# The Potential and Challenges of Artificial Intelligence (AI) in Special Needs Education: A Systematic Literature Review

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**ABSTRACT**

Inclusive education currently faces significant challenges because traditional learning models often fail to accommodate the diverse and unique characteristics of students with special needs. Therefore, this study aims to explore the potential, implementation, and challenges of artificial intelligence in supporting the learning of students with special needs. This study uses a qualitative approach with the Systematic Literature Review (SLR) method utilizing the PRISMA guidelines. The results show that AI technology has great potential in supporting the learning of students with special needs, such as helping to adjust learning materials and speed according to the needs of each student. In Indonesia, there is a gap in AI implementation between regions with advanced infrastructure and those with limited infrastructure. This is because the application of this technology still faces challenges that need to be addressed, such as teacher competency constraints, lack of infrastructure, and algorithmic bias that hinders access to inclusive education. This study emphasizes that although AI plays a role as a tool for educational transformation, the deep digital divide remains a major obstacle, requiring systemic improvements in infrastructure equity to realize its full potential.

***Keywords:*** *artificial intelligence, assistive, inclusive, special needs, technology.*

## 1. INTRODUCTION

Education is a guaranteed right in Indonesia (Law No. 8/2016), which calls for a shift towards inclusive education. However, the traditional “one-size-fits-all” model often fails to accommodate students with disabilities. To bridge this gap, Assistive Technology (AT)—particularly AI-based systems—has emerged as a vital solution that offers personalized learning capabilities and can dynamically adapt to the unique needs of students.

Although the potential of AI has been proven through successful global interventions (Paglialunga & Melogno, 2025) and local prototypes such as “Dif-Able Apps” (Herviani et al., 2022), a significant gap still exists in Indonesia. Field studies reveal that its implementation is still far from high-tech; schools predominantly rely on mid-tech solutions such as WhatsApp, YouTube, and basic tablets, rather than using advanced AI (Salsabila et al., 2022; Arifin & Widyastono, 2020).

This disparity is driven by systemic challenges, including limited facilities, infrastructure constraints, and a lack of crucial teacher training (Nurahma et al., 2025; Habib & Janae, 2024). Therefore, this study aims to analyze the gap between the ideal

potential of AI, its actual implementation in Indonesia, and the challenges that hinder its adoption.

## 2. METHODOLOGY

This study uses a qualitative approach with the Systematic Literature Review (SLR) method to critically analyze the potential, implementation, and challenges of applying AI to children with special needs. According to Guillaume (2019), a Systematic Literature Review is a method for synthesizing scientific evidence to answer specific research questions transparently, while attempting to include all published evidence on the topic and evaluate the quality of that evidence.

Inclusion criteria were established to ensure relevant study selection, focusing on research articles published between 2016 and 2025 in Indonesian or English that discuss topics related to Artificial Intelligence and Children with Special Needs. The literature search was conducted electronically on Google Scholar using Publish or Perish software.

The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines were chosen to ensure the clarity, transparency, and quality of the study (Liberati, et al, 2009). The literature selection process can be seen in Figure 1.

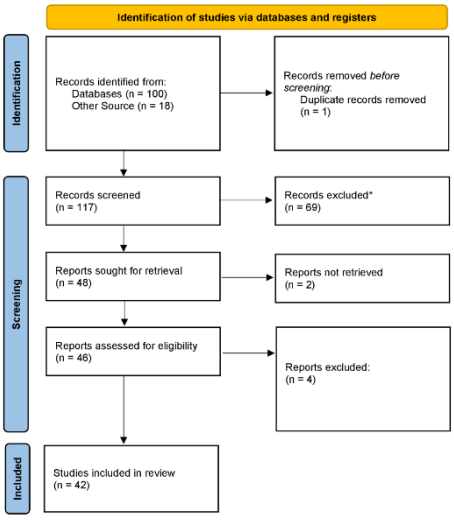


**Figure 1.** PRISMA Procedure Flow Chart

Based on Table 1, it can be seen that although the data was traced back to 2016, the initial studies found were published in 2019. In addition, the most notable finding from the review is the topicality and urgency of this topic. Of the 42 articles reviewed, the majority of studies were published in the last three years, with a significant increase. This indicates that studies on the use of AI for children with special needs are a rapidly growing field of research and are currently receiving massive academic attention.

## 3. RESULT AND DISCUSSION

### a. The Potential of Artificial Intelligence (AI) for Children with Special Needs

Artificial Intelligence (AI) holds significant potential to support inclusive education. Based on the synthesized literature, AI's primary potential lies in its ability to create learning environments that adapt to student needs, a critical necessity for students with special needs (Arriannor, 2025; Pratama et al., 2025). This capability is underpinned by machine learning and Natural Language Understanding (NLU), which enable systems to read student data in real-time and provide immediate, optimal responses tailored to each student's unique profile (Ayeni et al., 2024). This confirms that AI can deliver deep personalized learning (Tapalova & Zhiyenbayeva, 2022; Ahmed et al., 2025), aligning with the principles of Universal Design for Learning (UDL) to ensure students with disabilities are no longer marginalized (Hopcan et al., 2022; Suwahyo et al., 2022; Afriani et al., 2023).

Concretely, this potential is beginning to materialize as a sensory bridge through various assistive technology innovations. For visually impaired students, for instance, AI can convert visual text into speech using Text-To-Speech (TTS) technology and screen readers such as Non-Visual Desktop Access (NVDA) and Job Access with Speech (JAWS) (Inayah & Prasetyo, 2025; Wijaya et al., 2023; Lutfio et al., 2023). The potential of computer vision is also being expanded to assist in independent object recognition, as seen in devices like "Dif-Able Apps" (Herviani et al., 2022). Similarly, for hearing-impaired students, communication barriers are bridged through Automatic Speech Recognition (ASR) and sign language applications like I-Chat. Meanwhile, for physical disabilities, AI's potential appears in adaptive robotics and eye-tracking technologies, offering tangible solutions for student mobility and independence (Ayeni et al., 2024; Arifin & Widyastono, 2020).

Beyond the physical aspect, AI holds immense potential as a "cognitive prosthesis," a term used by Edyburn (2006) to describe technology that acts as a thinking tool, providing students with disabilities new

**Table 1.** Selected Articles

| Author | Year | Journal Name | Country |
|---|---|---|---|
| Paglialunga, A., & Melogno, S. | 2025 | Brain Sciences | Italy |
| Ahmed, et al. | 2025 | Digital | Bangladesh |
| Arriannor, W. | 2025 | Jurnal Al Ulum | Indonesia |
| Inayah, Y., & Prasetyo, T. | 2025 | Mudir: Jurnal Manajemen Pendidikan | Indonesia |

| Author | Year | Journal Name | Country |
|---|---|---|---|
| Muda, R. S. A. | 2025 | IJNRSM | Indonesia |
| Nurahma, et al. | 2025 | JIPSD: Jurnal Inovasi Pendidikan Sekolah Dasar | Indonesia |
| Elza, P. | 2025 | Jurnal Inovasi Pendidikan | Indonesia |
| Pierrés, O., et al. | 2025 | Education and Information Technologies | Switzerland |
| Pratama, F. I. P., & Husadani, R. | 2025 | EDUTECH: Jurnal Inovasi Pendidikan Berbantuan Teknologi | Indonesia |
| Raza, M. M., Alam, A., & Alam, M. F. | 2025 | The Academic: International Journal Multidisciplinary Research | India |
| Chalkiadakis, A, et al. | 2024 | Education Sciences | Multi-National (UK, US, Sweden, Ghana, Italy, Spain) |
| Adako, O.P., et al. | 2024 | Journal of Computational and Cognitive Engineering | Multi-National (UK, Nigeria, Malaysia) |
| Aliu, T. V. | 2024 | Systemic Analytics | Developing Countries (Nigeria & Pakistan) |
| Almufareh et al. | 2024 | Journal of Disability Research | Saudi Arabia & Pakistan |
| Ayeni et al. | 2024 | World Journal of Advanced Research and Reviews | United States |
| Goldman et al. | 2024 | Journal of Special Education Technology | United States |
| Habib, H., & Janae, J. | 2024 | Bulletin of Engineering Science and Technology (BESTEC) | - |
| Idhartono, A. R., et al. | 2024 | Kanigara: Jurnal Pengabdian Kepada Masyarakat | Indonesia |

| Author | Year | Journal Name | Country |
|---|---|---|---|
| Ismail et al. | 2024 | Journal of Comprehensive Science | Indonesia |
| Chemnad, K., & Othman, A. | 2024 | National Library of Medicine | Mexico |
| Maulidin | 2024 | TEACHER: Jurnal Inovasi Karya Ilmiah Guru | Indonesia |
| Afriani, A., B., et al. | 2023 | Proceedings of Unimbone 2023 | Indonesia |
| Mawa, H. A., et al. | 2023 | Jurnal Pendidikan Inklusi Citra Bakti | Indonesia |
| Lutfio, M. I., et al. | 2023 | Jurnal Pendidikan | Indonesia |
| Marino, M.T., et al. | 2023 | Journal of Special Education Technology | United States |
| Prayogo, et al. | 2023 | SOSCIED | Indonesia |
| Toyokawa, Y., et al. | 2023 | Springer Open | Japan |
| Alenizi, M. A. K., et al. | 2023 | Innoeduca. International Journal of Technology and Educational Innovation | Saudi Arabia |
| Newman-Griffis, D., et al. | 2022 | arXiv | - |
| Habib, H., et al. | 2022 | Multidisciplinary Science Journal | Brazil |
| Herviani, V. K., et al. | 2022 | Jurnal Pendidikan Kebutuhan Khusus | Indonesia |
| Hopcan, S., et al. | 2022 | Interactive Learning Environments | Turkey |
| Suwahyo, B. W., et al. | 2022 | Edcomtech | Indonesia |
| Tapalova, O., & Zhiyenbayeva, N. | 2022 | Electronic Journal of e-Learning | Kazakhstan and Russia |
| Zdravkova, K., et al. | 2022 | Frontiers in Artificial Intelligence | Multi-National (Macedonia, Sweden) |
| Chakraborty, N., et al. | 2021 | Materials Today: Proceedings | India |

| Author | Year | Journal Name | Country |
|---|---|---|---|
| Kharbat, F. F., et al. | 2021 | Emerald Publishing | United Arab Emirates |
| Lambercy, O., et al. | 2021 | Frontiers in Robotics and AI | - |
| Ramadan, Z., et al. | 2021 | Psychology & Marketing | Lebanon |
| Arifin, M., & Widyastono, H. | 2020 | BEST Journal (Biology Education, Sains and Technology) | Indonesia |
| Bah, Y. M., & Artaria, M. D. | 2020 | COUNS-EDU: The International Journal of Counseling and Education | Nigeria & Pakistan |
| Uddin, M., et al. | 2019 | NPJ Digital Medicine | United Kingdom |

opportunities to develop skills (Marino et al., 2023). In cases of neurodiversity, such as Autism SpectrumDisorder (ASD) and Attention Deficit Hyperactivity Disorder (ADHD), the technological potential becomes highly specific. AI can facilitate learning environments through neurofeedback tools or time-management gamification (Paglialunga & Melogno, 2025; Aliu, 2024). An analysis by Toyokawa et al. (2023) further indicates that AI can support students at every phase of literacy, utilizing visual behavior analysis that is significantly faster and more precise than conventional methods (Zdravkova et al., 2022).

Within the classroom, AI's potential expands as an intelligent assistant. The presence of Large Language Models (LLMs) like ChatGPT or Intelligent Tutoring Systems (ITS) demonstrates AI's capacity as an interactive virtual tutor (Pierrés et al., 2025; Mogbel et al., 2023; Aliu, 2024). Raza et al. (2025) emphasize that by having AI take over administrative tasks, teachers can refocus on personal interactions and the formulation of accurate Individualized Education Programs (IEP). Although conventional physical media remains relevant (Mawa et al., 2023), digital integration offers a richer new dimension. This potential even extends to the psychosocial realm, where technologies like VR and advanced AI capable of analyzing facial expressions and voice patterns can provide real-time insights into emotional cues, a vital feature for individuals with ASD, while simultaneously reducing stigma through discreet assistance (Adako et al., 2024; Chalkiadakis et al., 2024; Suwahyo et al., 2022).

As a crucial concluding note, although many technologies such as TTS or ASR have been implemented, they do not yet fully represent AI's complete potential. The true transformative power of AI extends beyond these standalone applications; rather, it lies in its future ability to integrate them into a holistic adaptive learning ecosystem.

These findings confirm that AI is not merely a tool, but a transformative force for realizing equitable inclusive education services (Habib et al., 2022).

**b. Implementation of Artificial Intelligence (AI) for Children with Special Needs**

Indonesia, as the fourth most populous country in the world, cannot be separated from the rapid global trend of Artificial Intelligence (AI). Nationally, Indonesia has recorded a 47% year-on-year increase in AI adoption (Beritasatu, 2023). However, the application of AI and digital technology in Special Needs Education in Indonesia shows a polarized reality. On the one hand, there are those who are undergoing progressive digital transformation. On the other hand, there are many regions experiencing severe infrastructure crises.

On the progressive side, the integration of the digital ecosystem is beginning to show promising results, paving the way for the adoption of AI in the future. One prime example is SLB Negeri 2 Gunungkidul, which is a candidate for Google Reference School. This school has successfully undergone a total digital transformation by integrating the Google Workspace for Education ecosystem into its management and learning processes. Specifically, students with intellectual disabilities and autism are taught to use Chromebooks for learning activities (BKT DIY, 2025). This case indicates that some special needs schools in certain regions have the infrastructure ready to integrate AI.

Conversely, a significant digital divide still persists, especially in Eastern Indonesia. Reports from East Nusa Tenggara (NTT) and Papua highlight a fundamental "blank spot" crisis. In NTT, hundreds of villages do not have adequate telecommunications signals (Yustriani, 2021), let alone the high-speed internet required for AI applications. This situation is exacerbated by geographical challenges and natural disasters such as cyclones. This infrastructure gap is a critical obstacle, as most AI technologies rely on stable connectivity.

However, there are now many studies developing AI for application in Special Education. For example, a study conducted by Inayah & Prasetyo (2025) on the development of AI in the form of a Text-to-Speech (TTS) tool. This tool has a vital feature that can convert written text into speech through digital software and AI assistance. This innovation enables visually impaired students to listen to information smoothly and independently without direct assistance, as well as helping deaf people control electronic devices and communicate. In terms of visuals, this accommodation need is met by Screen Reader devices such as Non-Visual Desktop Access (NVDA) and Job Access with Speech (JAWS), which function to read the screen and even generate Braille sounds by converting graphic text displayed on the computer screen, including emails, websites, program menus, icons, and applications (Lutfio et al., 2023).

In its implementation as a mobility and navigation aid, innovative robot designs have been developed to assist in adaptive ("multi-size") mobility for lower limb disabilities, which are able to adjust to uneven surfaces and stabilize the user's movements, as a form of AI-based physical personalization (Muda, 2025). In addition, advanced technologies such as eye-tracking can also be utilized for students with mobility limitations (Arifin & Widyastono, 2020).

In everyday contexts, AI also provides crucial Functional Support and Independence (Smart Home/Daily Life). AI-based voice assistants such as enable 24/7 functional support and social role support. Through voice commands, people with disabilities can control home devices (such as lights, security systems, and thermostats) and call for help in emergencies, thereby significantly increasing their independence and freedom (Ramadan et al., 2020).

**c. Challenges of Utilizing Artificial Intelligence (AI) for Children with Special Needs**

The use of AI technology in the context of inclusive education and support for people with disabilities offers positive potential, but on the other hand presents a variety of complex challenges, from technical, ethical, to social aspects. One of the most dominant challenges identified is algorithmic bias. This arises because AI systems are trained using publicly available datasets from the internet, which are not representative of user diversity, including persons with disabilities, so that AI responses may contain implicit biases derived from existing historical and social biases (Goldman, et al. 2024). As a result, in the context of support for persons with disabilities, bias can lead to unequal access to opportunities, services, or resources for individuals with disabilities (Almufareh, et al. 2024). Implicit bias in AI systems can also lead to discrimination against vulnerable groups and hinder the achievement of educational justice. This is in line with the opinion of Ayeni et al. (2024) that algorithmic bias is one of the most detrimental problems in the use of AI technology, especially for people with disabilities.

The aspect of human resource readiness, especially teachers and educators, is another challenge in the use of AI technology. In line with the research by Nurahma et al. (2025), three main problems were found, namely the existence of discrimination in the school environment, minimal supporting facilities, and limited training and readiness of teachers. These findings highlight the importance of teacher training so that they can effectively integrate AI into inclusive learning. In addition, the lack of policy support and educational infrastructure is one of the challenges in the use of AI, especially for people with disabilities. Arriannor (2025) emphasizes that without improving teacher competence and policies that support inclusive education, AI technology risks becoming merely a technical innovation without a transformative impact on students.

Challenges in terms of infrastructure and the digital divide, such as limited access to the internet, digital devices, and technological knowledge, are also major obstacles to the use of AI technology for people with disabilities, especially for students from lower-middle-class families. Zdravkova, et al. (2022) argue that the relatively high price of AI-based assistive devices further widens the economic gap between financially capable and incapable groups in society. Thus, it can be said that poorly designed technology can inadvertently reinforce existing discrimination. This confirms that the challenges of inclusive AI use lie not only in technical aspects, but also in socio-economic issues and the readiness of infrastructure and government service support.

## 4. CONCLUSION

The use of Artificial Intelligence (AI) in inclusive education offers tremendous transformative potential, especially in creating an adaptive and personalized learning ecosystem for children with special needs. Theoretically, AI can function as a "sensory bridge" and "cognitive prosthesis" through advanced technologies that empower student independence.

However, the findings of this research reveal a highly polarized reality of implementation in Indonesia. On the one hand, there are pockets of digital progress that are ready to adopt advanced digital ecosystems. On the other hand, there is a fundamental infrastructure crisis in 3T regions where electricity and basic internet access remain obstacles, creating an extreme digital divide. As a result, the application of technology is still uneven, even though innovations in academic assistance, visual-auditory communication, and physical mobility are beginning to emerge.

This gap is driven by multidimensional challenges, ranging from algorithmic biases that risk exacerbating discrimination to the unpreparedness of teachers' competencies and real physical infrastructure inequalities. Therefore, this study concludes that the integration of AI in special needs education can only be realized if there are systemic interventions that prioritize equal digital access as a key prerequisite. Without improvements to basic infrastructure and massive teacher training, the adoption of AI risks becoming an exclusive innovation that actually widens the gap of educational inequality.

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