

Cultural Change of Mathematics Teachers' Views On Technology: Navigating the Artificial Intelligence Revolution

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ABSTRACT

The development of technology related to Artificial Intelligence is growing rapidly, and one of its implications is teaching mathematics in the classroom. Therefore, it is necessary to conduct research on the perspective of mathematics teachers in addressing the development of artificial intelligence (AI) used in mathematics learning. This study examines the role of AI technology in facilitating pedagogical reform in mathematics education from the perspective of teachers. Through a questionnaire distributed to mathematics teachers, this paper identifies teachers' perspectives on the development of AI and its use in their classrooms. A total of 56 mathematics teachers participated in this study. In addition to the five-item questionnaire, an open-ended questionnaire was also provided. A number of AI that teachers use in their teaching are also mentioned in this paper. The paper also discusses the challenges mathematics teachers face when using AI in mathematics lesson planning in their classrooms. It concludes that mathematics learning using AI has significant potential to improve students' competencies by equipping them with essential skills for the digital age.



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1. Introduction

The rapid evolution of both AI and traditional technologies. The development of technology affects various sectors of life, including education. Technological development affects education, and vice versa; education also affects technological development. The reciprocal relationship between education and technology goes hand in hand. Artificial Intelligence (AI) offers exciting possibilities that could transform traditional teaching methods. Integrating AI in the classroom is more than just a tech upgrade; it signifies a cultural shift in how educators view and use technology. Artificial Intelligence (AI) is changing how we interact with technology and live our lives. It can potentially revolutionize education, particularly teacher education [1].

Teaching is a dynamic profession, even more so today. The rapid growth of new technologies is transforming education and posing new challenges. Today, almost all teachers utilize some form of presentation software. They have various ways to interact with students through email, mailing lists, instant messaging, blogs, and online videos [2]. However, the development of technology used in education by teachers is still mainly limited to traditional forms of technology that do not utilize AI, such as computers, tablets, mobile phones, and others. However, the use of AI in education has recently begun to flourish. Various studies show that AI is used in designing learning [3] and as a

classroom activity tool [4], [5]. As a learning evaluation tool [6], some even go beyond replacing the teacher's duties [7].

Various studies on the use of AI in education are conducted in various fields, including learning English [8], [9], [10], [11]. AI is also found in music teaching [3], [4], [12], [13], [14], sciences [15], [16], and maths [17]. A study also proved that AI is better than humans at carrying out certain detailed tasks and navigating large amounts of factual knowledge [2].

Research shows that teachers' attitudes towards AI play a crucial role in its practical use in the classroom. Teachers' perceptions of AI greatly influence their willingness to use these technologies in teaching [18]. This highlights the importance of fostering a positive outlook towards AI to ensure its successful implementation. Furthermore, integrating AI into education requires rethinking the teacher's role [7]. As AI takes over more administrative [11] and repetitive tasks, teachers can focus on meaningful student interactions [10], fostering critical thinking [19], creativity [19], and problem-solving skills [20].

With its foundation in logic and problem-solving, mathematics is at the cutting edge of this change. Traditionally, teaching mathematics has relied on a straightforward, step-by-step approach to explain concepts [21]. However, AI brings a new dynamic, adapting to individual student needs [22], [23], providing instant feedback [23], [24], [25], and offering fresh ways to tackle math problems. Mathematics teachers now face the challenge of incorporating these advanced technologies into their teaching while staying true to their educational philosophies. This shift enhances the learning experience and reshapes the professional identity of mathematics teachers.

Despite the potential benefits, adopting AI in mathematics education comes with challenges [9], [26]. Concerns about data privacy, the digital divide, and the adequacy of teacher training are significant barriers that need addressing. There is a need for comprehensive professional development programs to equip teachers with the necessary skills and confidence to use AI effectively.

In conclusion, the cultural change in mathematics teachers' views on technology, especially AI, is a complex process involving overcoming resistance, rethinking teaching approaches, and addressing practical challenges. As we navigate the AI revolution, we must support teachers through ongoing professional development and create an environment that embraces technological innovation while maintaining educational values. AI is a leap across creative and innovative thinking in various fields, including mathematics education [27]. On the other hand, learning mathematics using AI has pros and cons for teachers and students. Concerns about the use of AI have been related to ethics. The next question concerns teachers' attitudes towards AI, including maths teachers' knowledge of AI. This research reveals how maths teachers' understanding of AI, the utilization of AI in mathematics classrooms, and maths teachers' attitudes towards AI.

2. Method

2.1. Research Method

This study aims to reveal how maths teachers' understanding of AI, utilization of AI in mathematics classrooms, and maths teachers' attitudes towards AI. To gather the data, the researcher conducted a study on how maths teachers' understanding of AI, utilization of AI in mathematics classrooms, and maths teachers' attitudes towards AI through questionnaires to mathematics teachers, with the following grid (see Table 1).

Table 1. Questioner Grid of Mathematics Teachers' Views on AI

<i>Aspect</i>	<i>Indicators</i>
Maths teachers' understanding of AI	Mathematics Teachers recognise AI
	Mathematics Teachers aware of AI applications in education
Utilization of AI in the mathematics classroom	Mathematics Teachers use AI to support learning
	Mathematics Teachers use AI for evaluation
Maths teachers' attitudes towards AI	Mathematics Teachers find AI helpful
	Mathematics Teachers have a positive view on the future of AI in education

In addition, we also added an item in the questionnaire that contains open-ended questions about the AI teachers use and teachers' efforts in learning AI in training.

2.2. Data Collection

Data was collected through a questionnaire through Google Forms and distributed through the WhatsApp group of teachers. Based on the results of the questionnaire distributed, data was obtained from 56 teacher respondents who teach mathematics, most of whom came from Yogyakarta (21%), Bantul (21%), Sleman (13%), and others from various other cities.

2.3. Data Analysis

Two data types are obtained through the distributed questionnaires, i.e., data derived from closed-ended questions and data derived from open-ended questions. Data from closed-ended questions (quantitative data from surveys) was processed with descriptive statistics, which included summarising the data, the percentage of teachers who experienced it (frequency distribution), and the mode of the data obtained. Meanwhile, data derived from open-ended questions were processed to complement the closed-ended questions and analyzed descriptively.

3. Results and Discussion

This study explored the existing use of AI in mathematics teaching and learning in schools. To answer the research question, a questionnaire was used to explore mathematics teachers' knowledge, utilization, and attitudes toward using AI in mathematics learning.

3.1. Teachers' Knowledge of AI

Over half of the teaching staff surveyed indicated awareness of AI, with over a quarter demonstrating recognition of the technology. A mere 11% of teachers indicated they were aware of AI, with no respondents stating that they were unfamiliar with the concept. As illustrated in Figure 1 (blue line), mathematics teachers demonstrate an awareness of AI.

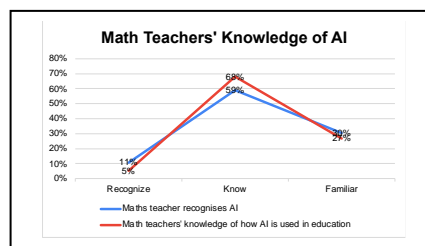


Fig. 1. Mathematics Teacher's Knowledge of AI

Almost three-quarters of teachers indicated that they were aware of the utilization of AI in education. In comparison, 27% of the same group reported that they were conversant with the application of AI in this domain. A mere 5% of teachers indicated awareness of the use of AI in education, while no teachers stated a lack of understanding. Mathematics teachers' awareness about using AI in an educational context is illustrated in Figure 1 (red line).

The results demonstrate that most mathematics teachers are aware of AI, with over half indicating that they possess knowledge of AI and over a quarter reporting familiarity with AI. A mere 11% of respondents identified AI as the technology in question, with none indicating a lack of understanding. In terms of the application of AI in education, nearly three-quarters demonstrated sufficient knowledge, over a quarter exhibited awareness, and only 5% identified its utilization. None of the teachers surveyed indicated that they were unaware of the educational applications of AI.

3.2. Utilization of AI in Education

Most teachers (52%) frequently employ AI applications to prepare lessons, whereas a minority (5%) invariably utilize them. Most teachers (30%) occasionally utilize AI, while 13% do so infrequently, and none indicated that they never employ it (blue line). Most teachers (64%) frequently utilize AI to enhance classroom learning activities, with a notable proportion (18%) employing it occasionally. A smaller percentage of respondents indicated that they rarely (7%) or never (4%) utilize AI for this purpose, while 7% stated that they always do so (red line). A considerable proportion of teachers (52%) frequently employ AI to provide student feedback. A similar proportion of teachers

(11%) utilize AI to provide feedback, either occasionally or never, while 5% do so infrequently and 11% do so consistently (yellow line).

The graph illustrates that a considerable number of teachers frequently employ AI in their pedagogical practice, particularly for the preparation of lessons and the facilitation of classroom activities. Providing feedback to students via AI is also a common practice, albeit with a more diverse range of frequencies. The most frequently occurring response across all three AI applications was "often." The lowest frequency was consistent 'never,' indicating that most teachers incorporate AI into their teaching in some capacity.

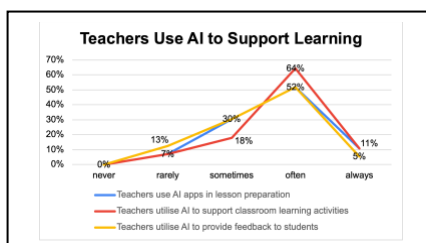


Fig. 2. Mathematics Teacher’s Utilization of AI for Learning

Most teachers (52%) utilize AI applications regularly for lesson preparation, with a further 30% employing them occasionally. Only 13% of respondents indicated that they rarely utilize AI, while a small proportion (5%) said they always do so. A significant proportion of teachers (64%) frequently integrate AI into their classroom learning activities. 18% of teachers do so occasionally, while a smaller number (7%) or even a minority (4%) rarely or never do so. A minority of respondents (7%) indicated they use AI for classroom learning activities.

Additionally, AI provides feedback, with 52% of teachers doing so frequently. A smaller proportion of respondents (11%) indicated that they sometimes or never use AI for feedback, with 5% stating that they rarely do so and 11% indicating that they always do. The data demonstrates the pervasive use of AI in pedagogical contexts, particularly for lesson preparation and classroom activities. The most common frequency of use across these applications is "often."

Most teachers (52%) frequently employ AI for assessment purposes. A notable proportion of teachers (34%) occasionally utilize AI for assessment purposes, whereas a relatively small number of teachers (14%) seldom, if ever, employ this technology in this capacity. A minority of respondents (4%) indicated they always employ AI for assessment purposes (represented by the blue line). A considerable proportion of teachers (46%) frequently employ AI to evaluate teaching methodologies. Most respondents (30%) indicated that they occasionally utilize AI. A minority of teachers indicated that they rarely (14%) or always (5%) employ AI to evaluate teaching methods. None of the respondents reported ever utilizing this technology (red line). The graph illustrates that a considerable number of teachers incorporate AI into the evaluation process for both assessment and the assessment of teaching methods. The category "often" represents AI's most frequently utilized frequency in assessing and evaluating teaching methods, with 52% and 46%, respectively. The "never" category was the least often used for both purposes, with 2% for assessment and 0% for evaluating teaching methods. The utilization of AI for assessment was observed to occur with slightly greater frequency than that of AI for the evaluation of teaching methods, with a higher percentage of responses indicating the former to be employed 'often' (52% vs. 46%). Nevertheless, a more significant proportion of teachers utilized AI to evaluate teaching methods consistently, as opposed to its use in assessment (5% vs. 4%).

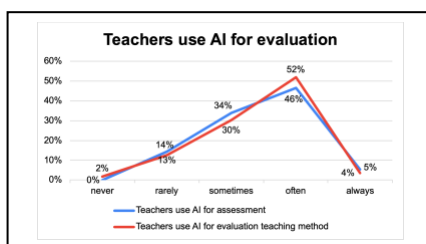


Fig. 3. Mathematics Teacher’s Utilization of AI for Evaluation

A significant proportion of teachers (52%) frequently employ AI for assessment purposes, while a further 34% utilize it on occasion. A small proportion of respondents indicated that they rarely (14%) or never (2%) utilize AI for assessment purposes. Additionally, 4% of respondents indicated they always employ AI for assessment. The evaluation of teaching methods: Most teachers (46%) frequently employ AI to evaluate teaching methods, while a third (30%) do so occasionally. A smaller proportion utilize AI less regularly, with 14% doing so rarely and 5% doing so regularly. The category of "often" was the most frequently occurring response for the frequency of AI utilization in assessing and evaluating teaching methods. The use of AI for assessment purposes is slightly more prevalent than its use for evaluating teaching methods.

The survey results, which included open-ended questions about the use of AI, indicated that most teachers reported utilizing ChatGPT and Gemini. In addition, the respondents stated that they had received AI-related training, including at the Gemini Academy, on using AI (Copilot), creating AI-based learning materials, GPT chat workshops, and training on using Piloting, among other topics.

3.3. Teachers Attitude Towards AI

The majority of teachers hold a favorable view of AI technology in education. Most teachers strongly agree that AI is useful and believe it can enhance the quality of learning. 46% of respondents agreed with the assertion that AI is helpful, while 57% expressed the belief that AI has the potential to enhance the quality of learning. A mere 4% of respondents expressed disagreement with the assertion that AI is helpful, while no one disagreed with the proposition that AI can enhance the quality of learning.

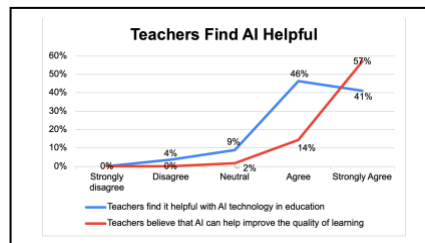


Fig. 4. Mathematics Teacher's Find AI Helpful

A significant proportion of teachers hold a favorable view of AI technology in education. Most teachers concur or strongly concur that AI is beneficial, with the highest level of agreement observed in the belief that AI can enhance the quality of learning (57%). There is minimal opposition to integrating AI in education, as evidenced by the absence of any respondents who selected either the 'Strongly Disagree' or 'Disagree' options in the context of AI improving the quality of learning. The majority of teachers hold a favorable view of AI in education. Forty-six percent of teachers strongly agree that AI is highly beneficial in education. A significant proportion of teachers (57%) hold the view that AI has the potential to enhance the quality of learning.

Teachers positive outlook on AI's future in education is shown in Figure 5. There is a paucity of opposition to the integration of AI in education. Only 4% of respondents expressed disagreement with the assertion that AI is beneficial, while 0% indicated that they believe it is not capable of enhancing the quality of learning. A minority of teachers remain neutral or express some degree of agreement. No teachers were neutral on the benefits of AI, while 2% were neutral on its impact on learning quality. Overall, the data suggests strong support for integrating AI technology in education among teachers, particularly its potential to enhance learning quality.

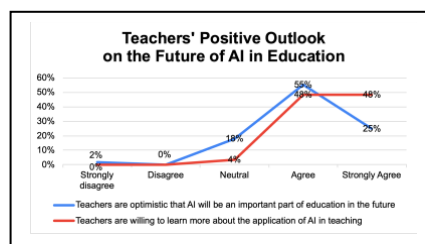


Fig. 5. Mathematics Teacher's Positive Outlook on the Future of AI in Education

The majority of teachers surveyed expressed optimism about the potential of AI to enhance educational outcomes. Many indicated a desire to participate in AI-related training, with a subset having already attended such training (Fig. 6.).

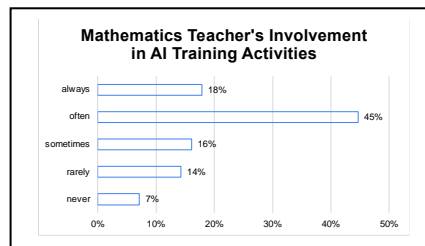


Fig. 6. Mathematics Teacher's Involvement in Training Activities on the Use of AI in Education

Over half of the teaching staff express optimism regarding the potential of AI to become a significant component of the educational landscape in the future. Additionally, most teachers indicate a desire to engage in AI-related training (Fig. 5). Indeed, some have even participated in training programs on the utilization of AI (Fig. 6).

4. Conclusion

The present study examines mathematics teachers' perspectives on AI, its utilization, and their attitudes toward AI. Most mathematics teachers are familiar with AI and have a basic understanding of its principles. Concerning utilization, it was established that AI is employed at all stages of the learning process, including planning, implementation, and evaluation. With regard to attitude, the majority of teachers evinced a favorable view of AI technology in education. The majority of teachers surveyed expressed the view that AI has the potential to enhance the quality of learning. This extensive support underscores the potential of AI to enhance the quality of learning and mathematics teaching practices markedly.

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Declarations

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Additional information. No additional information is available for this paper.

Data and Software Availability Statements

Data and Software availability statements show where data and software supporting the results reported in a published article can be found, including hyperlinks to publicly archived datasets and software analyzed and generated during the study/experiments.

References

- [1] A. Jamal, "The Role of Artificial Intelligence (AI) in Teacher Education: Opportunities & Challenges," *International Journal of Research and Analytical Reviews (IJRAR)*, vol. 10, no. 1, pp. 139–146, 2023.
- [2] C. V. Felix, "The Role of the Teacher and AI in Education," no. March, pp. 33–48, 2020, doi: 10.1108/s2055-36412020000033003.
- [3] J. Li, "Study on Integration and Application of Artificial Intelligence and Wireless Network in Piano Music Teaching," *Comput Intell Neurosci*, vol. 2022, 2022, doi: 10.1155/2022/8745833.

- [4] Y. Guan and F. Ren, "Application of Artificial Intelligence and Wireless Networks to Music Teaching," *Wirel Commun Mob Comput*, vol. 2021, 2021, doi: 10.1155/2021/8028658.
- [5] X. Zhang, A. Tlili, K. Shubeck, X. Hu, R. Huang, and L. Zhu, "Teachers' adoption of an open and interactive e-book for teaching K-12 students Artificial Intelligence: a mixed methods inquiry," *Smart Learning Environments*, vol. 8, no. 1, 2021, doi: 10.1186/s40561-021-00176-5.
- [6] M. Fundi, I. T. Sanusi, S. S. Oyelere, and M. Ayere, "Advancing AI education: Assessing Kenyan in-service teachers' preparedness for integrating artificial intelligence in competence-based curriculum," *Computers in Human Behavior Reports*, vol. 14, p. 100412, May 2024, doi: 10.1016/J.CHBR.2024.100412.
- [7] S. Chen *et al.*, "An integrated model for predicting pupils' acceptance of artificially intelligent robots as teachers," *Educ Inf Technol (Dordr)*, vol. 28, no. 9, 2023, doi: 10.1007/s10639-023-11601-2.
- [8] R. Zhi and Y. Wang, "On the relationship between EFL students' attitudes toward artificial intelligence, teachers' immediacy and teacher-student rapport, and their willingness to communicate," *System*, vol. 124, p. 103341, Aug. 2024, doi: 10.1016/J.SYSTEM.2024.103341.
- [9] O. Synekop, I. Lytovchenko, Y. Lavrysh, and V. Lukianenko, "Use of Chat GPT in English for Engineering Classes: Are Students' and Teachers' Views on Its Opportunities and Challenges Similar?," *International Journal of Interactive Mobile Technologies*, vol. 18, no. 3, 2024, doi: 10.3991/ijim.v18i03.45025.
- [10] A. K. Ajeesh and S. Rukmini, "Integrating hyperreal literature with CALL in English language curriculum for engineering studies in India: an empirical study of the impact on students' learning," *World Journal of Engineering*, vol. 19, no. 2, 2022, doi: 10.1108/WJE-07-2021-0393.
- [11] M. Jamshed, I. Alam, S. Al Sultan, and S. Banu, "Using artificial intelligence for English language learning: Saudi EFL learners' opinions, attitudes and challenges," *J Educ Elearn Res*, vol. 11, no. 1, 2024, doi: 10.20448/jeelr.v11i1.5397.
- [12] Z. Zhang, Z. Li, J. Pan, W. Chen, and Q. Bai, "Artificial Intelligence Development and Music Education System Reform in the Context of 5G Network," *Wirel Commun Mob Comput*, vol. 2022, 2022, doi: 10.1155/2022/2384794.
- [13] F. Chen and H. Meng, "The Use of Wireless Network Combined with Artificial Intelligence Technology in the Reform of Music Online Teaching System," *Wirel Commun Mob Comput*, vol. 2022, 2022, doi: 10.1155/2022/5957708.
- [14] Q. Jiang, "Application of Artificial Intelligence Technology in Music Education Supported by Wireless Network," 2022. doi: 10.1155/2022/2138059.
- [15] M. B. Lahmidi, R. M. Medir Huerta, and S. Calabuig I Serra, "Digital technologies and education for sustainable development. An analysis of scientific production," *Pixel-Bit, Revista de Medios y Educacion*, no. 54, 2019, doi: 10.12795/pixelbit.2019.i54.05.
- [16] C. O. Nja *et al.*, "Adoption of artificial intelligence in science teaching: From the vantage point of the African science teachers," *Smart Learning Environments*, vol. 10, no. 1, 2023, doi: 10.1186/s40561-023-00261-x.
- [17] A. Flogie and B. Aberšek, "Transdisciplinary approach of science, technology, engineering and mathematics education," *Journal of Baltic Science Education*, vol. 14, no. 6, 2015, doi: 10.33225/jbse/15.14.779.
- [18] D. Wang, C. Bian, and G. Chen, "Using explainable <sc>AI</sc> to unravel classroom dialogue analysis: Effects of explanations on teachers' trust, technology acceptance and cognitive load," *British Journal of Educational Technology*, Apr. 2024, doi: 10.1111/bjet.13466.

- [19] C. B. Fontao, "ChatGPT's Role in the Education System: Insights from the Future Secondary Teachers," *International Journal of Information and Education Technology*, vol. 14, no. 8, pp. 1035–1043, 2024, doi: 10.18178/ijiet.2024.14.8.2131.
- [20] Z. Chen and R. Ye, "Principles of Creative Problem Solving in AI Systems," *Sci Educ (Dordr)*, vol. 31, no. 2, 2022, doi: 10.1007/s11191-021-00270-7.
- [21] K. Heinz, M. Kinzel, M. A. Simon, and R. Tzur, "Moving students through steps of mathematical knowing: An account of the practice of an elementary mathematics teacher in transition," *The Journal of Mathematical Behavior*, vol. 19, no. 1, pp. 83–107, Mar. 2000, doi: 10.1016/S0732-3123(00)00037-7.
- [22] P. Klayklung, P. Chocksathaporn, L. Limna, T. Kraiwanit, and K. Jangjarat, "Revolutionizing education with ChatGPT: Enhancing learning through conversational AI," *Universal Journal of Educational Research*, vol. 2, no. 3, 2023.
- [23] A. J. Guerrero-Quiñonez, M. C. Bedoya-Flores, E. F. Mosquera-Quiñonez, Á. E. Mesías-Simisterra, and J. V. Bautista-Sánchez, "Artificial Intelligence and its scope in Latin American higher education," *Ibero-American Journal of Education & Society Research*, vol. 3, no. 1, 2023, doi: 10.56183/iberoeds.v3i1.627.
- [24] S. Hawanti and K. M. Zubayduloevna, "AI chatbot-based learning: alleviating students' anxiety in english writing classroom," *Bulletin of Social Informatics Theory and Application*, vol. 7, no. 2, 2023, doi: 10.31763/businta.v7i2.659.
- [25] R. N. Albdrani and A. A. Al-Shargabi, "Investigating the Effectiveness of ChatGPT for Providing Personalized Learning Experience: A Case Study," *International Journal of Advanced Computer Science and Applications*, vol. 14, no. 11, 2023, doi: 10.14569/IJACSA.2023.01411122.
- [26] N. A. Dahri *et al.*, "Extended TAM based acceptance of AI-Powered ChatGPT for supporting metacognitive self-regulated learning in education: A mixed-methods study," *Heliyon*, vol. 10, no. 8, p. e29317, Apr. 2024, doi: 10.1016/J.HELIYON.2024.E29317.
- [27] Z. Boussouf, H. Amrani, M. Zerhouni Khal, and F. Daidai, "Artificial Intelligence in Education: a Systematic Literature Review," *Data and Metadata*, vol. 3, no. 3, 2024, doi: 10.56294/dm2024288.