**International Journal of Social Science and Education Research Studies**

**ISSN(print): 2770-2782, ISSN(online): 2770-2790**

**Volume 05 Issue 04 April 2025**

**DOI: https://doi.org/10.55677/ijssers/V05I04Y2025-07, Impact Factor: 7.573**

**Page No : 400-404**


# Application and Practice of Emerging Educational Technologies in the Inclusive Education of Students with Autism

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**ABSTRACT**

This article provides an in-depth discussion of the current status, advantages and challenges of the application of novel educational technologies in the inclusive education of students with autism. A utism is a serious neurodevelopmental disorder with a rising incidence in recent years, making it a global public health issue. Inclusive education emphasizes providing equal educational opportunit ies for all students, but traditional educational methods have limitations in supporting students wit h autism. Emerging educational technologies (including artificial intelligence, virtual reality, augm ented reality, robotics, and somatosensory interaction) offer new hope for inclusive education for s tudents with autism. These technologies have significantly improved the learning outcomes and so cial integration abilities of students with autism through personalized learning plans, immersive ex periences, and emotional interactions. However, their application also faces many challenges, such as high technology costs, uneven resource distribution, insufficient professional training for teache rs, and low technology acceptance. In the future, with the advancement of technological integratio n and innovation, the strengthening of cooperation between families and schools, and the further c larification of policy support and research directions, it is expected to promote the widespread app lication and optimization of these technologies, create a more inclusive and efficient educational e nvironment for students with autism, and help them develop in an all-round way.

**Published Online: April 16, 2025**

**KEYWORDS:**

emerging educational technologies, inclusive education, students with autism, special education

## 1.INTRODUCTION

Autism Spectrum Disorder (ASD) is a severe neurodevelopmental disorder characterized by impaired social interaction, impaired language development, narrowed interests and stereotyped behavior (“Autism Spectrum Disorder,” 2020). In recent years, the incidence of autism has been on the rise and has become a public health problem worldwide (Zeidan et al., 2022). The global prevalence rate of autism spectrum disorders is approximately 16 cases per every 1,000 individuals as reported by the World Health Organization Based on the "China Autism Education and Rehabilitation Industry Development Status Report (V)", there are approximated to be close to 2 million autism children aged between 0-14 years in China and another approximately 160,000 added annually. There are more than 13 million Chinese autism children, and their population is rising by an average of nearly 200,000 annually (Clark et al. 2019).

Inclusive Education is an educational philosophy and model of practice emphasizing that all learners, regardless of ability, gender, race, cultural background, or physical status, ought to have equitable access to education opportunities and learn within a general education setting (Qu, 2020). With the concept of inclusive education gaining momentum, more and

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***Cite this Article: Mingqing Liu, Jiaxing Xiong (2025). Application and Practice of Emerging Educational Technologies in the Inclusive Education of Students with Autism. International Journal of Social Science and Education Research Studies, 5(4), 400-404***

more students with autism are placed within general education settings. But they encounter numerous challenges in inclusive education. For instance, certain students with autism struggle to comprehend teachers' directions in class and cannot actively interact with their classmates, leading to them frequently feeling isolated in their studies and lives (Qu, 2020).

There are clear constraints of traditional education methods in supporting inclusive education for students with autism (Chinchay et al., 2024). On one hand, teachers in mainstream schools are not typically professionally trained for students with autism and have difficulties in understanding their individualized needs, not to mention providing effective one-on-one teaching assistance (Chinchay et al., 2024). On the other hand, the school resources are not evenly distributed, and therefore it becomes difficult to cater to the specific needs of students with autism for assistive technology and personalized learning plans. In this context, the emergence of new education technologies brings new hope for inclusive education for autism students with the potential to provide better assistance to autism students through tailor-made learning programs, experiential and emotional involvement (Chinchay et al., 2024).

In the past few decades, with the explosive development of information technology, the application of emerging educational technologies in education has been increasingly broad and has developed into a strong force to push educational change and innovation (Mendoza et al., 2024). The primary emerging educational technologies include artificial intelligence, virtual reality (VR), augmented reality (AR), robotics, and somatosensory interaction technology (Gandedkar et al., 2021). The rapid development of such novel educational technologies in education has infused new hope in special education. These technologies not only provide an improved personalized and immersive learning experience but also help students with autism to fit into general education settings more easily through emotional involvement and multi-sensory stimulation (Gandedkar et al., 2021).

This article aims to comprehensively sort out the current status of the application of emerging educational technologies in the inclusive education of autism students, promote the scientific application of emerging educational technologies in the inclusive education of autism students summarize the successful practice cases at home and abroad, analyze in depth the advantages and challenges of the actual application of these technologies, and suggest the future research direction and practice path, so as to provide valuable references to the educators, researchers, and policy makers. Provide valuable references for educators, researchers and policy makers.

## 2. CURRENT STATUS OF EMERGING EDUCATIONAL TECHNOLOGIES IN INCLUSIVE EDUCATION FOR STUDENTS WITH AUTISM SPECTRUM DISORDERS

### 2.1 Artificial Intelligence Technology

Artificial intelligence technology provides students with autism individualized education plans (IEPs) through data analysis, with the ability to dynamically adjust instructional content and strategies according to the learning status, interest, and behavior mode (Hopcan et al., 2022). For example, Star Future, a high-end learning system developed by Central China Normal University, integrates implicit evaluation and precise educational intervention, and realizes autism children's adaptive and personalized learning through human-computer interaction games and multimodal perception technology (Hopcan et al., 2022). The personalized learning strategy can better adapt to the personal learning pace of autism students and improve learning performance. Second, AI is also capable of analyzing autism students' emotional state by detecting their facial expressions, tone of voice, and behavioral patterns, and providing real-time feedback and intervention. For example, Pabba and Kumar (2021) research findings show that AI-driven systems are able to detect students' facial expressions via cameras, analyze their emotional changes, and send warnings to teachers or parents in time to provide them with appropriate emotional support. This technology not only would allow students with autism to better express their emotions but can aid teachers with more effective means of intervention.

### 2.2 Virtual Reality (VR) and Augmented Reality (AR) Technologies

Initially, AR and VR technology offer autism students interactive virtual learning environments for rehearsing social interaction and life skills in a simulated world (Manekar et al. 2024). For example, Digital Medicine Intelligence's AI Star River VR-based cognitive training platform combines social interaction, emotional intelligence, and training in life skills through interactive virtual reality experiences and advanced AI algorithms (Shaikh et al., 2022). This virtual environment can function effectively to alleviate the stress of autism students and enhance learning motivation and engagement. Secondly, with VR and AR technologies, autism students can learn social skills through simulated environments (Shaikh et al., 2022). For example, according to certain research, the use of VR

technology in simulating life scenarios such as street crossing and going to the mall has been shown to significantly improve the social understanding and interacting capability of autistic pupils. Not only does it introduce diversified social scenarios, but it also dynamically adjusts the level of difficulty in training according to the response of the students in real time (Manekar et al. 2024).

### 2.3 robotic technology

Robotics is also applied in most areas of autism student education like language acquisition, emotional support, and social communication (Saleh et al., 2020). For example, robot NAO has been widely used in rehabilitation training for autism children to communicate with students and offer emotional support in facial expression and body posture (Saleh et al., 2020). This technology can assist autism students' stable interactive objects to employ and even facilitate their advancement in language articulation and socialization. Additionally, robotics not only supports an integral part of the rehabilitation training in schools but also helps autistic students in their homes. For example, some parents employ robots as assistants to facilitate learning and children's communication easily day by day. This technology can potentially provide more stable and consistent educational support to students with autism and help them develop overall (Chia et al., 2018).

### 2.4 Somatosensory Interaction Technology

Somatosensory interaction technology presents multisensory stimulation to autistic students by way of motor and tactile feedback to enable them to enhance their sensory integration disorder and motor skill acquisition (Lu et al., 2024). For instance, Kinect-based somatosensory games can promote the enhancement in motor coordination and sensory sensitivity of autistic students via motor imitation and interactive play. The technology has the capability of offering autism students high-quality sensory experience and storing their motor skills. At the same time, gamified learning using somatosensory technology can stimulate the learning interest of autism students and improve their participation and learning effect (Lu et al., 2024). For example, applying somatosensory games to train emotional recognition and social skills has been shown by some studies to have a significant impact on the participation and learning effect of autism students. This kind of gamified learning not only unleashes the learning motivation of autism students but also enhances their self-confidence and learning effect (Lu et al., 2024).

## 3 STRENGTHS AND CHALLENGES OF EMERGING EDUCATIONAL TECHNOLOGIES IN THE INCLUSIVE EDUCATION OF STUDENTS WITH AUTISM

### 3.1 Strengths

#### 3.1.1 Individualized Support

Emerging learning technologies have the potential to provide individualized learning experiences to cater to the diverse needs of autistic learners based on their differences (Adako et al., 2024). Artificial intelligence technology provides students individualized content that suits their learning preference based on systematic algorithmic screening. For example, AI learning companion "Aya Xiaozhi" combines personalized learning recommendations, classroom engagement, and other intelligence functions of digital classrooms, and is also realized as a cuddly panda stuffed animal avatar, thereby enabling students to achieve personalized learning support through simply operating it on call (Adako et al., 2024).

#### 3.1.2 Immersive experiences

Virtual Reality (VR) and Augmented Reality (AR) technologies can offer students with autism a more interactive learning experience, boosting their motivation and engagement a great deal (Manekar et al. 2024). VR technologies can merge the real and virtual worlds, simulating various situations by using algorithms to design immersive experiences. For example, studies have shown that a cognitive behavioral training program using VR technology can successfully improve the social and emotional cognitive abilities of autism children (Shaikh et al., 2022).

#### 3.1.3 Emotional interaction

Robotics and artificial intelligence technologies offer significant advantages in emotional support to enable autism students to communicate better and build relationships. The NAO robot is an example, and it has been used comprehensively for training autism children in rehabilitation training to provide emotional support via facial expression and body language (Saleh et al., 2020).

### 3.2 Challenges

#### 3.2.1 Technology costs and resource allocation

The economic cost of the acquisition, maintenance and upkeep of emerging education technologies places further pressure on schools and families (Walker et al., 2022). For example, devices such as VR and AR devices and intelligent robots are expensive and require constant updating and maintenance, which is a significant challenge to schools and

poor families. In addition, the unevenness of the provision of facilities becomes more evident, and some schools and districts may not have appropriate technical services and equipment, and therefore these technologies may be used to a lesser extent in inclusive education (Walker et al., 2022).

#### 3.2.2 Specialized training and technical support

Teachers face training needs and inadequate technical support in the use of emerging educational technologies (Khlaif et al., 2022). Many teachers report that their mastery of emerging educational technologies is only at the basic operational level and that they lack the ability to apply these technologies in depth for innovative teaching and learning (Khlaif et al., 2022).

#### 3.2.3 Technology acceptance and integration difficulties

There is a low level of acceptance of new education technologies by some educators, students and parents, which affects the diffusion and use of technologies in inclusive education (F. sahin et al., 2023). Some teachers and parents may be skeptical about the effectiveness of new technologies or fear that the use of technology will increase the workload. Additionally, the integration of new educational technologies within the existing education system faces certain challenges and requires adjustments and innovations in teaching methodology and curriculum design (F. sahin et al., 2023).

## 4 FUTURE OUTLOOK

### 4.1 Technology Convergence and Innovation

In the near future, applications of new education technologies in autism inclusive education will show a deep integration and innovation trend. For example, combining AI and VR technology will make it possible for autism students to have a more immersive and individualized learning experience. Through AI algorithms, the system can adapt the difficulty and content of the VR scene in real time according to the response and learning process of the students to help students better adapt to the learning environment.

### 4.2 Strengthening of cooperation between families and schools

Familial and scholastic collaboration in the implementation of new education technologies to support inclusive education to children with autism will become closer. With the adoption of effective communication models and collaboration mechanisms, schools and families can help one another to provide more integrated and cohesive education support to children with autism.

### 4.3 Policy Support and Research Directions

In the coming future, policy will focus on more investment in research and development, and application of new education technology to secure equitable distribution of resources. Simultaneously, more research will be on the monitoring of the long-term implications of technology and its impact on the psychological development of autism students.

## 5 CONCLUSION

Emerging educational technologies provide personalized, immersive and emotionally interactive support for the inclusive education of students with autism, significantly enhancing learning outcomes and social integration. However, issues such as technology costs, insufficient professional training, and the difficulty of technology acceptance and integration still need to be addressed. In the future, technological integration and innovation should be strengthened, personalized education should be deepened, cooperation between families and schools should be enhanced, and the wide application and optimization of technology should be promoted through policy support and research. This will create a more inclusive and efficient social integration environment for students with autism and help them develop in an all-round way.

Conflict of Interest

The authors declare no conflict of interest

Funding

Supported by the General Program of Social Science Planning of Jiangxi Province, China, “An empirical study on the blocking mechanism from autism to autism spectrum disorder” (Project Number: 20JY33)

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