

Artificial Intelligence in Mathematics Learning: Examining the Readiness of Pre-Service Mathematics Teachers


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ABSTRACT

The use of AI in mathematics learning plays a crucial role. However, in practice, AI has not been used optimally by teachers to support learning. This study analyses the readiness of pre-service mathematics teachers to use AI in mathematics learning. The research sample was selected purposively, consisting of 42 respondents from the Mathematics Education program at IAIN Kendari in the 2024/2025 academic year. The method used is a descriptive research design with a qualitative approach. Data were collected via Google Forms and semi-structured interviews addressing pre-service teachers' readiness across four dimensions: knowledge, technical, attitudinal, and pedagogical readiness. The data were analysed through thematic analysis involving coding, categorising, and theme development, supported by technical triangulation between questionnaire responses and interview data. The results show that all pre-service mathematics teachers demonstrate knowledge readiness regarding the types of AI frequently used, including ChatGPT, Blackbox AI, Gemini, Photomath, Deepseek, and Mathway. Regarding technical readiness, 40 respondents (95.2%) reported that they can use AI, whereas 2 (4.8%) reported that they cannot. They use AI to compile learning materials, solve problems, and develop instruments. The attitudinal readiness was assessed as follows: 2 respondents (4.8%) were very confident, 29 (69%) were confident, and 11 (26.2%) were not confident. Regarding pedagogical readiness, 3 respondents (7.1%) reported being very ready to integrate AI into mathematics learning, 34 (81%) were ready, and 5 (11.9%) were not ready. The results indicate that pre-service mathematics teachers are generally ready to utilise AI in mathematics learning, but need to be supported by training, policy, and other supporting facilities.

Keywords: Artificial Intelligence, Mathematics Learning, Pre-service Teachers, Readiness.

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Introduction

The development of information technology has significantly contributed to all aspects of life, including education (Ilham, 2022). Among emerging technologies in education, Artificial Intelligence (AI) has become one of the most influential innovations, with the potential to reshape teaching and learning (Chaudhry & Kazim, 2022). In mathematics education, AI supports both teachers and students by providing adaptive and personalised learning experiences, improving instructional effectiveness, and facilitating more flexible learning processes unconstrained by time and space (Badri, 2024; Fadila et al., 2025; Mohamed et al., 2025). In addition, technology-enhanced learning environments, such as dynamic mathematics software, interactive

simulations, and digital platforms, have been shown to improve students' engagement, conceptual understanding, and learning outcomes by making abstract mathematical concepts more visual and interactive (Hillmayr et al., 2020; Li & Ma, 2010).

In mathematics education, AI-powered Intelligent Tutoring Systems (ITS) can personalise instruction by adjusting problem difficulty and feedback according to students' performance, thereby supporting more efficient and individualised learning pathways. Furthermore, AI enables automated assessment and error diagnosis, allowing educators to identify students' misconceptions and learning gaps more accurately (Hwang & Tu, 2021). AI-driven learning analytics can also analyse large-scale student data to monitor progress and predict learning difficulties, enabling timely and targeted interventions (Holmes et al., 2019; Luckin et al., 2016). However, despite these potential benefits, the integration of AI in mathematics learning also raises concerns regarding teachers' technological readiness, ethical considerations, data privacy, and the possible overreliance on AI-generated solutions in the learning process (Holmes et al., 2019; Loglo & Zawacki-Richter, 2023).

Recent studies also highlight that integrating AI into mathematics education can improve students' interest, performance, and overall perception of the subject, while promoting more adaptive and data-informed teaching practices (Gabriel et al., 2025; Nanda & Pradhan, 2025). Furthermore, AI can transform negative perceptions of mathematics, often perceived as complex and abstract, into more engaging and realistic learning. AI-based learning systems can adapt mathematical materials to students' environments, needs, and levels of understanding (Dabingaya, 2022; Zhao et al., 2025).

From another perspective, if not properly managed by teachers, the use of AI can lead to student dependence on technology (Luckin et al., 2016). Furthermore, excessive use of AI can diminish critical thinking and problem-solving skills because students tend to accept instant answers without in-depth analysis (Selwyn, 2019). Furthermore, the use of AI also opens up the potential for misinformation, which can disrupt a comprehensive understanding of mathematical concepts (Mudenda, 2025).

The success of AI in mathematics learning depends not only on the sophistication of the technology itself but also on the readiness of teachers and pre-service teachers, particularly pre-service mathematics teachers, to adapt and integrate it into classroom mathematics instruction (Jita et al., 2025; Luon et al., 2025). Teachers are the primary agents in the classroom learning process; therefore, their ability to integrate technology into instruction will positively affect their students' success. Thus, pre-service teachers

must possess the knowledge, skills, and positive attitudes necessary to effectively use AI in mathematics learning, thereby enabling an engaging, effective, and efficient mathematics classroom. However, such readiness cannot be assumed, as many pre-service teachers still face challenges in integrating AI into mathematics instruction.

Based on observations of pre-service teachers in the Mathematics Education study program at IAIN Kendari revealed that some pre-service mathematics teachers still haven't utilised AI technology to develop or prepare mathematics lessons. The biggest obstacle they face is a lack of ability to integrate AI into their learning. Furthermore, there hasn't been adequate training on AI competency to enable them to use it wisely.

This is supported by research results showing that teacher readiness for technological innovation varies widely. In the context of AI integration in learning, several studies have revealed that teachers and pre-service teachers still face various challenges, such as limited technical knowledge about AI, lack of practical experience in using AI tools, concerns about the social impact of AI use, and inadequate facilities and infrastructure (Holmes et al., 2019; Luon et al., 2025; Mujib & Walid, 2025; Rahiman & Kodikal, 2024; Wardat et al., 2024). Teachers and pre-service teachers often do not receive adequate training in the effective and efficient use of AI in classroom instruction. However, according to Ofem et al. (2025), teacher readiness must encompass both technical and pedagogical aspects. Teachers must be able to operate and integrate AI into learning. As prospective teachers, they must equip themselves with various types of AI to support future learning.

Although the literature on AI in education is growing (Korkmaz Guler et al., 2024; Luon et al., 2025; Wardat et al., 2024), research on the readiness of pre-service mathematics teachers to adopt AI in learning remains limited. Most studies examine teacher readiness in general, rather than specifically for mathematics learning, which has distinct characteristics and pedagogical challenges. For example, understanding abstract and complex mathematical concepts requires a different AI approach than in other fields of study (Zawacki-Richter et al., 2019). Furthermore, there is a lack of research on the analysis of pre-service mathematics teachers' readiness within the mathematics education study program, including knowledge of AI, technical readiness, attitude, and pedagogical readiness. This issue is becoming increasingly urgent due to the rapid development of AI technologies and their growing integration into mathematics education.

By explicitly identifying pre-service mathematics teachers' readiness to use AI, the challenges they face, and their needs, this study can provide preliminary information on their readiness to prepare teachers who can adapt to AI developments in learning.

The results of this study will inform the design of targeted educational development programs to enable pre-service teachers to maximise AI's potential to improve the quality of mathematics learning. Therefore, this study aims to analyse pre-service mathematics teachers' readiness to utilise AI in mathematics learning.

Methods

Research Design and Participants

This study employed a descriptive qualitative research design to explore pre-service mathematics teachers' readiness to use Artificial Intelligence (AI) in mathematics education. The research was conducted with students from the Mathematics Education study program at IAIN Kendari during the 2024/2025 academic year. A total of 42 participants (R1–R42) were involved in the study. Purposive sampling was used to select pre-service mathematics teachers who were at least in their fourth semester.

Data were collected through an asynchronous semi-structured online interview integrated into a Google Forms questionnaire. Online qualitative interviews are considered appropriate for qualitative research because they provide participants with flexibility in responding and enable data collection without geographical or time constraints (Harris et al., 2024; Salmons, 2014). In this study, participants responded independently to open-ended questions and described their experiences using their own words. Previous studies have shown that asynchronous written interviews conducted through online platforms can generate rich qualitative data while also offering practical advantages in accessibility and efficiency (Opara et al., 2023; Ratislavová & Ratislav, 2014).

Research Instruments

The study used a structured questionnaire distributed through Google Forms, consisting of closed-ended and open-ended questions. The questionnaire was developed to measure four dimensions of readiness adapted from Chuyen & Vinh (2025) and Ofem et al. (2025), namely knowledge readiness, technical readiness, attitudinal readiness, and pedagogical readiness. The instrument was validated through expert judgment involving two experts in mathematics education and one expert in educational technology from IAIN Kendari.

The open-ended questions functioned as asynchronous written interview prompts that allowed participants to elaborate on their perspectives regarding AI use in mathematics education. These questions explored participants' reasons for agreeing or disagreeing with AI use, their confidence in using AI, their perceived readiness, the supporting needs they identified, and the challenges they encountered. The inclusion

of these open-ended responses enabled the researcher to obtain richer qualitative insights that complemented the structured questionnaire data.

Data Analysis

Data analysis followed a thematic analysis procedure adapted from (Braun & Clarke, 2006) and comprised the following stages. First, all questionnaire responses were tabulated and descriptive statistics (frequencies and percentages) were calculated for each readiness dimension. Second, open-ended responses were read repeatedly to achieve data familiarisation. Third, initial codes were generated from the qualitative responses by identifying meaningful segments related to the four readiness dimensions. Fourth, codes were grouped into potential themes and reviewed against the data set to ensure coherence. Fifth, themes were refined and defined, then mapped onto the four readiness dimensions. Data trustworthiness was ensured through technical triangulation, in which findings from the structured questionnaire items were systematically compared with the open-ended qualitative responses to identify convergence and divergence between the two data sources.

Result and Discussions

The use of AI in mathematics education has become necessary as technology continues to advance. This requires pre-service teachers to possess strong adaptability in understanding, operating, and integrating AI into their learning. This readiness encompasses knowledge, technical, attitude, and pedagogical readiness. Each dimension is presented below, supported by both questionnaire results and qualitative findings.

Knowledge Readiness

In relation to the readiness of knowledge about AI, information was obtained about whether pre-service teachers know about Artificial Intelligence (AI).

Table 1. Pre-service Mathematics Teachers' Knowledge of AI

Response	Amount	Percentage (%)
Yes	42	100
No	0	0
Amount	42	100

Table 1 shows that 42 (100%) pre-service teachers reported knowing about Artificial Intelligence (AI). This indicates that all pre-service teacher respondents already have knowledge of AI. Based on the interview results, they already had initial knowledge of AI through independent learning on AI tools commonly used by pre-service

mathematics teachers, namely ChatGPT, Blackbox AI, Gemini, Photomath, DeepSeek, and Mathway. This aligns with research by Luon et al. (2025) and Tashtoush et al. (2024), which indicates that most teachers are aware of AI technology. This finding suggests that awareness of AI among pre-service mathematics teachers is relatively high and consistent with current trends in educational technology adoption.

The qualitative responses provided further insight into how this knowledge was acquired. The majority of respondents reported that their familiarity with AI tools came through self-directed exploration rather than formal instruction within their teacher education program. Several respondents reported using multiple tools simultaneously for different purposes; for instance, one respondent stated as follows.

- Interviewer* : “Alat atau aplikasi apa yang biasa Anda gunakan ketika belajar matematika?”
 [“What AI tools or applications do you usually use when learning mathematics?”]
- R2 : “Chat GPT, Blackbox AI, Gemini.”
- R13 : “ChatGPT, Photomath, dan Deepseek.”
 [“ChatGPT, Photomath, and Deepseek.”]
- R30 : “GeoGebra, Mathway, Wolfram Alpha.”

The breadth of tools identified suggests that pre-service teachers are not limited to a single AI platform but have explored various options suited to different mathematical tasks.

This finding is noteworthy because it suggests that while knowledge readiness is universally present among the respondents, this knowledge is largely informal and self-acquired. From the perspective of the Technological Pedagogical Content Knowledge (TPACK) framework (Mishra & Koehler, 2006), technological knowledge alone is insufficient for effective integration; it must intersect with pedagogical and content knowledge.

Technical Readiness

Specifically regarding technical readiness for the application of AI in mathematics learning, information is obtained.

Table 2. Pre-service teachers who can use AI in mathematics learning

Response	Amount	Percentage (%)
Yes	40	95.2
No	2	4.8
Amount	42	100

Based on Table 2, 40 (95.2%) pre-service teachers reported using AI in mathematics learning, whereas 2 (4.8%) reported being unable to use it. These results indicate that some pre-service mathematics teachers already have knowledge of AI but are not yet able to integrate it into mathematics instruction.

For pre-service teachers who have already used AI in mathematics courses, AI is employed in several ways. The following describes the use of AI in mathematics instruction.

Table 3. Type: Utilisation of AI in mathematics learning

Types of AI Utilisation	Amount	Percentage (%)
Compiling Teaching Materials	14	33.3
Compiling Student Worksheet	14	33.3
Developing Test Instruments	16	38.1
Solving Math Problems	32	76.2
Other	9	24

Based on Table 3, 40 pre-service teachers reported implementing AI in mathematics instruction across several activities. There were 32 respondents (76.2%) who used AI to solve mathematical problems, 16 respondents (38.1%) who used it to help compile test instruments, and 14 respondents (33.3%) who used it to compile the Student Worksheet and Teaching Materials.

The qualitative data both confirmed and elaborated upon these questionnaire findings. The predominance of solving math problems as the primary use of AI (76.2%) was explained by respondents as reflecting their immediate academic needs. As the respondents explained as follows.

Interviewer : “Mengapa Anda menggunakan AI ketika belajar matematika?”

[“Why do you use AI in learning mathematics?”]

R10 : “Karena memberikan solusi ketika sudah tidak bisa mengerjakan soal.”

[“Because it provides solutions when I can no longer solve the problem.”]

R5 : “Sebab AI juga banyak membantu mahasiswa utamanya dalam segi mengefisienkan waktu dalam proses pengerjaan.”

[“Because AI also helps students a lot, mainly in terms of making the work process more time-efficient.”]

The relatively lower use of AI for compiling teaching materials (33.3%) and student worksheets (33.3%) compared to solving problems (76.2%) reveals a gap between technical ability and pedagogical application. This pattern aligns with Kasneci et al.

(2023), who noted that novice educators tend to adopt AI tools for immediate task completion rather than for deeper pedagogical purposes.

Attitudinal Readiness

The use of AI is believed to improve students' understanding of mathematical concepts. This statement is supported by research on pre-service teachers' attitudinal readiness in implementing AI, which shows the following.

Table 4. Pre-service Teachers' Confidence in the Use of AI in Mathematics Learning Can Improve Students' Understanding of Mathematical Concepts

Confidence Level	Amount	Percentage (%)
Very Confident	2	4.8
Certain	29	69
Not sure	11	26.2
Total	42	100

Based on [Table 4](#), it was found that the level of confidence of pre-service teachers in the use of AI in mathematics learning that can improve student understanding is very confident, as many as 2 respondents (4.8%), confident as many as 29 respondents (69%), and not confident as many as 11 respondents (26.2%).

The qualitative data revealed that attitudinal differences were rooted in distinct experiences, beliefs, and reasoning. Respondents who expressed confidence articulated specific mechanisms through which they believed AI could enhance student understanding.

Interviewer : "Menurut Anda, apakah AI dapat meningkatkan pemahaman matematika siswa? Mengapa?"

["Do you think AI can improve students' understanding of mathematics? Why?"]

R7 : "Saya yakin AI dapat meningkatkan pemahaman siswa karena AI memberikan penjelasan yang mudah dipahami, latihan yang sesuai kemampuan, dan umpan balik langsung."

["I am confident AI can improve students' understanding because AI provides explanations that are easy to understand, exercises suited to their abilities, and direct feedback."]

Conversely, respondents who were not confident (26.2%) expressed substantive concerns.

Interviewer : *“Menurut Anda, apakah AI dapat meningkatkan pemahaman matematika siswa? Mengapa atau mengapa tidak?”*

["Do you think AI can improve students' understanding of mathematics? Why or why not?"]

R35 : *“Tidak yakin karena biasa saja dalam pembelajaran matematika siswa hanya akan bergantung pada AI dan tidak banyak berfikir saat memecahkan persoalan-persoalan matematika.”*

["Not confident because usually in mathematics learning, students will only depend on AI and not think much when solving mathematical problems."]

As noted by Herasymchuk et al. (2025), Pisica et al. (2025), and , there are pros and cons to using AI in learning, but its judicious use can improve student understanding.

Pedagogical Readiness

This belief indicates pre-service mathematics teachers' readiness to integrate AI into mathematics instruction. The research findings are as follows.

Table 5. Readiness of Pre-service Teachers in the Utilisation of AI in Mathematics Learning

Readiness Level	Amount	Percentage (%)
Very Ready	3	7.1
Ready	34	81
Not Ready	5	11.9
Total	42	100

Referring to the results in Table 5, the readiness of pre-service teachers to integrate AI in mathematics learning was categorised as very ready by 3 respondents (7.1%), ready by 34 (81%), and not ready by 5 respondents (11.9%). This indicates that the majority of pre-service mathematics teachers are ready to utilise AI in their mathematics learning.

The qualitative data provided crucial depth to these findings by revealing the factors that differentiate levels of pedagogical readiness. The most frequently cited need was for training on AI use in education, institutional policies governing AI use, and adequate technology infrastructure. Several respondents identified training on ai use as the primary supporting facility, while others emphasised policies on ai use in the education environment, and electronic devices.

Interviewer : *“Fasilitas atau dukungan apa yang dibutuhkan untuk mengoptimalkan penggunaan AI dalam pendidikan?”*

["What facilities or support are needed to optimise the use of AI in education?"]

R1 : *“Pelatihan Penggunaan AI.”*

- R6 : *["Training on AI Use."]*
: *"Kebijakan Penggunaan AI di lingkungan Pendidikan"*
["Policies on AI Use in the Education Environment."]
- R8 : *"Perangkat Elektronik."*
["Electronic Devices."]

The most prevalent obstacle reported was the unreliability of AI outputs in mathematics.

- Interviewer : *"Tantangan apa yang Anda alami ketika menggunakan AI dalam pembelajaran matematika?"*
["What challenges do you experience when using AI in mathematics learning?"]
- R3 : *"Kadang ada jawaban dari AI yang saya tidak paham dan jawabannya kurang tepat."*
[Sometimes there are answers from AI that I don't understand and the answers are not quite right.]
- R7 : *"Keterbatasan akses teknologi, seperti perangkat yang tidak memadai dan koneksi internet yang tidak stabil."*
[Limited access to technology, such as inadequate devices and unstable internet connection.]

Based on these results, the use of AI must be supported by adequate AI infrastructure. Furthermore, intensive training is needed so that pre-service mathematics teachers have adequate digital literacy skills and pedagogical competencies to integrate AI into mathematics learning. As Mulyani et al. (2025) stated, teachers must have a sound knowledge of AI to be able to use it wisely. On the other hand, policy support is crucial to ensuring that AI implementation in learning meets high standards, thus improving the quality of learning (Chan, 2023; Klarisa et al., 2023).

Synthesis and Implications

Taken together, the findings across the four readiness dimensions reveal a pattern that is both encouraging and instructive for mathematics teacher education. Pre-service teachers at IAIN Kendari demonstrate strong foundational readiness—universal AI awareness, high technical capability (95.2%), generally positive attitudes (73.8% confident or very confident), and predominant willingness to integrate AI pedagogically (88.1% ready or very ready). However, beneath these surface-level indicators lies a more complex reality. The qualitative data reveal that readiness is unevenly distributed across dimensions and is significantly influenced by the accuracy of AI outputs, access to infrastructure, prompt literacy, and the presence or absence of formal training.

From a theoretical perspective, the findings align with both the TPACK framework and the Technology Acceptance Model (TAM). The TPACK framework helps explain why pre-service teachers who possess technological knowledge but lack pedagogical integration skills struggle to envision effective AI-enhanced instruction—they can use AI to solve their own problems, but cannot yet design AI-enhanced lessons for their future students. This is clearly reflected in the data: 76.2% of respondents used AI to solve mathematical problems, yet only 33.3% used it to compile teaching materials or student worksheets. The gap between personal utility and pedagogical application indicates that technological knowledge, without deliberate integration with pedagogical and content knowledge, remains insufficient for effective classroom use (Mishra & Koehler, 2006). The TAM model further illuminates why direct, positive experiences with AI tools foster stronger attitudes and greater readiness, while experiences with inaccurate outputs or difficult prompting breed hesitation. As the qualitative data showed, respondents who encountered AI's capacity for step-by-step explanations and accessible information expressed greater confidence, whereas those who experienced incorrect AI-generated solutions—as one respondent noted, "*Kendalanya jawaban matematika dari AI itu tidak selalu nya benar*" [The obstacle is that mathematical answers from AI are not always correct] (R25)—developed more cautious attitudes. This aligns with the TAM principle that perceived usefulness and perceived ease of use are primary determinants of technology acceptance (Aksakalli & Daşer, 2025).

These findings carry important implications for mathematics teacher education programs. First, AI literacy should be embedded as a formal component of the pre-service teacher curriculum, moving beyond general digital literacy to include discipline-specific applications of AI in mathematics instruction. This could include modules on prompt engineering for educational purposes, critical evaluation of AI-generated mathematical content, and strategies for designing AI-enhanced mathematics lessons. The respondents' consistent identification of training needs, as evidenced by numerous participants citing "*Pelatihan Penggunaan AI*" [Training on AI Use] as the primary supporting facility they require (R1, R4, R13, R29, R31), underscores the urgency of this recommendation. Furthermore, one respondent explicitly articulated the need for targeted pedagogical training: "*Saya masih kurang pengalaman dan pelatihan dalam menggunakan AI secara efektif, sehingga perlu belajar lebih lanjut agar penggunaannya benar-benar membantu siswa memahami konsep, bukan sekadar mencari jawaban*" [I still lack experience and training in using AI effectively, so I need to learn more so that its use truly helps students understand concepts, not just search for answers] (R42). This response captures precisely the gap that curriculum reform should address.

Second, institutions must address infrastructural barriers by ensuring adequate access to devices, stable internet connectivity, and AI software. The respondents' identification of "*Perangkat Elektronik*" [Electronic Devices] (R8, R9, R38) and "*Perangkat lunak AI*" [AI Software] (R1, R29, R30) as critical supporting needs indicates that readiness cannot be fully realised without equitable access to technology. One respondent captured this challenge vividly: "*Keterbatasan akses teknologi, seperti perangkat yang tidak memadai dan koneksi internet yang tidak stabil*" [Limited access to technology, such as inadequate devices and unstable internet connection] (R7). In the Indonesian educational context, where digital infrastructure remains unevenly distributed across regions and institutions (Rahiman & Kodikal, 2024), addressing these material conditions is a prerequisite for any meaningful AI integration effort.

Third, clear institutional and national policies regarding AI use in education are needed to provide guidance and build confidence among pre-service teachers. The frequent mention of "*Kebijakan Penggunaan AI di lingkungan Pendidikan*" [Policies on AI Use in the Education Environment] (R6, R11, R23, R24, R25, R35) reflects a genuine desire for structured guidelines that legitimise and govern AI use in educational settings. The absence of such policies contributes to uncertainty, as one respondent noted: "*Kendala nya terkadang terkendala di aksesnya yang terbatas*" [The obstacle is sometimes limited access] (R13), suggesting that without institutional direction, pre-service teachers are left to navigate AI integration independently, without clear boundaries or standards. Policy support is crucial to ensuring that AI implementation in learning meets high standards, thus improving the quality of learning (Chan, 2023; Klarisa et al., 2023).

Fourth, ethical considerations deserve particular attention in preparing pre-service teachers for AI integration. The qualitative data revealed that respondents are already grappling with ethical concerns, even without formal instruction on the topic. One respondent expressed concern about dependency: "*Kekhawatiran akan ketergantungan pada AI, belum semua AI itu update terhadap kurikulum terbaru dan masih perlu di perhatikan kembali karena AI sering juga keliru*" [Concern about dependence on AI; not all AI are updated to the latest curriculum, and it still needs to be reviewed because AI is often also wrong] (R2). Another respondent raised a more fundamental pedagogical concern: "*Karena kemampuan setiap mahasiswa berbeda-beda, jadi dengan menggunakan AI tidak semua mahasiswa dapat memahami sepenuhnya tanpa penjelasan contoh dari seorang dosen*" [Because each student's ability is different, so by using AI, not all students can fully understand without example explanations from a lecturer] (R40). These organically emerging concerns about academic integrity, AI accuracy, over-dependence, and the irreplaceable role of human instruction represent a foundation upon which formal ethical training can be built. Issues such as algorithmic bias in AI-

generated content, data privacy, and the potential for AI to perpetuate or exacerbate educational inequalities should be incorporated into teacher training programs (Holmes et al., 2019; Zawacki-Richter et al., 2019). Pre-service teachers must be equipped not only to use AI effectively but also to critically evaluate its outputs and guide students in responsible AI use.

Therefore, the use of AI in mathematics education requires thorough, multi-level preparation. At the individual level, pre-service teachers need structured training that bridges the gap between personal AI use and pedagogical AI integration. At the institutional level, teacher education programs must provide adequate infrastructure, embed AI literacy into the curriculum, and establish clear guidelines for AI use. At the policy level, national frameworks are needed to ensure standardisation and quality assurance in AI-enhanced education. Only through this systemic approach—addressing individual competencies, institutional conditions, and policy frameworks simultaneously—can the strong foundational readiness demonstrated by pre-service teachers at IAIN Kendari be translated into effective, ethical, and pedagogically meaningful AI integration in mathematics learning.

Conclusion

Based on the research results, it can be concluded that pre-service mathematics teachers are generally well prepared to utilise AI in mathematics learning across knowledge, technical skills, attitudes, and pedagogy. Pre-service mathematics teachers are not only familiar with various types of AI (ChatGPT, Blackbox AI, Gemini, Photomath, DeepSeek, and Mathway) but also able to use them to develop teaching materials, student worksheets, and evaluation instruments, and to assist in solving complex mathematical problems.

However, some respondents still expressed doubts regarding the potential misuse of AI and its impact on students' thinking skills, indicating that this readiness is not yet fully distributed. Furthermore, it is necessary to strengthen the competencies of pre-service mathematics teachers through training so that they can use AI according to correct and wise procedures. Importantly, policy support is key to the successful use of AI to ensure good standardisation.

These findings provide an important empirical basis for developing pre-service teacher training programs and formulating more systematic policies for AI integration in both mathematics and other learning activities. However, this study is limited by its sample size and single-institution coverage, so generalisation of the findings requires caution. Therefore, further research is recommended to involve a wider sample, use a more in-depth research approach, and examine in more depth the effectiveness of

using AI on students' learning achievement, critical thinking skills, and 21st-century skills in mathematics learning.

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Author 2: Writing - Translate
Author 3: Validation and Supervision
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