



## Artificial Intelligence in Inclusive Education: A Systematic Review of Teacher Competencies

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### Abstract

This study aims to systematically review the competencies required of teachers to implement AI in the context of inclusive education. A systematic review approach was used, referring to the PRISMA 2020 guidelines. Data sources were obtained from the Scopus and Google Scholar databases, covering publications from 2017 to 2025. Of the total 714 articles identified, eight articles met the inclusion criteria and were analyzed thematically. The results of the study show that the application of AI in inclusive education requires mastery of three main dimensions of teacher competence, namely technical foundations, ethical awareness, and inclusive pedagogy. AI has the potential to strengthen personalized learning, foster equitable access, and improve the psychological well-being of students. However, teacher readiness, training limitations, and weak policy support remain major obstacles to its implementation. This study emphasizes the need to strengthen teachers' AI literacy through targeted professional training, education policies that support inclusivity, and ethical governance that is adaptive to technological dynamics. The results of this review are expected to form the basis for the development of policies and programs to improve teacher competence in the era of artificial intelligence.

**Keywords:** AI literacy; artificial intelligence; inclusive education; PRISMA; teacher competency.

### Abstrak

Penelitian ini bertujuan meninjau secara sistematis kompetensi guru yang diperlukan untuk mengimplementasikan AI pada konteks pendidikan inklusif. Pendekatan *systematic review* digunakan dengan mengacu pada pedoman PRISMA 2020. Sumber data diperoleh melalui basis data Scopus dan Google Scholar dengan rentang publikasi 2017–2025. Dari total 714 artikel yang teridentifikasi, sebanyak delapan artikel memenuhi kriteria inklusi dan dianalisis secara tematik. Hasil kajian menunjukkan bahwa penerapan AI dalam pendidikan inklusif menuntut penguasaan tiga dimensi utama kompetensi guru, yaitu fondasi teknis, kesadaran etis, dan pedagogi inklusif. AI berpotensi memperkuat personalisasi pembelajaran, menumbuhkan keadilan akses, serta meningkatkan kesejahteraan psikologis peserta didik. Namun, kesiapan guru, keterbatasan pelatihan, dan lemahnya dukungan kebijakan masih menjadi hambatan utama dalam implementasinya. Penelitian ini menegaskan perlunya penguatan literasi AI bagi guru melalui pelatihan profesional yang terarah, kebijakan pendidikan yang berpihak pada inklusivitas, serta tata kelola etika yang adaptif terhadap dinamika teknologi. Hasil tinjauan ini diharapkan menjadi dasar bagi pengembangan kebijakan dan program peningkatan kompetensi guru di era kecerdasan buatan.

**Kata kunci:** Literasi AI; kecerdasan buatan; pendidikan inklusif; PRISMA; kompetensi guru.

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## Introduction

Artificial Intelligence (AI) is developing rapidly and is increasingly being used in education in response to the complexity of 21st-century learning needs. The application of AI is not only aimed at improving the effectiveness of the teaching and learning process, but also at expanding access to education for students with diverse backgrounds and needs. AI contributes to administrative efficiency, adaptive learning development, and personal support through intelligent guidance, automated assessment, and predictive analysis, thereby driving the transformation of modern teaching methods (Ahmad et al., 2021; Chen et al., 2020; Wang et al., 2024). This development is in line with the demands of modern education, which emphasizes personalized learning, improved learning outcomes, and the strengthening of the principle of inclusion as the foundation of an equitable education system. In particular, the emergence of Generative AI opens up new opportunities in creating a more inclusive learning environment through adaptive systems, learning analytics that are sensitive to diversity, and collaborative evaluation models that encourage the active participation of all learners (Nixon et al., 2024).

Although the number of publications on AI in education has increased rapidly in the last decade, the focus of research is still dominated by studies on the application of technology in general. Most studies emphasize the technical aspects of AI system development, algorithm effectiveness, and their quantitative impact on student learning outcomes, while the dimension of teacher competence in the context of inclusive education still receives relatively little attention (Chen et al., 2020; Mustafa et al., 2024). Some studies have begun to touch on the role of teachers as key actors in integrating AI into daily learning practices (Feigerlova et al., 2025). However, as Tan et al (2025) point out, the majority of studies still emphasize technological aspects rather than exploring the pedagogical, ethical, and practical competencies required of teachers. In fact, teacher competencies are a key factor in ensuring that AI truly supports the principle of inclusivity, given that teachers play a direct role in adapting technology to suit the diverse needs of students.

Teacher competencies in integrating AI into inclusive education generally cover three main interrelated dimensions. First, technological literacy, which includes understanding basic AI concepts, the ability to use various AI applications in the learning process, and the skills to critically assess recommendations or decisions generated by the system (Delcker et al., 2025; Younis, 2025). Second, ethical awareness, which requires teachers to understand the ethical implications of AI use, including potential algorithmic bias, data privacy and security issues, and its impact on fairness and equity in education (Chai et al., 2024; Fundi et al., 2024). Third, pedagogical competence within the Technological Pedagogical Content Knowledge (TPACK) framework, which enables teachers to design AI-based learning strategies that are effective, contextual, and responsive to the diverse needs of students (Celik, 2023; Sun et al., 2023). These three dimensions are important prerequisites for the creation of inclusive AI-based learning practices.

However, previous studies have rarely systematically examined how these three dimensions of competence develop, the challenges teachers face in real-world practice, and opportunities for future competence improvement (Ng, Leung, et al., 2023). In the context of global policy, UNESCO (2024) launched AI competency frameworks for teachers, which contain five main competency areas to support teachers' professional development so that they can use AI responsibly, effectively, and ethically. This condition indicates a research gap in understanding teacher competency as the main mediator between AI and inclusive educational practices.

Based on this background, this study conducted a Systematic Literature Review (SLR) of scientific publications from 2017 to 2025. This time frame was chosen because it spans

from the introduction of the Transformer architecture as an important milestone in the development of modern AI Vaswani et al (2017) to the increasing use of Generative AI in the current educational context. This study aims to systematically map teachers' competencies in integrating AI into inclusive education, while identifying challenges and opportunities for future competency improvement. Thus, this study is expected to provide a comprehensive overview of AI's contribution to teachers' competencies in inclusive education and offer insights for more effective implementation strategies.

## Method

This study uses a Systematic Literature Review (SLR) approach with reference to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines to ensure that the entire literature review process is conducted transparently, systematically, and replicably. PRISMA provides a standard framework that covers the stages of planning, literature search, study selection, data collection and analysis, to comprehensive reporting of results (Page et al., 2021). This approach was chosen because it is relevant for synthesizing diverse and scattered research findings on the integration of Artificial Intelligence (AI) in inclusive education and teacher competency development. Operationally, the research stages include literature search, study selection based on predetermined criteria, data extraction and quality assessment, thematic analysis, and reporting of results according to PRISMA standards (Tan et al., 2025).

## Literature Search

The literature search was conducted on two main databases, Scopus and Google Scholar, which were selected because they have extensive coverage of reputable publications in the fields of education, learning technology, and teacher professional development. The search focused on articles published between January 1, 2017, and September 7, 2025, considering that 2017 marked the introduction of the Transformer architecture as an important milestone in the development of modern AI (Vaswani et al., 2017), which then triggered the rapid use of AI, including Generative AI, in the context of education. The keywords used were arranged in Boolean combinations as follows: (“Artificial Intelligence” OR “Generative AI” OR ‘AI’) AND (“Inclusive Education” OR “Special Education” OR “Special Educational Needs”) AND (“Teacher Competencies” OR “Teacher Skills” OR “Professional Development” OR “Teacher Training”).

In the Scopus database, the search was conducted through the TITLE-ABS-KEY column to identify articles containing keywords in the title, abstract, or keyword list. Meanwhile, the search on Google Scholar was conducted with the help of the Publish or Perish (POP) application to facilitate search result management, export data to a structured format, and minimize potential duplication between articles. The initial search process yielded 714 articles, consisting of 214 articles from Scopus and 500 articles from Google Scholar, which were then selected based on topic relevance and suitability to the research objectives.

## Inclusion and Exclusion Criteria

Inclusion and exclusion criteria are formulated to ensure that only relevant and high-quality studies are included in the review. Selected articles must meet the following criteria: they must have undergone peer review, be empirical studies (qualitative, quantitative, or mixed methods) or systematic reviews discussing the application of AI in the context of education and teacher competence, be relevant to inclusive education or learning for students with diverse needs, and be available in English with full text. Meanwhile, articles were excluded from the analysis if they were non-empirical in nature, such as opinions, editorials, or conference proceedings; did not undergo a peer-review process; did not explicitly discuss

teacher competency or aspects of inclusivity; or were not available in full text. The process of establishing these criteria aimed to maintain the credibility and focus of the study so that it remained in line with the research objectives (Ng, Lee, et al., 2023).

### Article Selection Process

All search results were imported into the Mendeley application and underwent automatic and manual deduplication to remove duplicates between databases. Article selection was conducted in two stages: screening of titles and abstracts to assess initial relevance, and screening of full texts to ensure compliance with inclusion criteria. The selection process was carried out by two independent researchers, and any differences of opinion were resolved through discussion until a final agreement was reached. Of the total 714 articles obtained (214 from Scopus and 500 from Google Scholar), 8 articles ultimately met all criteria and were used in the analysis process. The article selection flow is described in Figure 1, which illustrates the stages of identification, screening, eligibility, and inclusion in accordance with the PRISMA 2020 Flow Diagram format.

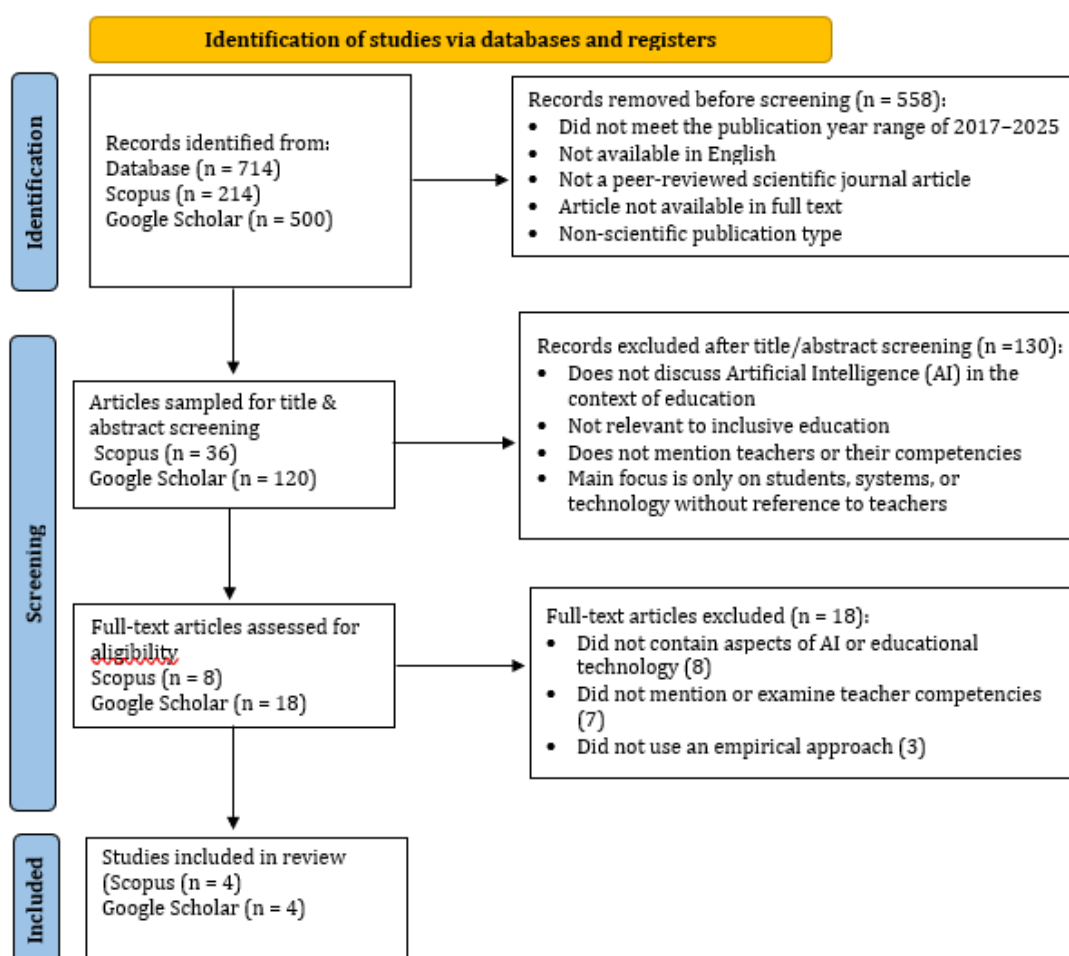


Figure 1. PRISMA 2020 Flowchart for Research Article Selection

### Results and Discussion

This section presents the results of a systematic review of eight articles published between 2017-2025 that are relevant to the theme of artificial intelligence (AI) in inclusive education and teacher competency development. The analysis process was carried out through the stages of identification, selection, and synthesis of findings from each article to find common patterns, differences, and relationships between findings. The table below displays the analysis of research articles that form the basis for the thematic results in this study.

**Table 1.** Analysis of Articles on AI and Teacher Competence in Inclusive Education

No	Author & Year	Article Title	Participants/Sample	Main Results
1	(Tafazoli, 2024)	<i>Exploring the Potential of Generative AI in Democratizing English Language Education</i>	23 English as a foreign language (EFL) teachers in Iran.	Five main themes were identified: (1) access to broader and more relevant learning materials; (2) personalized learning experiences; (3) reduced ideological influence; (4) ability to overcome technological barriers; (5) improved global connectivity.
2	(Ogbu Eke, 2024)	<i>Assessing the Readiness and Attitudes of Nigerian Teacher Educators Towards Adoption of Artificial Intelligence in Educational Settings</i>	250 teacher educators in Nigeria.	Shows readiness and positive attitudes toward AI; teachers recognize the benefits of AI (personalized learning, automated assessment, virtual tutors), but face barriers in the form of infrastructure, lack of training, and ethical issues.
3	(Alnaim & Al-Otaibi, 2025)	<i>Learning Disabilities Teachers' Perceptions of Employing Artificial Intelligence Applications in Teaching Their Students</i>	108 teachers of students with special needs (learning disabilities) in Dammam, Saudi Arabia.	The level of AI use was moderate. Teachers were most familiar with and used VR and speech recognition, while applications such as Thinkster Math were less commonly used. The main challenges include a lack of teacher training, digital infrastructure, and financial incentives.
4	(Yan et al., 2025)	<i>Facilitating Indigenous-serving Computer Science Teachers' Curriculum Design and Implementation through a Long-term Professional Development</i>	7 computer teachers (90% serving indigenous students) and 40 high school students in the southwestern United States.	Teachers successfully integrated local culture into AI and CS learning (e.g., traditional dancing with Sphero robots, traditional quilt design with binary code). The t-test results showed a significant increase in student perceptions (+1.2) and interest (+0.78) in CS.
5	(Kalniņa et al., 2024)	<i>Artificial intelligence for higher education: benefits and challenges for pre-service teachers</i>	240 students at the University of Latvia (aged 19–60; 94% female); 50% ISCED-5, 37% bachelor's degree, 10% master's degree, 3% doctoral degree.	43% have used AI for learning (23% ChatGPT); main benefits: language assistance (75%), access to global knowledge (70%), support for special needs (65%); concerns: laziness/decreased interest in research (66%), plagiarism (59%), decreased critical thinking (58%); no significant differences in perceptions based on age/gender/level.

6	(Arranz-García et al., 2025)	<i>Perceptions, Strategies, and Challenges of Teachers in the Integration of Artificial Intelligence in Primary Education: A Systematic Review</i>	28 empirical studies (2014–2024); global coverage (various countries) in the context of K-12/primary education.	AI has the potential to increase engagement, problem solving, and personalization of learning, but its application is still limited due to a lack of training, resources, and institutional support. The need for continuous professional development and an AI literacy competency framework is emphasized, as well as attention to issues of ethics, privacy, and bias so that AI integration is safe, inclusive, and effective.
7	(Kathy Cheng et al., 2025))	<i>Policy Drivers and Barriers to Inclusive EdTech Adoption in Special Education: A Logistic Regression Study</i>	704 teachers from 28 special education schools; Taiwan; postal questionnaire; response rate ≈92.9%.	AI was assessed to increase motivation/attention/learning outcomes, 41.2% experienced operational constraints, 92.2% needed training, and 90% requested mentoring. Adoption tended to be higher with training.
8	(Liu et al., 2025)	<i>Psychological Preparation of Physical Education Teachers in Inner Mongolia Before Class</i>	No direct participants (literature review); context: Inner Mongolia, China; focus on PJOK teachers & AI integration.	Findings indicate that teachers' psychological readiness (through emotional control, stress management, and resilience) improves classroom management and communication effectiveness. AI integration through emotion detection systems and virtual simulation helps teachers recognize students' emotions and manage inclusive interactions.

Based on the analysis presented in the previous table, it can be concluded that research on the application of artificial intelligence (AI) in the context of inclusive education shows increasingly comprehensive and multidimensional developments. The expansion of the study is not only evident from the diversity of research focuses and methodological approaches used, but also from the increasing attention to the implications of AI for strengthening teachers' professional competencies. In general, the synthesis results in three main groups of findings that represent the direction of development as well as the challenges of applying AI in inclusive education, namely: (1) teachers' perceptions and readiness for AI, (2) strategies and practices for applying AI in supporting inclusive learning, and (3) policies, obstacles, and systemic support that influence the strengthening of teacher competencies in the digital era. The following description analytically and critically elaborates on the findings from each of these themes based on the results of the literature review that was analyzed.

### **Teachers' Perceptions and Readiness for AI in Inclusive Education**

The results of the study show that teachers in various geographical contexts are increasingly showing a positive attitude towards the use of artificial intelligence (AI) in learning. However, behind this optimism, there is still a clear gap in terms of technological literacy, digital ethics, and pedagogical readiness to effectively integrate AI in an inclusive context. Ogbu Eke (2024) shows that the potential of AI to improve efficiency, such as through automated assessment, rapid feedback, and material differentiation, goes hand in hand

with anxiety about AI and technological resistance triggered by limited professional training, inadequate digital infrastructure, and ethical concerns related to algorithmic bias and data privacy. In line with this, Kalniņa et al (2024) found an increase in the use of AI, including ChatGPT, among teachers, although their perceptions and readiness still vary across demographic groups. This shows that readiness is not only determined by technical competence but is also influenced by social and cultural backgrounds.

Research by Alnaim & Al-Otaibi (2025) in Saudi Arabia confirms that special education teachers show a high level of interest in technologies such as speech recognition and virtual reality, but their utilization remains limited due to technical constraints, a lack of digital facilities, and insufficient institutional support. Meanwhile, Tafazoli (2024) provides a more philosophical perspective by viewing Generative AI, such as ChatGPT, as a means of democratizing education. AI is used not only as a technological tool, but also as a medium for expanding cross-cultural learning access, which requires teachers to have ethical competence and high-level critical thinking skills.

These findings show that a positive perception of AI is not enough to ensure its successful integration into inclusive education practices. (UNESCO, 2024) states that teachers should ideally master the technical foundations of AI (AI foundations), AI pedagogy, and ethical awareness (ethics of AI). Only by combining these three dimensions can teachers use AI responsibly and inclusively. The Intelligent-TPACK model emphasizes that the integration of AI in education is not only about the use of tools, but also how teachers combine AI ethically and effectively in the intersection of content, pedagogy, and technology, taking into account values and context (Celik, 2023; Ning et al., 2024). The gap between perception and practice shows that acceptance of AI has not been fully accompanied by complete professional readiness. Therefore, teacher development needs to be directed towards training that harmoniously integrates technical, pedagogical, and ethical dimensions so that the use of AI is not only effective in terms of instruction but also morally fair and inclusive.

### **Strategies and Practices for Applying AI to Inclusive Learning**

This theme reveals how teachers translate AI technology into concrete inclusive learning strategies. From various studies, three main strategic patterns emerge, namely personalized learning, cultural and social adaptation, and psychological support for teachers and students. In the realm of personalized learning, Arranz-García et al (2025) found that teachers utilize AI to support adaptive learning, automatic formative assessment, and the application of intelligent tutoring systems. This technology enables the adjustment of content, methods, and learning speed according to the profiles of learners, including those with learning disabilities. This approach reinforces the practice of differentiated learning, which is at the heart of inclusive education because it provides space for each student to develop according to their capacities and needs.

Furthermore, in terms of cultural and social adaptation, Yan et al (2025) presented an innovative example of teachers in indigenous communities in the United States who developed a Computer Science and Artificial Intelligence curriculum based on local values and languages through a Design-Based Research approach. The integration of cultural context not only increased students' interest and positive perceptions of technology, but also strengthened their cultural identity. This finding expands the meaning of inclusivity, which focuses not only on special needs but also on appreciation for social and cultural diversity.

The third dimension, psychological support, is reflected in the research by Liu et al (2025), which highlights the use of technologies such as emotion detection, gesture analysis, and virtual simulation to help teachers recognize students' emotional states and respond to them empathetically. The results of this study show that teacher competence in the AI era not only includes cognitive abilities but also social-emotional skills that play an important role in creating a supportive and psychologically safe learning environment.

These three findings mark a shift from the use of AI as a technical tool to the role of AI as a pedagogical partner that supports holistic learning well-being. The AI Pedagogy and AI-TPACK frameworks emphasize the importance of AI integration that meaningfully combines technology, learning objectives, and content (Eden et al., 2024; Ning et al., 2024). The principles of Universal Design for Learning (UDL) and the theory of Culturally Responsive Pedagogy and Inclusive AI Design reinforce this idea by emphasizing flexibility, accessibility, and cultural and linguistic relevance (Hyatt & Owenz, 2024; Saborio-Taylor & Rojas-Ramírez, 2024). Thus, the implementation of inclusive AI requires teachers to balance technological proficiency with pedagogical and cultural sensitivity, which forms the basis for the development of policies and teacher training oriented towards humanistic and contextual AI learning.

### **Policies, Barriers, and Systemic Support for Teacher Competence**

This theme highlights the role of education policy, institutional support, and structural barriers in shaping teachers' readiness to implement artificial intelligence (AI) in inclusive education. The success of AI integration is determined not only by the capacity of individual teachers, but also by policy designs that encourage innovation, equity, and continuous training. A number of studies confirm this direction. Tafazoli (2024) maps out five key themes, namely access, training, curriculum integration, ethics, and assessment, which require a clear policy framework and institutional support. Arranz-García et al (2025) emphasize ethical governance, stakeholder collaboration, and equal access guarantees so that AI becomes an instrument of empowerment. Kalniņa et al (2024) highlight the importance of AI literacy in higher education as the basis for competency improvement policies. Kathy Cheng et al (2025) link the use of AI with the need to strengthen teachers' professional competencies, including training, ethics, and pedagogy, so that the use of AI is inclusive.

Various obstacles continue to limit the effectiveness of policies at the implementation level. Ogbu Eke (2024) found that teachers' readiness and positive attitudes are often hampered by limited facilities, administrative burdens, and inadequate human resource support. Alnaim & Al-Otaibi (2025) showed that the level of AI adoption is still in the moderate category due to a lack of structured training, incentives, and institutional support. These conditions reduce teachers' motivation to develop AI competencies, so policies require concrete implementation mechanisms in the form of funding, infrastructure, and incentives that are in line with teachers' needs.

A number of studies show forms of systemic support that can bridge the gap between policy and practice. Yan et al (2025) show that long-term professional development programs rooted in the local context can strengthen teachers' technological skills as well as their socio-cultural sensitivity to student diversity. Liu et al (2025) add to this the importance of psychosocial support. For example, the use of AI-based emotion detection can help teachers manage stress and build empathetic interactions in the classroom. In line with this, Arranz-García et al (2025) emphasize the need for an ethical and collaborative governance ecosystem so that AI implementation is sustainable and humane.

Within the theoretical framework, UNESCO (2024) recommends that AI teacher competency standards need to be systematically integrated into national and institutional education policies, accompanied by adequate resource allocation, digital infrastructure support, and continuous training programs relevant to learning practices. The Sociotechnical Systems perspective shows that structural barriers, such as organizational norms, facility availability, and institutional culture, are an integral part of the socio-technological system that must be harmonized so that AI adoption does not stop at the use of tools but is truly integrated into everyday pedagogical practices (Kizilcec, 2024; Mamlok, 2025). The ongoing teacher professional learning (OTPL) model shows that communities of practice, mentoring, and ongoing professional development enable teachers to overcome real challenges in the

field and strengthen their AI capabilities (Densmaa & Enkhbat, 2025; Trevisan et al., 2024). Thus, the successful implementation of AI in inclusive education depends heavily on consistent synergy between clear policies, ongoing systemic support, and teacher professional development that is context-oriented and meets real needs.

### **Limitations**

Although this study has been systematically compiled with reference to the PRISMA guidelines, a number of limitations need to be considered when interpreting the findings. This study only utilized two main databases, namely Scopus and Google Scholar, so there is a possibility that some relevant publications indexed in other databases have not been accommodated (Amboka et al., 2025; Gusenbauer, 2024). In addition, the restrictions on the publication range and strict inclusion criteria, although intended to maintain the quality of the study, resulted in a relatively limited number of articles that met the criteria, so that the synthesis of findings emphasized the development of conceptual understanding rather than broad empirical generalization. Variations in geographical context, educational levels, and student characteristics in the studies analyzed may also influence the diversity of findings and their interpretation. Furthermore, the focus on English-language publications has the potential to limit the representation of local or non-English perspectives, particularly from developing countries, which may have different AI implementation practices and challenges (Lund, 2022; Tissingh et al., 2022). Therefore, the results of this study should be understood as an initial mapping that is theoretical and contextual in nature, and as a foundation for further empirical research that is more in-depth, comparative, and context-oriented to enrich our understanding of AI integration in inclusive education.

### **Conclusion**

The integration of artificial intelligence (AI) in inclusive education is largely determined by the competence of teachers as the primary mediators between technology, pedagogy, and the diverse contexts of learners. Findings indicate that although teachers' perceptions of AI tend to be positive, their level of professional readiness varies and is often hampered by limitations in AI literacy, ethical awareness, and pedagogical readiness. This indicates a gap between the acceptance of technology and teachers' actual ability to implement AI inclusively and responsibly. In practice, AI is utilized through learning personalization strategies, social and cultural adaptation, and psychological support that reinforces instructional differentiation and learning well-being. AI is no longer positioned solely as a technical tool, but as a pedagogical partner that supports adaptive, culturally sensitive, and responsive learning to the emotional needs of students. However, the effectiveness of these strategies is highly dependent on teachers' ability to integrate AI into a meaningful pedagogical framework, as emphasized in the AI-TPACK model and the principles of inclusive education.

Furthermore, this study confirms that the success of strengthening teacher competencies cannot be separated from education policy and systemic support. Structural barriers in the form of limitations in infrastructure, training, incentives, and ethical governance remain major challenges in the implementation of AI. Therefore, synergy between UNESCO competency-based policies, institutional support, and continuous professional development is a prerequisite for AI to truly contribute to equitable, inclusive, and sustainable education. Thus, this study develops a conceptual understanding that AI in inclusive education must be viewed as part of a socio-technological system that places teachers as key actors of pedagogical change.

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