & Florida in (2022) to see the relationship between parental involvement and this model in determining student academic performance. Montes & Montes (2021) did a study on parents of children with Attention Deficit Hyperactivity Disorder (ADHD) participation with their study likewise focusing on the EPSTEIN model. Another study was also conducted by Newman et al. (2019) to determine if there were statistically significant differences in parents' perceptions of the frequency and effectiveness of parental involvement among different demographic groups such as ethnicity, education level, socioeconomic status, and number of children in the home.

Thus, this article will also use EPSTEIN as a reference model to discuss the involvement of parents in the development of ASD children. The six categories of the EPSTEIN model will be discussed in more detail on the interaction between parental involvement and AI technology for children with ASD.

**The role of parents
with ASD children
in using AI technology**

Artificial intelligence (AI) has the ability to improve teaching and learning methods and tackle a number of the major difficulties facing the field of education today. In addition to using top-notch learning resources and qualified teachers, AI could assist ASD children to learn more rapidly and effectively. UNESCO (2019) stated that the connection between AI and education involves three aspects which are 1) learning with AI – the use of AI-powered tools in classrooms, 2) learning about AI related to its technologies and techniques and 3) preparing for AI by enabling all citizens to better understand the potential impact of AI on human lives. In discussing the involvement of parents in the education of ASD children using AI technology, there are four main AI technologies used in the learning process nowadays.

These four technologies are seen from the aspect of how they can help ASD children and also how parents play a major role in achieving learning objectives.

Language technology

Language technology, usually referred to as human language technology, is the science of how computer programs and devices interpret, alter, or react to spoken and written human communication. The development of language technology has shown that machines are capable of

understanding languages other than those spoken by people. Additionally, it is multi-disciplinary, which implies that it draws on a variety of computer-related fields, including natural language processing, computational linguistics, deep neural networks, and speech technology. Concerning the education of autistic children, learning technology is seen to offer many advantages to ASD children, including fostering inhibited engagement with oral and written language (Sulaiman et al., 2022), increasing familiarity with digital print (Saniputri & Tati, 2021), and developing literacy skills like writing, listening, speaking, and reading in addition to blending diverse language features like phonics and vocabulary (Bailey & Arciuli, 2022).

The involvement of parents with ASD children in the use of technology language has been done a lot by previous researchers. For instance, a study on conducting oral and written language-adapted tele-assessments conducted by Conner et al., (2022) revealed that parental support and assistance during the administration of their child's test showed a positive, strong relationship with corrective verbal assistance/support and that parent involvement behavior made up about two-thirds of the coded behaviors. Children with ASD struggle with learning, making decisions, passing judgement, and remembering things.

However, the goal of assistive technology is to enhance social and behavioral abilities. A number of studies showed that computer-assisted learning technology, which is increasingly used, functions as an effective treatment aid for autistic children. A visual presentation application known as VALE-Emotions App has been built to see ASD children's response to emotions at different intensity levels (Olmedo-Vizueta et al., 2017). This application was created by producing several videos and games that act to teach ASD children about different kinds of emotions and analyze their progress. The study's findings indicate that developing activities can help ASD children recognize different emotions quickly and with a high level of accuracy. Parents have responded well to the use of emotion applications in assisting children with ASD.

This is demonstrated by a study from Kalantarian et al., (2020) incorporating parental involvement in this emotion application, which demonstrates that parents may monitor and track their children's performance and improve school-to-parent communication.

This coincides with what is stated in the EPSTEIN model that applications and software can help in creating living spaces that encourage children's academic success.

Games Playing

Play has an essential component of a child's growth to build fine and gross motor skills, social skills, communication skills, language, thinking and problem-solving skills. It develops language,

thinking, problem-solving, social, communication, and fine and gross motor skills.

Playing diverse games helps kids learn different things. Children with autism may require assistance learning to play in ways that help them develop their talents. In a study conducted by Hassani et al., (2022) showed that videogames are one of the effective learning methods in helping the development of physical performance of children with autism. A study involving 30 ASD children using the evaluation tools included the Brininx-Oresetsky Test (BOT) and a program named "I Can Have Physical Literacy" (ICPL) and Sport, Play, and Active Recreation for Kids (SPARK) is seen to help the development of motor skills of these special children.

Penev et al., (2021) in a study that focuses on the development of ASD children's communication in a mobile game platform known as Gueeswhat shows that parental involvement is an important element that can have a positive impact on ASD children's therapy. Furthermore in 2017, Malinverni et al had also conducted game research on how ASD children develop. In the Pico's Adventure game, children engaged with an avatar, their parents, and other kids in a virtual setting where they had to complete tasks to help the animated character Pico the alien. Exploratory findings demonstrated that when autistic children were engaged in the task, they were more vocal and direct with their parents and peers during game-play. In this way, if any issues arise when using the software or applications, parents can get in touch with the school, talk with them, and share their thoughts about the kids with the teachers.

Parents can learn about their child's growth, behavior, and any issues in this method. In addition to motivating parents to further develop their parenting abilities, the dialogue and sharing with the school can assist them in resolving issues their kids may be having (Josilowski & Morris, 2019).

A better education for children can be ensured by the presence of two-way communication between parents and teachers, who can also inform parents on their children's early growth (Yunitasari et al., 2023). In addition, game playing helps the development process of ASD children when parents spend time with their children and are aware of the problems their children face. All of the indicators mentioned are related to the EPSTEIN model from the point of view of communicating and parenting. Nonetheless, parents should remain vigilant on how games are used in education to ensure they don't take the place of real-world issues.

Robotics

The use of robots in the education system for autistic children is gaining ground in most schools around the world. Many previous studies have shown that the use of robots can help the educational process of autistic children (Mező & Szabóné, 2021).

In April 2021, a social robotics company known as LUXai has successfully released a robot called QTrobot. The creation of QTrobot is to help children with autism to learn and practice new social, emotional, and cognitive skills while having a social engagement with the robot playmate (Luxembourg National Research Fund, 2021).

Prior to the creation of QTrobot, in 2015, a professor in Hong Kong developed Robot for Autism Behavioral Intervention (RABI) with the intention of assisting autistic persons in enhancing their social skills. RABI is designed for autistic people between the ages of three and 18 to play a specific role to help those with autism to interact (So & Song, 2022). Parents of children with ASD have reacted favorably to the development of RABI as it appears to be able to help autistic children discern between appropriate conduct and inappropriate behavior, such as yelling and raging, based on two tiny robots performing in a specific scenario.

Children with autism will watch the play and then be asked to practice their social skills with a human tutor. The involvement of parents in the use of robots for ASD children was done by Richardson et al., (2018) where the results showed that children with ASD preferred to be with caregivers during the intervention when the novelty effect was caused by a robot and they tended to resort to close individuals. Further study by Butchart et al., (2021) reveals that parents who own robots at home are crucial in keeping their child motivated while they are learning. This is because it is well known that autistic children undergo abrupt mood fluctuations; therefore, it is guaranteed that parental support and motivation will aid these autistic children's learning processes.

Apart from that, the involvement of parents in learning to use robots can also be seen in terms of planning learning activities for autistic children (Mitsea et al., 2020). Planning children's activities by making study schedules is one of the efforts to ensure that their children are more consistent with their learning.

Parental involvement is also an important element in improving the social communication skills of ASD children as research has been done by Amirova et al., (2022) on the effect of parental involvement in Robot-Assisted Autism Therapy (RAAT). According to the study's findings, children with ASD engage more fully with the robot during parent-involved RAAT sessions than during sessions without parents. The majority of parents in the research thought the suggested RAAT was a valuable experience to encourage their children's social participation.

Virtual Reality (VR)
ASD children are more likely to have sensory problems than their typical peers. Sensory issues among ASD children included sights, sounds, increased movement and also increased stimming such as hand flapping or fingers fidgeting (Laurie, 2022). Some research suggests that autism

is closely tied to specific causes of blindness for instance, optic nerve hypoplasia (Gutiérrez et al., 2022), retinopathy of prematurity and ano-phthalmia in which one or both eyes fail to develop (Molinaro et al., 2020). The most common eye movement disorder in children with ASD is strabismus, a condition that causes the eyes to point in different directions (Buffenn, 2021).

Virtual reality (VR) technology is one of the AI technologies that involve sensory input that can help ASD children in the learning process. Virtual reality is a technology for full sensory integration that permits the development of entirely fictitious virtual environments (Oktay & Yuzer (2023).

Children with ASD will be able to sense synesthesia, sensory overload, and hypersensitivity with full intensity through virtual reality. The ability of autistic people to perceive sounds, lights, patterns, and unpleasant factors shapes the illuminating insight into their daily life (Nair et al., 2022). A project titled the Immersive Virtual Reality as a Tool for Autistic Pupils and Teachers project (IVRAP), which intends to teach students with learning challenges and autism spectrum disorders how to "learn to learn," was funded by European Commission's Erasmus in 2019. Erasmus is an EU's programme to support education, training, youth and sport in Europe. Erasmus has built IVRAP after researching the usefulness of virtual reality (VR) in assisting the development process

of ASD children (Autism Europe, 2021). Apart from that, AcclimateVR was built by Jaclyn Wickham which aims to support children and teenagers with autism spectrum disorders in learning how to live independently, practice social abilities, increase safety awareness, and negotiate difficult community settings. With AcclimateVR, students may practice practical life skills at their own speed while experiencing real-world problems and circumstances in a safe setting. The development of AcclimateVR can also assist students in gaining practical life skills at their own speed while allowing them to experience real-world problems and scenarios in a calm environment (Nasr & Calabrese, 2020).

Learning at home, which can be connected to ASD children using VR at home, is one of the sorts of parent participation in the EPSTEIN paradigm. With the help of the VR concept, these exceptional kids can review what they have learnt in class while virtually being at home with their parents.

Method

The methodology of this study uses a literature review approach only. This is because this study is at an early stage, and data collection activities in the field have not yet been done. The researcher has chosen to use several online services to obtain reference materials, namely through The International Journal of Artificial Intelligence in Education (IJAIED)

website, Springer, Web of Science, Researchgate, and Google Scholar starting from 2017 until 2023. In the results of the study library, the researcher has found the highlights of the literature that has been carried out by previous studies that found that parental involvement has been widely recognized in autism education but there is no direct evidence that parental involvement benefits children during AI interventions. To locate relevant research, the Initial search terms such as parental involvement, parent's role, virtual reality, Autism spectrum disorder (ASD), autism, technology for autism education and EPSTEIN model have been used.

Conclusion

This article has discussed the importance of parents' involvement in the learning process and development of ASD children through the use of artificial intelligence.

Numerous earlier research have demonstrated the significance of parents' influences on their ASD children's learning. AI assists in identifying the knowledge gaps and what an ASD student knows and does not know in order to create a customized study regimen for each child. In this approach, AI makes learning more effective by adjusting it to the individual needs of each student. AI also allows parents to be better informed of their children's progress and understanding, providing more accurate feedback and allowing parents to assist their children in areas of difficulty.

Future qualitative research should be done on the parent's involvement in the utilization of AI technology for their ASD child and how it would benefit and affect the children.

References

Acapela Group (2015). Advanced Robotics: Meet Milo, an Intelligent Robot That is Really Good at Teaching Children with Autism Social Skills. URL: https://www.prnewswire.com/news-releases/advanced-robotics-meet-milo-an-intelligent-robot-that-is-really-good-at-teaching-children-with-autism-social-skills-562351711.html

Alam, A. (2022). Employing Adaptive Learning and Intelligent Tutoring Robots for Virtual Classrooms and Smart Campuses: Reforming Education in the Age of Artificial Intelligence. In Advanced Computing and Intelligent Technologies: Proceedings of ICACIT 2022 (pp. 395-406). Singapore: Springer Nature Singapore. Doi: 10.1007/978-981-19-2980-9_32

Aliffia, Netha, Thifalia Nurli Al-Kahfi, Putri Fardha Asa Oktavia Hans, Ayu PutriPamungkas Muti, and M. Fariz Fadillah Mardianto. "The effectiveness of speech pathology telepractice during COVID-19 pandemic for Autistic children in Indonesia." In AIP Conference Proceedings, vol. 2554, no. 1, p. 030012. AIP Publishing LLC, 2023. Doi: 10.1063/5.0104036

Al-Mosawi, A. J. (2020). Our experience with childhood pervasive developmental disorders (Autism and Asperger Syndrome): Cure is Possible. EC Clinical and Medical Case Reports, 3(4), 01-08. Doi: 10.5281/zenodo.3892198

Amirova, A., Rakhymbayeva, N., Zhanatkyzy, A., Telisheva, Z., & Sandygulova, A. (2022). Effects of parental involvement in robot-assisted autism therapy. Journal of Autism and Developmental Disorders, 1-18. Doi: 10.1007/s10803-022-05429-x

Autism Europe (2021). IVRAP- Virtual reality to support learning (2019-2022) – Autism Europe. [online] URL: https://www.autismeurope.org/blog/what-we-do/ivrap-virtual-reality-to-support-learning-2019-2022/. Available at: https://www.autismeurope.org/blog/what-we-do/ivrap-virtual-reality-to-support-learning-2019-2022/

Autism Speaks (2021). What is autism? [online] Autism Speaks. Available at:https://www.autismspeaks.org/what-autism.

Autism Speaks (2022). New study shows increase in global prevalence of autism. [online] Autism Speaks. Available at: https://www.autismspeaks.org/science-news/new-study-shows-increase-global-prevalence-autism.

Bailey, B., & Arciuli, J. (2022). Literacy instruction for autistic children who speak languages other than English.

Autism, 26(2), 389-405. Doi: 10.1177/13623613211025422

Bentenuto, A., Perzolli, S., de Falco, S., & Venuti, P. (2023). Play in Children With Autism Spectrum Disorder: Development and Characteristics. In Handbook of Research on Play Specialism Strategies to Prevent Pediatric Hospitalization Trauma (pp. 240-267). IGI Global.

Bozhilova, N., Welham, A., Adams, D., Bissell, S., Bruining, H., Crawford, H., ... & Moss, J. (2023). Profiles of autism characteristics in thirteen genetic syndromes: a machine learning approach. Molecular Autism, 14(1), 1-14. Doi: 10.1186/s13229-022-00530-5

Buffenn, A. N. (2021). The impact of strabismus on psychosocial heath and quality of life: a systematic review. Survey of Ophthalmology, 66(6), 1051-1064. Doi: 10.1016/j.survophthal.2021.03.005

Bullivant, F. F., & Woods, S. (2020). Autism and Eating Disorders in Teens: A Guide for Parents and Professionals. Jessica Kingsley Publishers.

Burns, E. (2022). What is artificial intelligence (AI)? [online] SearchEnterpriseAI. Available at: https://www.techtarget.com/searchenterpriseai/definition/AI-Artificial-Intelligence.

Butchart, J., Harrison, R., Ritchie, J., Martí, F., McCarthy, C., Knight, S., & Scheinberg, A. (2021). Child and parent perceptions of acceptability and

therapeutic value of a socially assistive robot used during pediatric rehabilitation. Disability and rehabilitation, 43(2), 163-170. Doi: 10.1080/09638288.2019.1617357

Christopoulou, M., Drosos, K., & Petinou, K. (2022). Recent Advances of Telepractice for Autism Spectrum Disorders in Speech and Language Pathology. Neuropsychiatric Disease and Treatment, 2379-2389. Doi: 10.2147/NDT.S384300

Conner, C., Henry, A. R., Solari, E. J., & Zajic, M. C. (2022). Conducting oral and written language adapted tele-assessments with early elementary-age children with autism spectrum disorder. Autism & Developmental Language Impairments, 7, 23969415221133268. Doi: 10.1177/23969415221133268

Copeland, B.J. (2022). Artificial intelligence | Definition, Examples, and Applications. In: Encyclopedia Britannica. [online] Available at: https://www.britannica.com/technology/artificial-intelligence.

Copeland, J.N. (2018). What Is Autism Spectrum Disorder? [online] Psychiatry.org. Available at: https://www.psychiatry.org/patients-families/autism/what-is-autism-spectrum-disorder.

Demeter, Z., & Mező, K. (2023). A mesterséges intelligencia pedagógiai használatára vonatkozó hajlandóság vizsgálata gyógypedagógus hallgatók körében (Investigating the

Willingness to Use Artificial Intelligence in Education Among Students of Special Education Teachers). *Különleges Bánásmód - Interdiszciplináris folyóirat*, 9(2), 31–45. Doi: 10.18458/KB.2023.2.31

Domínguez-Lucio, S., Compañ-Gabucio, L. M., Torres-Collado, L., & de la Hera, M. G. (2022). Occupational therapy interventions using new technologies in children and adolescents with autism spectrum disorder: A scoping review. Journal of Autism and Developmental Disorders, 1-27. Doi: 10.1007/s10803-022-05431-3

Etemadi-Aleagha, A., & Akhgari, M. (2022). Psychotropic drug abuse in pregnancy and its impact on child neurodevelopment: A review. World Journal of Clinical Pediatrics, 11(1), 1. Doi: 10.5409%2Fwjcp.v11.i1.1

Fenning, R. M., & Butter, E. M. (2019). Promoting parent engagement in parent training for children with autism spectrum disorder. In C. R. Johnson, E. M. Butter, & L. Scahill (Eds.), Parent training for autism spectrum disorder: Improving the quality of life for children and their families (pp. 61–84). American Psychological Association. Doi: 10.1037/0000111-004

Fernández-Lechuga, A. I., Nuñez-Arcos, L. Y., Carrillo, P., García, L. I., Coria-Ávila, G. A., Toledo, R., ... & Manzo, J. (2021). Reduction of cutaneous von Frey thresholds in boys with autism

following a year of tactile and emotional stimulation. Revista mexicana de neurociencia, 22(3), 85-88. Doi: 10.24875/rmn.20000002

Fombonne, E., Coppola, L., Mastel, S., & O'Roak, B. J. (2021). Validation of autism diagnosis and clinical data in the SPARK cohort. Journal of Autism and Developmental Disorders, 1-16. Doi: 10.1007/s10803-021-05218-y

Gajić, A., Arsić, B., Maćešić-Petrović, D., Bašić, A., & Zdravković Parezanović, R. (2021). Teaching a child with autism spectrum disorders to tolerate delayed reinforcement. European Journal of Special Education Research, 7(2), 110-118. Doi: 10.46827/ejse.v7i2.3767

Ghazal, T. M., Munir, S., Abbas, S., Athar, A., Alrababah, H., & Khan, M. A. (2023). Early Detection of Autism in Children Using Transfer Learning. Intelligent Automation & Soft Computing, 36(1). Doi: 10.32604/iasc.2023.030125

Gutiérrez, C., Santoni, J. L. M., Merino, P., & de Liaño, P. G. (2022). Ophthalmologic Manifestations in Autism Spectrum Disorder. Turkish Journal of Ophthalmology/Turk Oftalmoloji Dergisi, 52(4). Doi: 10.4274/tjo.galenos.2021.46588

Hassani, F., Shahrbanian, S., Shahidi, S. H., & Sheikh, M. (2022). Playing games can improve physical performance in children with autism. International Journal of Develop-

mental Disabilities, 68(2), 219-226. Doi: 10.1080/20473869.2020.1752995

Hasyim, M., Saleh, F., Yusuf, R., & Abbas, A. (2021). Artificial Intelligence: Machine Translation Accuracy in Translating French-Indonesian Culinary Texts. Available at SSRN 3816594. Doi: 10.2139/ssrn.3816594

Höfer, J., Hoffmann, F., Kamp-Becker, I., Küpper, C., Poustka, L., Roepke, S., ... & Bachmann, C. J. (2019). Complementary and alternative medicine use in adults with autism spectrum disorder in Germany: results from a multi-center survey. BMC psychiatry, 19, 1-8. Doi: 10.1186/s12888-019-2043-5

Hurwitz, S., Garman-McClaine, B., & Carlock, K. (2022). Special education for students with autism during the COVID-19 pandemic:"Each day brings new challenges". Autism, 26(4), 889-899. Doi: 10.1177/13623613211035935

IBM (2022). What is Artificial Intelligence (AI)? | IBM. [online] www.ibm.com. Available at: https://www.ibm.com/topics/artificial-intelligence.

IEEE Spectrum (2022). Nao - ROBOTS: Your Guide to the World of Robotics. [online] robots.ieee.org. Available at: https://robots.ieee.org/robots/nao/#:~:text=Founded%20in%202005%2C%20Aldebaran%20has

Josilowski, C. S., & Morris, W. A. (2019). A qualitative exploration of teachers'

experiences with students with autism spectrum disorder transitioning and adjusting to inclusion: Impacts of the home and school collaboration. The Qualitative Report, 24(6), 1275-1286. Retrieved from https://www.proquest.com/scholarly-journals/qualitative-exploration-teachers-experiences-with/docview/2243315280/se-2

Kalantarian H, Jedoui K, Dunlap K, Schwartz J, Washington P, Husic A, Tariq Q, Ning M, Kline A, Wall DP. (2020) The Performance of Emotion Classifiers for Children With Parent-Reported Autism:Quantitative Feasibility Study JMIR Ment Health;7(4):e13174. Doi: 10.2196/13174

Kehinde, O. A., Lindly, O. J., Ntombela, B., & Hermann, C. (2022). Brief Report: Gender-Based Stereotypical Roles of Parents Caring for Autistic Children in Nigeria and South Africa. Journal of Autism and Developmental Disorders, 1-12. Doi: 10.1007/s10803-022-05582-3

Kumar, A.V.. & Kalpana M. (2020). Fuzzy Expert System in Agriculture Domain. Doi: 10.4018/978-1-5225-9175-7.ch001

Kundu, R., Panwar, D., & Singh, V. (2022). Autism Spectrum Disorder Study in a Clinical Sample Using Autism Spectrum Quotient (AQ)-10 Tools. In Proceedings of Third International Conference on Sustainable Computing: SUSCOM

2021 (pp. 249-255). Springer Singapore. Doi: 10.1007/978-981-16-4538-9_25

Laurie, C. (2022). Sensory and Motor Strategies: Practical Ways to Help Autistic Children and Young People Learn and Achieve. Jessica Kingsley Publishers.

Lung, F. W., Chiang, T. L., Lin, S. J., Lee, M. C., & Shu, B. C. (2018). Advanced maternal age and maternal education disparity in children with autism spectrum disorder. Maternal and child health journal, 22, 941-949. Doi: 10.1007/s10995-018-2470-9

Luxembourg National Research Fund (2021). From lab to startup: LuxAI and QTrobot – a robot to help children with autism. [online] FNR – Luxembourg National Research Fund. Available at: https://www.fnr.lu/research-with-impact-fnr-highlight/from-lab-to-startup-luxai/.

Malinverni L., Mora-Guiard J., Padillo V., Valero L., Hervás A., Pares N. (2017). An inclusive design approach for developing video games for children with Autism Spectrum Disorder. Comput. Hum. Behav. 71, 535–549. Doi: 10.1016/j.chb.2016.01.018

Martín-Gutiérrez, A., Leal-Vega, L., Alcoceba-Herrero, I., Herrera-Medina, J., Arenillas-Lara, J. F., & Coco-Martín, M. B. (2022). Educational Opportunities of Virtual Game-Based Initiatives for Students With Disabilities. In Handbook of Research on the

Influence and Effectiveness of Gamification in Education (pp. 433-454). IGI Global.

Masabanda, C., Oña, A., Loza, D., Cortez, B., & Alban, A. (2023, January). Design and Construction of an Anthropomorphic Robotic Head with Gestural Projection. In Applied Technologies: 4th International Conference, ICAT 2022, Quito, Ecuador, November 23–25, 2022, Revised Selected Papers, Part II (pp. 340-354). Cham: Springer Nature Switzerland. Doi: 10.1007/978-3-031-24971-6_25

McCrossin, R. (2022). Finding the true number of females with autistic spectrum disorder by estimating the biases in initial recognition and clinical diagnosis. Children, 9(2), 272. Doi: 10.3390/children9020272

Mező, K., & Szabóné Burik, E (2021): A robotokkal történő oktatás, az élménypedagógia aspektusából (Using Robots in the Teaching Process from an Experimental Educational Aspect. *Mesterséges intelligencia – interdiszciplináris folyóirat*, 3. (2.) 19-32. Doi: 10.35406/MI.2021.2.19

Mitsea, E., Lytra, N., Akrivopoulou, A., & Drigas, A. (2020). Metacognition, Mindfulness and Robots for Autism Inclusion. Int. J. Recent Contributions Eng. Sci. IT, 8(2), 4-20. Doi: 10.3991/ijes.v8i2.14213

Molinaro, A., Micheletti, S., Rossi, A., Gitti, F., Galli, J., Merabet, L. B., & Fazzi, E. M. (2020). Autistic-like features in visually impaired children: A review of literature and directions for future research. Brain sciences, 10(8), 507. Doi: 10.3390/brainsci10080507

Montes, G., & Montes, S. A. (2021). Parental involvement of parents of children with ADHD: a first population study. Journal of attention disorders, 25(10), 1497-1505. Doi: 10.1177/1087054720911099

Nair, A. S., Priya, R. S., Rajagopal, P., Pradeepa, C., Senthil, R., Dhanalakshmi, S., ... & Zuo,

X. (2022). A case study on the effect of light and colors in the built environment on autistic children's behavior. Frontiers in Psychiatry, 13, 2733. Doi: 10.3389/fpsyt.2022.1042641

Nasr, A., & Calabrese, M. (2020). Comments Of The Public Interest Spectrum Coalition Before the Federal Communications Commission In the Matter of Unlicensed Use of the 6 GHz Band Expanding Flexible Use in Mid-Band Spectrum Between 3.7 and 24 GHz (ET Docket No. 18-295, GN Docket No. 17-183). URL: https://alair.ala.org/handle/11213/16033

Nathans, L., Brown, A., Harris, M., & Jacobson, A. (2022). Preservice teacher learning about parent involvement at four universities. Educational Studies, 48(4), 529-548. Doi: 10.1080/03055698.2020.1793297

Newman, N., Northcutt, A., Farmer, A., & Black, B. (2019). Epstein's model of

parental involvement: Parent perceptions in urban schools. Language Teaching and Educational Research, 2(2), 81-100. Doi: 10.35207/later.559732

Nielsen, A. (2021). My Conversation with Mitja Mavsar, Co-Founder of Speech Blubs. [online] Big Abilities. Available at: https://bigabilities.com/2021/04/20/my-conversation-with-mitja-mavsar-co-founder-of-speech-blubs/

Oktay, Ö. S., & Yüzer, T. V. (2023). Immersive Learning, Immersive Scenarios, and Immersive Technologies. In Shaping the Future of Online Learning: Education in the Metaverse (pp. 83-111). IGI Global.

Olmedo-Vizueta, D., Hernandez-Ambato, J., Ávila-Pesantez, D., Bilotta, E., & Pantano, P. (2017). VALE-Emotions: Teaching mobile application for individuals with Autism Spectrum Disorders. Enfoque UTE, 8, 358-373. Doi: 10.29019/enfoqueute.v8n1.145

Papanastasiou, G., Drigas, A., Skianis, C., Lytras, M., & Papanastasiou, E. (2019). Virtual and augmented reality effects on K-12, higher and tertiary education students' twenty-first century skills. Virtual Reality, 23, 425-436. doi: 10.1007/s10055-018-0363-2

Penev, Y., Dunlap, K., Husic, A., Hou, C., Washington, P., Leblanc, E., ... & Wall, D. P. (2021). A mobile game platform for improving social communication in children with autism: a feasibility study. Applied clinical informatics, 12(05), 1030-1040. Doi: 10.1055/s-0041-1736626

Porayska-Pomsta, K., Alcorn, A. M., Avramides, K., Beale, S., Bernardini, S., Foster, M. E., ... & Smith, T. J. (2018). Blending human and artificial intelligence to support autistic children's social communication skills. ACM Transactions on Computer-Human Interaction (TOCHI), 25(6), 1-35. Doi: 10.1145/3271484

Puig-Lagunes, Á. A., Rocha, L., Morgado-Valle, C., Beltran-Parrazal, L., & Lopez-Meraz, M. L. (2021). Brain and plasma amino acid concentration in infant rats prenatally exposed to valproic acid. Anais da Academia Brasileira de Ciências, 93. Doi: 10.1590/0001-3765202120190861

Raja, M., & Priya, G. G. (2021). Conceptual Origins, Technological Advancements, and Impacts of Using Virtual Reality Technology in Education. Webology, 18(2). Doi: 10.14704/WEB/V18I2/WEB18311

Richardson, K., Coeckelbergh, M., Wakunuma, K., Billing, E., Ziemke, T., Gomez, P., Vanderborgt, B., & Belpaeme, T. (2018). Robot enhanced therapy for children with autism (DREAM): A social model of autism. IEEE Technology and Society Magazine, 37, 30–39. Doi: 10.1109/MTS.2018.2795096

Roll, I., & Wylie, R. (2016). Evolution and revolution in artificial intelligence in education. International Journal of

Artificial Intelligence in Education, 26, 582-599. Doi: 10.1007/s40593-016-0110-3

Sacrey, L. A. R., Zwaigenbaum, L., Bryson, S., Brian, J., & Smith, I. M. (2018). The reach-to-grasp movement in infants later diagnosed with autism spectrum disorder: a high-risk sibling cohort study. Journal of eurodevelopmental disorders, 10, 1-11. Doi: 10.1186/s11689-018-9259-4

Salac, L. M., & Florida, J. U. (2022). Epstein Model of Parental Involve-ment and Academic Performance of Learners. European Online Journal of Natural and Social Sciences, 11(2), pp-379. Available at: https://european-science.com/eojnss/article/view/6398

Saniputri, R. M., & Tati, T. (2021, March). Identifying e-books in promoting literacy for children in general and children with disabilities. In IOP Conference Series: Materials Science and Engineering (Vol. 1098, No. 2, p. 022114). IOP Publishing. Doi: 10.1088/1757-899X/1098/2/022114

Sassu, K. A., & Volkmar, F. R. (2023). Autism and intersectionality: Considerations for school-based practitioners. Psychology in the Schools, 60(2), 408-418. Doi: 10.1002/pits.22757

Shanok, N. A., Jones, N. A., & Lucas, N. N. (2019). The nature of facial emotion recognition impairments in children on the autism spectrum. Child Psychiatry & Human

Development, 50, 661-667. Doi: 10.1007/s10578-019-00870-z

Sin, B. S. Y., & Cheng, J. L. A. (2022). Psychoeducation and Family Intervention by Parents of Children with Attention Deficit Hyperactive Disorder: A Comprehensive Review. Journal of Cognitive Sciences and Human Development, 8(2), 115-138. Doi: 10.33736/jcshd.4745.2022

So, W. C., & Song, X. K. (2022). Whose Gestures are More Predictive of Expressive Language Abilities among Chinese-Speaking Children with Autism? A Comparison of Caregivers' and Children's Gestures. Journal of Autism and Developmental Disorders, 1-11. Doi: 10.1007/s10803-022-05658-0

St. George, B. (2023). What is the Turing Test? [online] SearchEnterpriseAI. Available at: https://www.techtarget.com/searchen terpriseai/definition/Turing-test#:~:text=The%20Turing%20Test %20is%20a.

Sulaiman, A., Rahman, H., Ali, N., Shaikh, A., Akram, M., & Lim, W. H. (2022). An augmented reality PQRST based method to improve self-learning skills for preschool autistic children. Evolving Systems, 1-14. Doi: 10.1007/s12530-022-09472-y

Tajik-Parvinchi, D. J., Farmus, L., Cribbie, R., Albaum, C., & Weiss, J. A. (2020). Clinical and parental predictors of emotion regulation following cognitive behaviour therapy in

children with autism. Autism, 24(4), 851-866. Doi: 10.1177/1362361320909178

Terzopoulos, G., & Satratzemi, M. (2019). Voice assistants and artificial intelligence in education. In Proceedings of the 9th Balkan Conference on Informatics (pp. 1-6). Doi: 10.1145/3351556.3351588

The National Autistic Society (2023). Loneliness. [online] Available at:https://www.autism.org.uk/advice-and-guidance/topics/loneliness.

UNESCO. (2019). Beijing consensus on artificial intelligence and education. URL: https://unesdoc.unesco.org/ark:/482 23/pf0000368303

Van Pelt, B.J., Idris, S., Jagersma, G. et al. (2020) The ACCEPT-study: design of an RCT with an active treatment control condition to study the effectiveness of the Dutch version of PEERS® for adolescents with autism spectrum disorder. BMC Psychiatry 20, 274 (2020). Doi: 10.1186/s12888-020-02650-9

Wallace, D., Herbert, J., McGhee Hassrick, E., & Kabourek, S. E. (2022). The frequency and clustering of autism-related behaviors during encounters between the police and theautism community. Policing: An International Journal, 45(3), 403-420. Doi: 10.1108/PIJPSM-10-2021-0141

World Health Organization (2019). ASD fact sheet newsroom 2019. Available at https://www.who. int/news-room/fact-sheets/detail/autism-spectrum-disorders

Yan, T., Hou, Y., & Deng, M. (2022). Direct, indirect, and buffering effect of social support on parental involve-ment among Chinese parents of children with autism spectrum disorders. Journal of autism and developmental disorders, 52(7), 2911-2923. https://link.springer.com/article/10.1 007/s10803-021-05170-x

Yunitasari, S. E., Budiarti, T. R., Amperawati, L., Rubiah, S. A., & Mongawara, L. (2023). Effective Communication Between Teachers and Parents in Handling Children with Autistic Disorders (Case Study of Handling Autistic Children at Al Azhar 13 Rawamangun Islamic Kindergarten). Cendikia: Media Jurnal Ilmiah Pendidikan, 13(3), 468-475. Doi: 10.35335/cendikia.v13i3.3480

Zoccante, L., Marconi, M., Ciceri, M. L., Gagliardoni, S., Gozzi, L. A., Sabaini, S., ... & Colizzi, M. (2021). Effectiveness of Equine-Assisted Activities and Therapies for improving adaptive behavior and motor function in autism spectrum disorder. Journal of clinical medicine, 10(8), 1726. Doi: 10.3390/jcm10081726