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Review

A Review of Artificial Intelligence Interventions for Students with Autism Spectrum Disorder

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Abstract: Autism Spectrum Disorder (ASD) is a complex neurodevelopmental disorder with challenges in social communication and interaction as well as stereotyped and repetitive behaviors, interests, and activities. Students with ASD often prefer to engage with technology because of its predictability and limited social demands. In recent years, the application of Artificial Intelligence (AI) in education has gained considerable attention. The present study aims to reveal the research trends regarding the design and development of AI teaching interventions in special education, especially for students with ASD, who often face significant challenges in academic, cognitive, and social domains. A search of the research literature from 2018 to 2024 in three electronic databases identified 1762 records. After applying eligibility criteria, 13 empirical studies were finally included, which were coded and analyzed in detail. The results demonstrated the potential of AI technology in supporting students with ASD in their learning, while also identifying gaps that warrant further investigation. This article concludes with future considerations for how AI could support students with ASD, emphasizing there are still gaps in the research, particularly in terms of long-term effectiveness and the standardization of methodologies for AI-based educational practices.

Keywords: artificial intelligence (AI); Autism Spectrum Disorder (ASD); education; intervention

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1. Introduction

Assistive technology, encompassing all systems and services related to the use of assistive products and the assisted performance of services, has evolved significantly to support teaching and learning processes, enhancing equal participation and progress for all students in several educational settings [1]. Artificial intelligence (AI) was introduced by John McCarthy in 1956 and refers to the capacity of computer systems to perform tasks that are typically associated with human intelligence, such as learning and reasoning, through machine learning systems, digital tools, and algorithmic applications [2]. By replicating and improving upon human actions in various fields, such as education, i.e., analysis, synthesis, adaptation, and learning, efficiency can be enhanced, innovation can be fostered, and complex problems can be solved [3–5].

The integration of AI in education is becoming increasingly widespread, with suggestions for how it can enhance educational experiences, increase learning outcomes, support assessment, and provide teaching guidance [6]. As recent research reveals, the possible benefits of AI indicate how this technology contributes to the development of skills that provide stimulation and support to all students. Specifically, AI-supported interventions may provide guidance in line with personalized learning or supports to each student based on their learning profile, interests, and preferences [7]. Additionally, they may reduce teachers' workloads by replacing traditional processes with automated assessments of students' knowledge. Furthermore, algorithmic systems are widely spread in education through various social media platforms, such as social networks, and mobile applications. Examples of these technology include intelligent tutoring systems, adaptive learning platforms, and robotics, all designed to offer personalized tutoring support for students in specific tasks [5].

1.1. Related Work

Research on the application of AI systems in special education has increased significantly [4,8]. When focusing on personalized learning experiences tailored to students' needs and their individualized profiles [8], AI may provide a variety of differentiated teaching and learning practices in line with the principles of a universal design [9–11]. According to Vincent-Lancrin and Van der Vlies [12], AI systems such as virtual and augmented reality robotics support students with special educational needs, by displaying 3D learning environments, where students are engaged. Immersive environments help students experience authentic and representative situations, where they can acquire new skills through even abstract or invisible content [13], and enhance their academic learning outcomes [8]. A very recent study by Hopcan et al. [14] revealed that the use of AI varies depending on the purpose of the application, with the most common applications being personalizing learning and efforts to reduce the challenges faced by students with special educational needs.

Individuals with Autism Spectrum Disorder (ASD) are a group of students expected to benefit from AI-supported interventions. Digital technology seems to respond to the needs of individuals with ASD and improves their learning outcomes [15]. AI may respond to these students' characteristics and unique needs. In this regard, the fifth edition of The Diagnostic and Statistical Manual of Mental Disorders (DSM-5) describes ASD as a neurodevelopmental disorder with deficits in social communication and social interaction, as well as stereotyped, repetitive behaviors and activities [16]. Individuals with ASD may face challenges in perceiving social cues, interpreting emotions, and understanding social contexts [17], and they may exhibit a range of developmental levels, depending on their strengths and deficits in the targeted domains, namely, academic, social-communicative, and practical [18]. AI technology facilitates the development of innovative approaches to education, with the potential to play a pivotal role in providing accessible and personalized learning environments for all students. Nevertheless, a lack of research on the delivery of support for students with ASD and their teachers by applying AI technology interventions was identified.

1.2. The Present Study

The purpose of the current study was to review the contribution of AI to the teaching and learning of students with ASD. The impact of AI affects different aspects of special education, namely, its academic, social, and communicative content as well as its affective and practical domains. The following research questions were considered:

RQ1: *What interventions supporting students with ASD through AI have been studied by researchers?*

RQ2: *Which educational objectives have been addressed?*

RQ3: *What are the advantages of AI in educational settings, as indicated in the included studies?*

The findings of this research may be beneficial to teachers, special educators, and other professionals engaged in the education of students with ASD.

2. Methodology

This study aimed to identify key research on the use of AI in the education of students with ASD and to analyze the findings from these studies. A total of 13 studies from 2018 to 2024 were examined; we did not include any from prior to 2018 as the rapid development of technology necessitates monitoring current research data.

2.1. Eligibility Criteria and Study Selection

Our search term was a Boolean combination of keywords that relate to the terms of interest in our review: artificial intelligence (“Artificial Intelligence” OR “Machine Learning” OR “Deep Learning”), Autism Spectrum Disorder (ASD OR autism OR “Autism Spectrum Disorder”), and education (teaching OR learning OR intervention OR instruction) were used in the three electronic academic databases: Scopus, ScienceDirect, and ERIC. The initial search yielded 1746 records, to which we added 16 references from handsearching. Articles meeting the following five inclusion criteria were further reviewed: (1) empirical studies from peer-reviewed journals or conference proceedings, (2) participants were primary, secondary, or postsecondary students with ASD, (3) research questions involved the use of AI in educational settings, and (4) articles were published after 2018. Citations were downloaded and duplicates were removed using Mendeley software (Mendeley Desktop v1.19.5). Additional studies were identified by reference-mining eligible studies. Titles and abstracts were reviewed for relevance by two researchers, with the articles limited to 121 in that way. The full-text articles were obtained and reviewed by three reviewers according to the inclusion criteria. Finally, a total of 13 studies remained for this review. During the textual screening of the studies, papers that did not present an empirical study or did not implement an intervention, such as assessments or theoretical studies, were also excluded. A consensus between the authors was achieved on the final number of records to review. Finally, based on the rigorous selection process, a total of 13 studies were accepted.

2.2. Data Analysis

Microsoft Office Excel was used to extract and code the data of the selected studies which were grouped into three main categories: (a) source description, (b) substantive issues, and (c) research methods and procedures. The source description included the publication date, author group, journal, and country of research. Substantive issues included the intervention implementer, intervention settings, participants’ age and characteristics, as well as AI applications. The research methods and procedures included the type of research strategy, the intervention objectives, and the outcomes. Two of this article’s authors independently coded the studies by their characteristics and classified them according to the predefined categories and sub-categories. This information was re-examined by the third and fourth authors to reach an agreement. Any discrepancies between the coders were resolved through discussion.

The following table presents and synthesizes the analysis and coding of the data, providing a summary of the key characteristics and main findings (Table 1).

Table 1. Synthesis of the reviewed studies.

Citation	Participants (ASD)/Age	Setting/Instructors	Technology and AI	Intervention Practices/ Content/Research Design	Learning Outcomes
Chung [19]	*n* = 14 M/ 9–11	School/ Researchers	SR and AI	SI—Robotic game-based Social skills—Social interaction—SD GS—Quan.	Positive (motivation and engagement, eye contact frequency and duration, verbal initiation)
Daniels et al. (2018) [20]	*n* = 23 (19 M, 4 F)/ Mean age 11.65	Not specified/ Researchers	SG and AI	EI Emotions—Emotion recognition—ED GS—Quan.	Positive (comfort while wearing glasses, emotion labeling accuracy, confusion between emotions)
Daniels et al. (2018) [21]	*n* = 14 (11 M, 3 F)/ Mean age 9.57	Home/ Parents	SG and AI	IT—Game-based intervention Social skills—Social interaction—SD GS—Quan. and Qual.	Positive (eye contact and social acuity)
Kalantarian et al. [22]	*n* = 8/ 4–12	Home/ Researchers—Parents	Android app	IT—Game-based intervention Emotions—Face tracking for assessment—Emotion recognition—CD and ED GS—Quan.	Positive (real-time assessment, engagement, and emotional state)
Sahin et al. [23]	*n* = 1 (M)/ Mean age 13.11	School/ Parents—Teachers	SG and AI	SI—AR-assisted and game-based Social skills—Social communication, cognition, motivation—SD CS and SSS—Quan.	Positive (social communication)
Scassellati et al. [24]	*n* = 12 (5 F, 7 M)/ 6–12	Home/ Parents—Caregivers	SR and AI	Home-based and robotic game-based Social skills—Social communication—SD Group treatment—Quan.	Positive (social communication, motivation, social cognition, reduction in restricted interests and repetitive behaviors)
Vahabzadeh et al. [25]	*n* = 4 (M)/ Mean age 7.5	School/ Teachers	SG and AI	SI Social skills/Social communication/SD SSS—Quan.	Positive (reduction in irritability, hyperactivity, and social withdrawal)
Zhang et al. [26]	*n* = 20 (18 M, 2 F)/ 5–9	School/ Researchers	SR and AI	SI Social skills/Complex social rules/SD GS—Quan.	Positive

Table 1. *Cont.*

Citation	Participants (ASD)/Age	Setting/Instructors	Technology and AI	Intervention Practices/ Content/Research Design	Learning Outcomes
Baldassarri et al. [27]	*n* = 12 (8 M, 4 F)/ 10–18	Special education center/ Researchers—Teachers—Parents	VG—tangible tabletops and AI	SI and IT Emotions and attention skills—Emotional recognition, attention, and engagement—ED and CD GS—Quan. and Qual.	Positive (increased interest, motivation, and attention, accurate emotion labeling)
Moon et al. [28]	*n* = 4 (M)/ 13–19	Not specified/ Researchers, postgraduate students	VR and AI	IB—Problem solving STEM/Automatic assessment cognitive and emotional during VR training/CD Randomized controlled trial—Quan.	Positive (cognitive and emotional flexibility)
Wan et al. [29]	*n* = 10/ 5–10	Hospital/ Researchers	Human-computer- robot interaction system and AI	SI Emotions—Recognize and express emotions—ED Not clear—Quan.	Positive (effective recognition and expression of basic emotions, increased interest)
Tuna [30]	*n* = 2 (1 M, 1 F)/ 6–8	School/ Teachers	SR and AI	Least to most prompting—Robotic game-based Emotional development and communication—Enhance symbolic play skills—SD SSS—Quan.	Positive (improved symbolic play skills)
Li et al. [31]	*n* = 18 (14 M, 4 F)/ 5–8	Local rehabilitation center/ Researchers—Parents—Teachers	AR and AI	SI—Game-based instruction Social skills—Facial expression recognition and social communication—SD GS—Quan.	Positive (increased engagement, attention, and participation, improved facial expression recognition)

Note: M (Male), F (f\Female), SR (Social Robot), SG (Smart Glasses), VG (Video Game), AR (Augmented Reality), VR (Virtual Reality), AI (Artificial Intelligence), SI (Systematic Instruction), EI (Explicit Instruction), IB (Inquiry-based Instruction), IT (Interactive and Technology-Assisted Instruction), SD (Social Domain), ED (Emotional Domain), CD (Cognitive Domain), GS (Group Study), SSS (Single-Subject Study), CS (Case Study), Quan. (Quantitative), Qual. (Qualitative).

3. Results and Discussion

The results and discussion are organized based on the characteristics, the participants and settings, and the research questions addressed by the empirical studies included in this review.

3.1. Study Characteristics

According to the criteria of this review, the search for articles covered the period from 2018 to 2024. The annual distribution of the publications shows that most of the studies (seven of them) were published in 2018, one study was published in 2019, two in 2020, two in 2022, and finally, one publication in 2023 (see Table 1). The studies were published in reputable scientific journals from fields such as health sciences [19,21,22], and education [23], and the majority of them were published in journals related to information technology [20,24,26,29–31]. Four different countries were identified for these studies: seven studies were conducted in the United States of America [20–25,28], four in China [19,26,29,31], one in Spain [27], and one in Turkey [30].

3.2. Participants and Settings

The total number of participants in the studies was 192, with the number of participants per study ranging from 1 to 43. The age of the participants was between 4 and 19 years. Of the total sample of 192 participants, 148 were diagnosed with ASD, while 44 were identified as typically developing and were used as control groups. Regard the ethnic backgrounds of the participants, they were reported to be Caucasian, Asian, Hawaiian, Chinese, or Hispanic origin [20,23,24,26]. However, most studies did not include data on the ethnicity of the participants. As for the gender of the participants, the majority of the studies indicated that the participants were male. Most of the studies provided information regarding the location where the interventions were implemented. However, some studies indicated this information indirectly through the involvement of participants and instructors. More specifically, most of them were conducted in educational settings, such as schools or special education centers [19,23,25,26,30], while the rest of the interventions were conducted in various settings, such as a hospital [29], schools [23,25,26,30], or at home [21,22,24]. The instructors who implemented each intervention were the researchers of the respective studies, parents, teachers, caregivers, and the school pedagogical team (see Table 1). In several studies, the researchers collaborated with parents or teachers [21–25,27,30,31].

3.3. RQ1: What Interventions for Supporting Students with ASD Through AI Have Been Studied by Researchers?

3.3.1. AI Technology

The deployment of technology has the potential to reinforce the teaching process and facilitate the optimal development of students with ASD [32]. The identified educational interventions with AI were found to utilize digital technology to implement their methodologies. Furthermore, the analysis demonstrated that the basic utilization of AI is based on the recording, processing, and analysis of video data, which is secured by digital technology devices such as cameras in order to monitor trainees.

In particular, four educational interventions using social robots were identified [19,24,26,30]. Chung's study [19] integrated a humanoid robot to assist instructors in structured social activities involving stories, songs, and dance. Scassellati et al. [24] used a robot-assisted system with a robot, touchscreen/computer, and two RGB cameras to monitor and record interactions between a student and their caregiver. Tuna [30] used a humanoid robot to enhance symbolic play and learning participation in students with ASD, and, finally, Zhang et al. [26] used the humanoid robot NAO to train students in social interactions and complex social rules through games.

In addition, five studies used digital applications on mobile phones, tablets, and computers [22,27–29,31]. Baldassarri et al. [27] used serious games on mobile devices to improve communication and attention in students with ASD. Kalantarian et al. [22] used the Android app Guess What to monitor and assess students' behavior and emotional state, requiring students to imitate faces and develop creativity. Li et al. [31] implemented the augmented reality game FaceMe for social–emotional education, teaching students basic facial expressions through social scenarios to improve emotional and communication skills. Moon et al. [28] developed an automated assessment using natural language processing to record and assess cognitive and emotional states in individuals with ASD using speech data. Finally, Wan et al. [29] studied the Facial Emotion Cognition and Training System (FECTS), a human–computer interaction system, to train students with ASD in emotion recognition.

Lastly, all four studies utilized AI-powered smart glasses, supported by augmented reality. Daniels et al. [20,21] investigated interventions using smart glasses for emotion identification via an Android app or computer interface. In addition, Sahin et al. [23] and Vahabzadeh et al. [25] utilized Google Glass Explorer Edition to enhance eye contact, providing real-time visual and auditory feedback based on eye contact maintenance during interactions with an instructor.

3.3.2. Intervention Practices

The majority of the interventions were based on games [19,21–24,30,31]. The implementation of game-based interventions offers several advantages [33]. For example, the use of serious games may reduce anxiety and stress levels, as well as enhance emotion recognition in children with neurodevelopmental disorders [34]. As evidenced in our review, the implementation of clear rules, repetition, and immediate feedback within the gaming environment proved to be particularly beneficial for students with ASD, who tend to thrive on routine and consistency. Moreover, several studies incorporated digital games that featured interactive and visual elements, effectively capturing the attention of students with ASD [33,34].

Regarding the instructional practices, the majority of the studies implemented systematic instruction, which involves structured, step-by-step teaching [19,25–27,29]. Specifically, these studies used systematic instruction to teach skills, such as emotion recognition and expression, in a controlled and repetitive manner, ensuring that each skill was gained before moving on to the next. The researchers used robot-assisted approaches or augmented reality to provide consistent and clear instructions, providing evidence aligned with previous studies [31] regarding the effectiveness of systematic instruction, as an effective method of teaching students with ASD. Our review also revealed that interactive instruction is one of the methods chosen by researchers [21,22,27], providing effective interactive and engaging learning experiences utilizing robotics or augmented reality. In regard to inquiry learning, it was found that students demonstrated different patterns of learning situations in identical-design problem-solving tasks, highlighting the value of effective, automatic, AI-powered evaluation [28]. In that way, students could experience individualized learning, fostering both their academic and social development. Furthermore, one of the studies employed prompting as a teaching technique to assist with symbolic play among students with ASD [30], a methodology which is effectively applied in special education [32,35].

The reviewed studies demonstrate a diverse range of teaching methods and techniques with the integration of various types of AI, used in order to design and develop suitable learning environments focusing on social, emotional, and cognitive content. The carefully designed learning experiences aimed to respond to the specific profiles and unique needs of students with ASD.

3.4. RQ2: Which Educational Objectives Have Been Addressed?

3.4.1. Content

The content of the reviewed studies targeted social skills, emotional recognition, and social communication of students with ASD. The studies included a variety of digital technologies to achieve their objectives, focusing on enhancing the ability of students with ASD to recognize and express emotions, understand social cues, and engage in social interactions.

Five studies focused on training the students with ASD to recognize and interpret facial expressions, which is crucial for understanding emotions [20,22,27,29,31]. The targeted emotions were happiness, sadness, anger, fear, disgust, surprise, neutral, and contempt. The targeted emotions ranged from basic to complex, aimed at helping students enhance their emotional recognition and social interaction skills. In addition, a significant focus of these studies was social skills improvement, such as the social motivation, social cognition, and eye contact of students with ASD [19,21,24–26,30,31]. Techniques regarding eye contact were also a common focus, as maintaining eye contact is a fundamental aspect of non-verbal communication and social connection [19,21]. Furthermore, several studies emphasize teaching students with ASD about social rules and perspective-taking, which are vital for understanding social dynamics and developing empathy [21,26].

Beyond social skills, two studies examine the impact of interventions on cognitive functions and behavioral regulation [22,27]. For example, the "Emotional Trainer" [27] and VR-based games could improve attention and strengthen memory and cognitive planning by engaging students in tasks that require emotional and behavioral control. Improved learning outcomes contribute to better adaptive functioning and overall development of students with ASD.

Only one of the reviewed studies diverged from the primary focus on social and emotional learning, addressing content related to Science, Technology, Engineering, and Mathematics (STEM) [28]. This indicates a predominant emphasis on fostering social and emotional development in educational interventions for students with ASD, with academic subjects like STEM receiving less attention in the current body of research.

3.4.2. Educational Domain

In terms of educational domains, eight out of the thirteen studies focused on the social domain, two on the emotional domain, one on the cognitive domain and a child's development, and the remaining two on both the emotional and cognitive domains. When examining the studies, it was found that social robots were used in interventions aimed at improving the social skills of students with ASD [19,24,26,28]. Essentially, the interventions use social robots to enhance social interaction, eye contact, verbal initiation of communication, symbolic play, learning of social rules, etc. To improve the social skills of students with ASD, the researchers used smart glasses [21,23,25]. Specifically, students were trained to recognize facial expressions and maintain eye contact in order to improve their social interactions. Finally, the study of Li et al. [31] used augmented reality with AI to help students recognize facial expressions and to improve their social communication [31].

In four studies, the researchers focused on emotion-based interventions. The specific objective was either to train students with ASD recognize and express emotions or to assess their emotions during training conditions. To this end, a variety of digital tools were employed, including smart glasses [20,21], computers [29], video games, a touch table [27], and an Android mobile app [20], which were integrated with AI.

Three studies focused on improving the cognitive skills of students with ASD [22,27,28].

3.4.3. Experimental—Research Design

To meet the stated objectives, an analysis of the methodologies presented in the existing literature revealed that a quantitative approach was the predominant method, whereas only a few studies included qualitative analyses [21,27].

Studies examining AI-based interventions for students with ASD used a range of experimental and research designs to assess their effectiveness. Some studies, such as those conducted by Daniels et al. [20,21], Kalantarian et al. [22], and Scassellati et al. [24], conducted group research that did not include control groups. Conversely, other studies, including those by Zhang et al. [26], Baldassarri et al. [27], and Li et al. [31], implemented group research with control groups consisting of typically developing students and other students with ASD. This difference in study design highlights the different approaches researchers are using to understand and evaluate AI interventions for ASD.

Tuna's [30] study used a single-subject research design, which is particularly useful when interventions are tailored to individual needs or when the number of participants is limited. Sahin et al. [23] also used components of a single-subject experimental design in their case study of a 13-year-old participant, focusing on the effects of the intervention on one individual.

The study of Vahabzadeh et al. [25] combined various elements to maximize the strengths of different research designs, and Wan et al. [29] did not specify the research design they applied.

3.5. RQ3: What Are the Advantages of AI in Educational Settings, Indicated in the Included Studies?

3.5.1. Outcomes

As far as learning outcomes are concerned, all the studies resulted in positive learning outcomes (see Table 1). For example, Chung's study [19] used a humanoid robot and increased eye contact (both frequency and duration), improved motivation and engagement, as well as enhanced the initial verbal communication among students with ASD. Daniels et al. [20] used the Google Glass wearable technology system to identify facial emotions. The students accepted the device and reported that it was both comfortable and not unduly stimulating. Additionally, a notable increase in the accuracy of facial emotion labeling was recorded [20]. The utilization of Superpower Glass smart glasses and the Android emotion recognition application had a beneficial effect on students' eye contact and social acuity. In their second study [21], the researchers reported improvements in social skills, facial emotion recognition, and eye contact, as observed and recorded by the parents and caregivers of students with ASD. Kalantarian et al. [22] used the Guess What application for Android, which was considered an appropriate game-based platform for collecting data to assess and track the emotional states and engagement of students with ASD during their educational experience. Regarding the implementation of educational interventions incorporating the Empowered Brain Face2Face system by Sahin et al. [23], the researchers found improvements in social communication, interaction, social cognition, as well as social motivation and interests among the participants. Moreover, a reduction in stereotypical behavior, irritability, hyperactivity, and social withdrawal was noted in the study of Vahabzadeh et al. [25]. The study by Scassellati et al. [24] demonstrated observable improvements in social communication, social motivation, and social cognition, along with a reduction in restricted interests and repetitive behaviors. Additionally, improvements in students' attention were noted even in the absence of the robot. In the study by Zhang et al. [26], students with ASD were observed to face challenges in learning the complex social rules introduced by the robot. However, the use of social robots proved to be an effective method for facilitating social learning.

Baldassarri et al. [27] observed that students with ASD exhibited a notable interest and motivation to engage in play activities, along with sustained attention. They demonstrated effective completion of required tasks in a timely manner. Students displayed an enhanced capacity to imitate emotions, accurately reproducing emotions such as happiness, fear, anger, and surprise, while finding emotions like disgust, sadness, and neutrality more challenging. The assessment system studied by Moon et al. [26] was found to be a useful tool for students with ASD, aiding in their training through VR by providing an effective automatic assessment of the cognitive and emotional states of trainees. The training intervention applied a human–computer–robot interaction system recognizing and expressing basic emotions (e.g., happiness, sadness, anger, fear), and it revealed that most students operated the program with ease and demonstrated improvements in emotion expression and imitation. Furthermore, they displayed a greater interest in this application compared to traditional methods [29]. In Tuna's pilot study [30], students demonstrated high levels of engagement with the robot throughout the sessions. Additionally, their symbolic play skills exhibited notable improvement. The social AR game (FaceMe) proved a beneficial experience for students with ASD, who exhibited heightened levels of active participation, attention, and engagement. An improvement in the recognition of facial expressions was observed, while the participants rated the gaming experience as excellent [31].

3.5.2. The Contribution of AI

In terms of digital tools used to apply AI in the education of students with ASD, three types were identified: social robots, digital devices such as cell phones, tablets, and computers, and smart glasses. The use of various types of robots with different functions and capabilities represents a rapidly developing field with applications. AI-enabled robots are increasingly employed in the education of students with ASD, with promising results in the academic, social, affective and communication skills targeted by the learning activities [19,24,26,30]. In the studies aiming at developing emotion recognition, memory, and attention skills through educational video games [27] and digital applications on portable devices such as cell phones, tablets, and computers [22,28,29,31], positive results were found for students with ASD. In addition, the use of AI-powered smart glasses marked an innovative approach to improve the attention of students with ASD, focusing on emotion recognition and eye contact [20,21,23,25].

Research applying AI in the early stages of special education, namely, early intervention or pre-school, and on school-aged students with ASD could provide crucial educational opportunities [11,12] and improvements in social interaction, addressing the challenges students face due to their limited social communication and interaction skills [15,19,21,23–26,30,31]. Furthermore, AI-based interventions had positive results in improving students' understanding of the emotional and mental states of others [20,22,27,29]. Finally, the contribution of AI in the cognitive field is considerable, in providing opportunities to assess cognitive functions during training [22,27,28]. The widespread implementation of these interventions in both home and school settings, involving parents and teachers, enhances their practical value.

Our review highlights that the integration of AI in special education has ushered in a transformative era, particularly for students with ASD. The pedagogical value of AI tools lies in their facilitation of personalized learning, social engagement, and cognitive development in safe, adapted, controlled, and inclusive learning environments for students with ASD. AI tools provide tailored educational experiences with positive learning outcomes by adapting to each student's unique strengths, challenges, and difficulties [19–21,23–27,29–31]. Additionally, AI-driven applications, such as social robots and digital platforms, support the development of crucial social and communication skills [19,24,26,30,31], where students with ASD often struggle. These technologies also facilitate continuous assessment and immediate feedback [22,28], allowing educators (teachers and caregivers) to refine their teaching strategies so that they meet the educational needs of students with ASD in real-time. Moreover, AI plays a crucial role in facilitating communication, especially for non-verbal students or those with speech limitations [19–30]. These tools are also instrumental in monitoring and analyzing behavioral, emotional, and social aspects, providing insights into triggers and patterns that can inform more effective interventions [22,28]. Moreover, AI-powered applications and robots can simulate social scenarios, offering interactive practice that is invaluable for students with ASD [19,24,26,29,30].

The rapid advancement of AI in education has significant potential but also brings ethical concerns and risks that must be carefully addressed to ensure its responsible and equitable implementation [35,36]. Key concerns include privacy and data security, informed consent for data use, ethical handling of data, algorithmic bias and discrimination, unequal access, commercialization of education, overreliance on AI, and diminished student and teacher autonomy [36].

As AI was designed to assist humans, its responsible and thoughtful use can positively enhance the educational experiences of students with ASD. However, when integrating AI for emotional regulation support in individuals with ASD, these ethical and privacy concerns become even more critical. Informed consent is essential, with autistic individuals and caregivers needing a clear, accessible explanation of the AI intervention, including its methods and potential risks. Individuals must retain control over their behaviors, and strong data security systems are necessary to safeguard confidential medical information from unauthorized access [35,36].

Algorithmic transparency is another key issue, as users should be able to understand how AI systems work, which fosters a sense of control and respect for their cognitive abilities. Cultural sensitivity is also crucial to ensure that interventions respect the norms and values of diverse communities and avoid harm in different cultural contexts. Autonomy is vital, with users needing freedom to choose whether to participate in AI-driven emotional regulation systems. Ensuring transparency in AI algorithms helps prevent biased or inappropriate responses, with continuous improvements leading to more effective and equitable support for individuals with autism. Privacy and ethical concerns are deeply interconnected, highlighting the need for strong data protection, clear communication, and respect for cultural diversity throughout the process.

In conclusion, personalized learning systems provide students with detailed and timely feedback, significantly enhancing their writing skills, while automated assessment tools reduce teachers' workload, enabling them to focus more on individual student needs. As AI continues to evolve, the collaboration between AI and educators will be pivotal in shaping the future of education, making it more inclusive and effective for all learners. However, the role of the teacher remains irreplaceable, as their guidance, empathy, and ability to adapt to the unique needs of each student are essential in fostering a supportive and enriching learning environment [36–38].

4. Limitations

The present study highlights the need for further research due to several limitations. The main limitation is the small number of studies that met the inclusion criteria, with only 13 studies identified. Furthermore, the search was conducted across only three databases (ERIC, Scopus, Science Direct), potentially overlooking studies indexed in other databases, such as Google Scholar, Web of Science, and ProQuest. Although the publication year range focused on the recent literature from the last seven years, this approach might have excluded a significant number of relevant studies. Moreover, the reviewed results primarily originated from the United States and Asia. In this review, "article" was selected as the document type. Future researchers may wish to examine reviews, editorials, theses, and dissertations. Another limitation related to the coding process is the lack of examination of the maintenance and generalization of skills acquired by students with ASD. Finally, the selection of ASD may have introduced a limitation to this research, which could be mitigated by including other types of disabilities. Considering these limitations and the early stage of research on this topic, several avenues for future research are apparent.

5. Conclusions

This review synthesized the research on the role of AI in supporting students with ASD, highlighting the key findings across the academic, cognitive, and social domains. As AI research for students with ASD is still in its early stages, the findings support broader scientific exploration and emphasize the need for collaboration beyond experts in designing evidence-based practices [20,21,23,25]. Further research is needed to address geographic gaps, particularly in Europe, the studies from prior to 2018, and economic and social barriers that may limit access to AI technology for students with disabilities and their families. Notably, some authors have been involved in multiple studies, suggesting stability in the research approach or cross-disciplinary collaboration. Demographically, most participants were boys, reflecting the typical male-to-female prevalence ratio in ASD [39]. These findings align with Rice and Dunn's [40] emphasis on the key roles of parents, caregivers, and teachers in supporting students with ASD.

The first research question aimed to identify the general characteristics of the interventions included. In this regard, the digital tools utilized in the reviewed interventions that emerged are social robots, smart glasses, and digital applications through computers, smartphones, and tablets. Most of the studies reviewed reported using interventions based on games to achieve the educational goals. In addition, many of them used digital prompts during the instructional processes. Finally, it was found that some studies deployed simple strategies based on the consumption of information, while others were devoted to instructional constructivist strategies based mostly on simulations. The second research question was formulated to examine the educational objectives of the reviewed studies. In this regard, it was found that, in most cases, the educational objectives concerned social skills and emotional development. There were only a few cases in which the cognitive processes and the effectiveness of the learning were examined. Finally, the third research question sought to determine the main learning outcomes measured by AI studies. In that context, it was found that the studies mainly measured affective and cognitive outcomes in their experiments. The evidence from the studies conducted thus far indicates that these interventions are effective in facilitating positive learning outcomes in areas that are of particular importance for students with ASD, such as the social and emotional domains.

In conclusion, all the reviewed interventions had positive outcomes, supporting AI's potential in the education of students with ASD [38]. While these studies provide valuable insights into AI technology in educational settings, further research is needed to deepen our understanding of the learning experiences of students with ASD undertaking evidence-based AI interventions. Future studies should combine quantitative and qualitative measures to better investigate AI's role in inclusive learning. As AI technology evolves, it offers the potential for enhanced learning experiences and greater inclusion of students with disabilities. Future research should explore student interactions within AI-driven environments, as well as broaden the scope to include other disabilities, larger participant samples, and the long-term retention and generalization of the acquired skills.

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