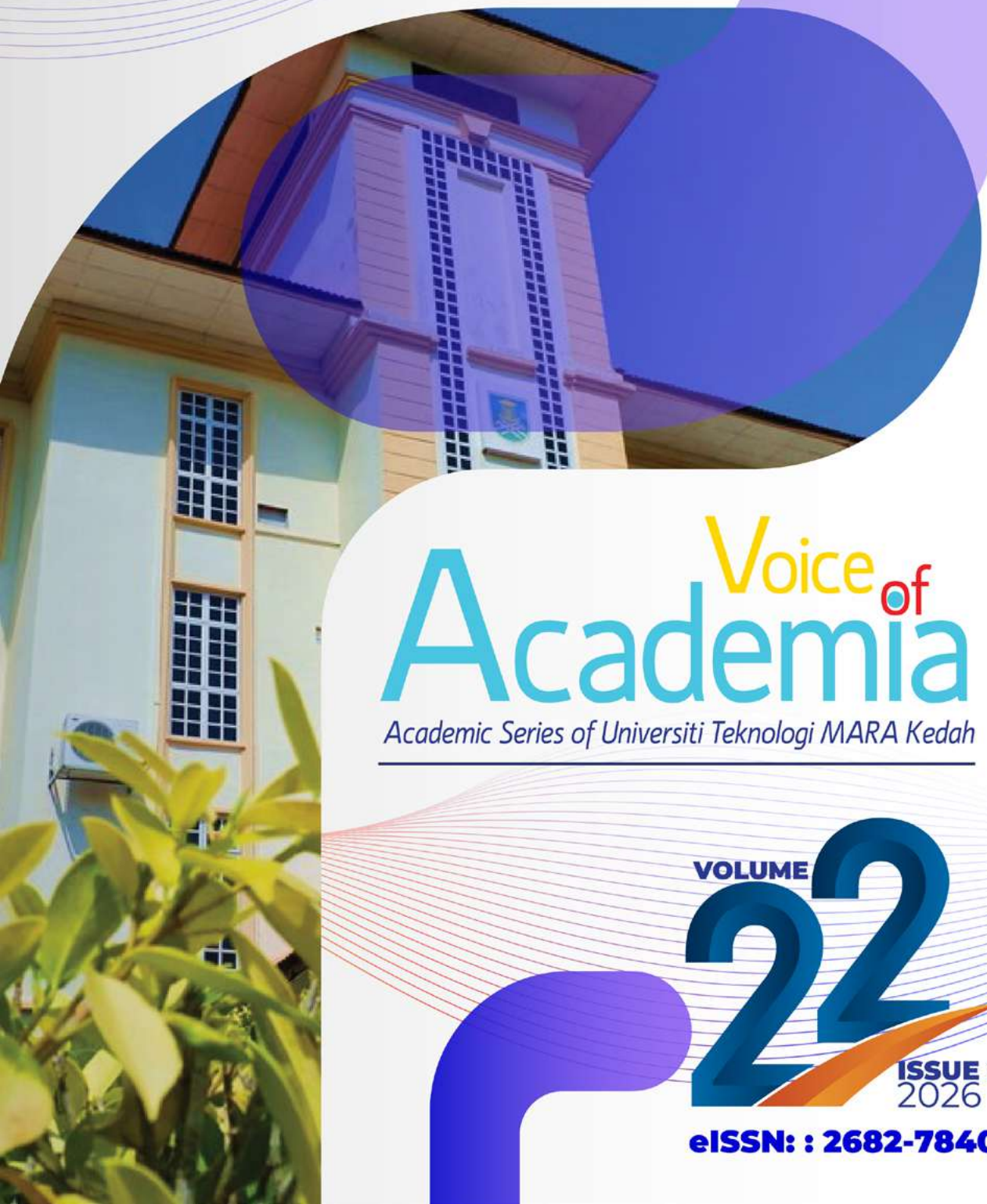

Voice of Academia

Academic Series of Universiti Teknologi MARA Kedah

VOLUME 22
ISSUE 2
2026
eISSN: : 2682-7840

e-ISSN:2682-7840

© Voice of Academia is jointly published by the Universiti Teknologi MARA Caawangan Kedah, Malaysia and Penerbit UiTM (UiTM Press), Universiti Teknologi MARA Malaysia, Shah Alam, Selangor.

TABLE of CONTENTS

Voice of Academia
e-ISSN: 2682-7840

Available online at
https://voa.uitm.edu.my/v1/
https://journal.uitm.edu.my/index.php/VOA/issue/archive

Voice of Academia 22(2) 2026, Chew et al.

Voice of Academia

Artificial Intelligence in Higher Education Mathematics: A Systematic Review of AI-based Platforms, Challenges, and Teaching Transformation

Yee Ming Chew[1], Set Foong Ng[2] & Kok Shien Ng[3*]

[1]*Department of Computer and Mathematical Sciences, Universiti Teknologi MARA Cawangan Pulau Pinang, Kampus Permatang Pauh*

[2]Faculty of Computer and Mathematical Sciences, Universiti Teknologi MARA, Cawangan Johor, Kampus Pasir Gudang

[3]*Civil Engineering Studies, Universiti Teknologi MARA Cawangan Pulau Pinang, Kampus Permatang Pauh*

ARTICLE INFO

Article history:

Received Jan 2026
Accepted June 2026
Published July 2026

Keywords:

Artificial Intelligence,
Mathematics,
Higher Education,
Learning

Corresponding Author:
ngkokshien@uitm.edu.my

DOI:
https://doi.org/10.24191/VoA.v22i2.13413

ABSTRACT

This study presents a systematic review of artificial intelligence (AI) applications in higher education mathematics, focusing on AI tools, associated challenges, and their implications for teaching transformation. Guided by PRISMA methodology, 16 studies published between 2021 and 2025 were selected from Scopus and Google Scholar. This review identifies generative AI tools, particularly ChatGPT, along with adaptive learning platforms such as ALEKS and KnowRe Math, as the most widely examined technologies. These tools support personalised and self-paced learning, enhance conceptual understanding through interactive features, and provide timely feedback. However, their key challenges include over-reliance on AI, data privacy concerns, and the need to preserve the critical role of educators in fostering deep and meaningful learning. Findings suggest that AI has the potential to transform teaching practices by enabling more adaptive, student-centred learning environments. However, its effectiveness depends on responsible and pedagogically informed integration. This review contributes to the field by synthesising current evidence and highlighting key considerations for effective implementation of AI in higher education mathematics.

1. Introduction

In recent years, artificial intelligence (AI) has been booming across various sectors, especially education. AI is a broad term that encompasses various related technologies, including but not limited to natural language processing, classical machine learning, robotics, and deep learning (O'Dea & O'Dea, 2023). With the rapid growth of digital learning environments, AI is being progressively integrated into mathematics education (Azevedo et al., 2024). AI is transforming mathematics education by facilitating

1* Corresponding author: ngkokshien@uitm.edu.my

personalised, adaptive, and dynamic learning environments that are tailored to students' cognitive characteristics, learning progress, and instructional requirements.

Owing to its capabilities in personalised learning, automated grading, and instant real-time feedback, AI has emerged to enhance the process of teaching and learning at all educational levels (Khairy et al., 2020; Lee & Yeo, 2022; Otero, Druga & Lan, 2025). A range of AI-driven platforms employ machine learning algorithms to analyse real-time student interactions, including problem-solving strategies, time spent on tasks, accuracy of response, and patterns of errors. Hence, AI can continuously adapt instructional content and feedback. By moving beyond static curricula, these systems develop detailed models of student knowledge, detect misconceptions, and provide targeted interventions designed to remediate specific learning gaps.

Given that students in higher education face real challenges in the workplace after graduation, it is essential for them to be equipped with the latest technologies, including AI, during their studies in university (Jafari & Keykha, 2024). With the rapid development and evolution of AI technology in mathematics education, identifying AI tools related to mathematics learning examined in recent studies can provide valuable resources for mathematics practitioners seeking to integrate AI to enhance learning. Nevertheless, ChatGPT is a widely used AI tool whose potential applications in mathematics learning warrant careful exploration. Generative artificial intelligence, particularly large language models (LLMs) like ChatGPT, extends these capabilities by enabling natural language interaction within mathematical learning contexts. Through conversational exchanges with AI tutors, students can receive explanations of complex concepts using diverse representations, including verbal, symbolic, or visual forms that encounter contextually rich word problems grounded in real-world scenarios. This interactive approach promotes deeper learner engagement and helps connect abstract mathematical ideas with their practical significance.

A key strength of AI in mathematics instruction is its capacity to facilitate differentiated learning pathways. Instead of relying on a uniform instructional model, AI-enabled platforms allow students to advance at an individualised pace, offering additional practice for difficult topics while permitting faster progression through concepts already mastered. This level of adaptability has been associated with enhanced academic performance and increased learner motivation, especially in heterogeneous classrooms where students differ substantially in prior knowledge and learning preferences (Engelbrecht & Borba, 2024). Despite the perceived benefits and potential of AI in mathematics education, limitations and challenges highlighted in recent studies should be made known to educators and learners for a better understanding of these AI tools. In line with this, this paper aims to provide a comprehensive understanding of the current state of integrating AI into mathematics learning and teaching practices, besides identifying the challenges and opportunities associated with AI in mathematics education. Specifically, this review addresses the following research questions:

1. What are the AI-based platforms used in mathematics learning at the university?
2. What are the challenges and opportunities associated with integrating AI into mathematics learning in universities?
3. How can AI technologies transform teaching practices in mathematics education at the university level?

2. Methodology

To establish a reliable and robust dataset for this review, data for this study were collected from the Scopus database and Google Scholar. It was conducted according to Preferred Reporting Items for Systematic Reviews and Meta-Analyses or PRISMA (Liberati et al., 2009).

2.1 Protocol of PRISMA

1* Corresponding author: ngkokshien@uitm.edu.my

A protocol was first developed using the PRISMA flow diagram to allow reproducible steps by all authors in the research team and as a reference for other researchers. The records searching process was done in 2025.

2.2 Data Processing

To carry out this review, the Scopus database was used for record searching. In line with the research questions, keywords used to search in the database covered three areas. First, the topic: artificial intelligence; second, the discipline: mathematics; third, the causal nature of the research: education.

The following terms were used to search from the title, abstract, and keywords of the documents in the database to identify the closest pool of records for the present review:
("artificial intelligence" OR "AI" OR "machine learning" OR "deep learning") AND ("mathematics" OR "math") AND ("learning" OR "education" OR "teaching") AND ("universities" OR "university" OR "higher education") AND ("technology" OR "digital" OR "tools" OR "resources" OR "challenges" OR "opportunities")

As a result, 629 records were identified through the Scopus database. The records were further screened based on the inclusion criteria and exclusion criteria as shown in Table 1.

Table 1. Inclusion Criteria and Exclusion Criteria for the Review

	Inclusion Criteria	Exclusion Criteria
Year of publication	Last 5 years (2021-2025)	Earlier than year 2021
Subject area	Mathematics	Other than mathematics
Type of document	Research articles	Other than research articles
Language	English	Other than English

From the initial identification of 629 records in the Scopus database, only 30 records remained after limiting the search on the documents to research articles in the subject area of mathematics published in the English language within the last five years. These criteria are important as the findings of the recent research would reflect more accurately on the actual issues related to the use of AI in mathematics learning and teaching practices.

At this stage, a careful assessment was performed on the full articles to evaluate the relevance of the reported results to the research question of this study. A total of six full articles were excluded for this reason. Finally, five full articles from the Scopus database were included in this review.

Due to the limited number of full articles obtained from the Scopus database, additional literature from Google Scholar was added to this review. The following terms were used to search from the title, abstract, and keywords of the documents in the Google Scholar database to identify the closest pool of records:
("artificial intelligence" OR "AI" OR "machine learning" OR "deep learning") AND ("mathematics" OR "math") AND ("learning" OR "education" OR "teaching") AND ("universities" OR "university" OR "higher education") AND ("technology" OR "digital" OR "tools" OR "resources" OR "challenges" OR "opportunities")

1* Corresponding author: ngkokshien@uitm.edu.my

The search on the documents to research articles in the subject area of mathematics published in the English language was limited to publications between 2021 and 2025.

The selection process of the additional 11 articles from Google Scholar was also aligned with the proposed research questions. As a result, a total of 16 full articles were included.

Articles processing procedure using PRISMA protocol (Identification, Screening, Eligibility, and Include) as shown in Figure 1 was followed for every stage, where all authors carried out frequent checks to ensure their consistency, reliability, and quality.

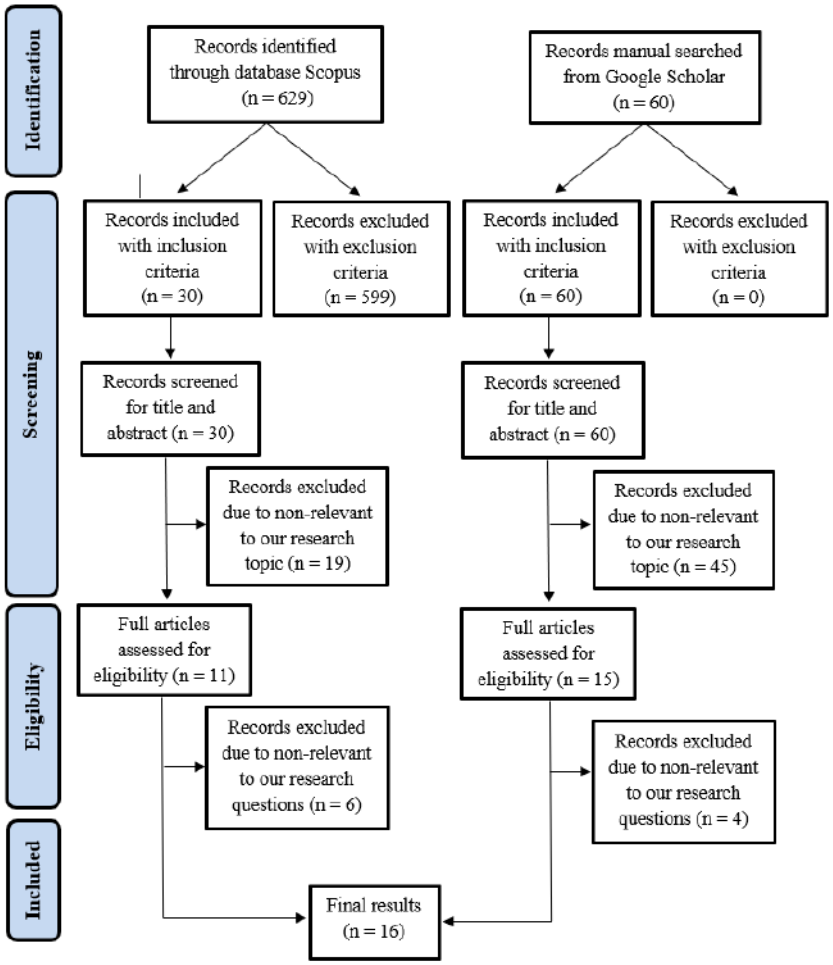

Figure 1. Flow Diagram of Articles Processing Procedure

The details of articles selected from the Scopus database and Google Scholar are summarised in Table 2.

Table 2 Summary of Articles

1* Corresponding author: ngkokshien@uitm.edu.my

No	Author (Year)	Title of article	Journal	Source
1	Alrakhawi, Jamiat & Abu-Naser (2023)	Intelligent tutoring systems in education: a systematic review of usage, tools, effects and evaluation	Journal of Theoretical and Applied Information Technology	Scopus
2	Gouia-Zarrad & Gunn (2024)	Enhancing students' learning experience in mathematics class through ChatGPT	International Electronic Journal of Mathematics Education	Scopus
3	Wardat *et al.* (2023)	ChatGPT: A revolutionary tool for teaching and learning mathematics	Eurasia Journal of Mathematics, Science and Technology Education	Google Scholar
4	Udias *et al.* (2024)	ChatGPT's performance in university admissions tests in mathematics	International Electronic Journal of Mathematics Education	Scopus
5	Delima, Kusuma & Paulus (2024)	The students' mathematics self-regulated learning and mathematics anxiety based on the use of Chat GPT, music, study program, and academic achievement	Infinity Journal of Mathematics Education	Scopus
6	Engelbrecht & Borba (2024)	Recent developments in using digital technology in mathematics education	ZDM–Mathematics Education	Google Scholar
7	Cho & Kim (2025)	Analyzing AI-based educational platforms for supporting personalized mathematics learning	International Electronic Journal of Mathematics Education	Google Scholar
8	Filiz (2025)	The use of digital tools in mathematics teaching: Bibliometric approach	International Electronic Journal of Mathematics Education	Google Scholar
9	Inoferio, Espartero & Asiri (2024)	Coping with math anxiety and lack of confidence through AI-assisted Learning	Environment and Social Psychology	Scopus
10	Govender (2024)	A reflection on the use of artificial intelligence tools for the meaningful learning of mathematics	Pythagoras-Journal of the Association for Mathematics	Google Scholar

1* Corresponding author: ngkokshien@uitm.edu.my

			Education of South Africa	
11	Awang, Yusop & Danaee (2025)	Current practices and future direction of artificial intelligence in mathematics education: A systematic review	International Electronic Journal of Mathematics Education	Google Scholar
12	Hossein Mohand *et al.* (2025)	AI in mathematics education: A bibliometric analysis of global trends and collaborations (2020-2024	EURASIA Journal of Mathematics, Science and Technology Education	Google Scholar
13	Wang *et al.* (2024)	Artificial intelligence in education: A systematic literature review	Expert Systems with Applications	Google Scholar
14	Son (2024)	Intelligent tutoring systems in mathematics education: A systematic literature review using the substitution, augmentation, modification, redefinition model	Computers	Google Scholar
15	Walkington (2025)	The implications of generative artificial intelligence for mathematics education	School Science and Mathematics	Google Scholar
16	Borah & Borah (2024)	A Review of use of Artificial Intelligence in Teaching and Learning of Mathematics	IJSAT-International Journal on Science and Technology	Google Scholar

3. Results

This section contains key results from the review of eligible studies based on the research questions.

Overview of Articles

To perform narrative synthesis, authors in the research team participated in the process of information extraction for mapping research questions for this review. Table 3 presents the summary of the articles and the related research questions.

Table 3. Methodology and Relationship to Research Questions

No	Article	Methodology			Relevant to RQ		
		Quantitative	Qualitative	Review	RQ1	RQ 2	RQ 3

1* Corresponding author: ngkokshien@uitm.edu.my

1	Alrakhawi, Jamiat & Abu-Naser (2023)			/	RQ1		
2	Gouia-Zarrad & Gunn (2024)	/	/		RQ1		
3	Wardat *et al.* (2023)		/		RQ1		RQ 3
4	Udias *et al.* (2024)	/					RQ 3
5	Delima, Kusuma & Paulus (2024)	/			RQ1		
6	Engelbrecht & Borba (2024)			/	RQ1	RQ 2	
7	Cho & Kim (2025)		/		RQ1		
8	Filiz (2025)			/	RQ1	RQ 2	RQ 3
9	Inoferio, Espartero & Asiri (2024)		/			RQ 2	
10	Govender (2024)		/		RQ1	RQ 2	
11	Awang, Yusop & Danaee (2025)			/	RQ1		RQ 3
12	Hossein Mohand *et al.* (2025)			/	RQ1		
13	Wang *et al.* (2024)			/	RQ1		
14	Son (2024)			/	RQ1		
15	Walkington (2025)			/	RQ1		RQ 3
16	Borah & Borah (2024)			/	RQ1	RQ 2	

4. Discussion

4.1 AI-based Tools Used in Mathematics Learning

In the last decade, artificial intelligence (AI) tools have become an increasingly important part of mathematics learning. AI-based platforms such as ChatGPT, KnowRe Math, ALEKS, Brainquake, Aleph, DreamBox, Mathway, Century AI, and Smart Tutoring have been promoting personalised learning experiences tailored to individual students' needs (Wardat et al., 2023; Cho & Kim, 2025; Engelbrecht &

1* Corresponding author: ngkokshien@uitm.edu.my

Borba, 2024; Govender, 2024; Wang et al., 2024; Filiz, 2025; Hossein Mohand et al., 2025; Walkington, 2025). Intelligent tutoring systems (ITS), widely implemented across various fields of education, have demonstrated a significant increase in students' academic performance, particularly at the university level. Moreover, these systems also promote self-directed learning, strengthen students' motivation, and act as an important source of reference (Alrakhawi, Jamiat & Abu-Naser, 2023; Son, 2024; Borah & Borah, 2024). The authors highlighted that the most often-used AI in ITS is Computer Science (36.1%), with 5.5% usage of ITS in Mathematics.

Cho and Kim (2025) reported that three well-known AI learning platforms, such as KnowRe Math, Khan Academy, and ALEKS, are widely implemented to support personalised mathematics learning that fosters mathematical understanding and problem-solving skills throughout primary, secondary, and higher education. Khan Academy facilitates learners' autonomy in their current learning content through instructional mathematics videos, practice problems, and quizzes. The learner's performance is evaluated based on five levels: mastered, proficient, familiar, attempted, and not started. Furthermore, Khanmigo is a chatbot developed by Khan Academy, guiding learners to find the answer by themselves, in contrast to ChatGPT, which provides the answer directly. This is also aligned with the study by Awang, Yusop, and Danaee (2025) that explored AI applications and trends in mathematics education through a systematic literature review. The authors asserted that chatbots like ChatGPT and Bard are the most popular AI tools implemented at universities owing to their capability to deliver immediate feedback in resolving mathematical problems. Furthermore, Delima, Kusuma, and Paulus (2024) discovered that ChatGPT had a positive impact on 78 Indonesian university students who studied Statistics, Mathematics, Mathematics Education, and other mathematical self-regulated learning, as university students exhibit moderate to high levels of self-regulated learning.

In another study, Gouia-Zarrad and Gunn (2024) examined the integration of ChatGPT in supporting interactive mathematics learning in a differential equations course. The course was structured around two main components. The first component was an analytical component that emphasised solving differential equations using algebraic methods to obtain exact solutions. The second component was a numerical component that required coding skills to generate approximate solutions. A key challenge arose in the numerical component as students possessed different levels of coding experience due to their diverse educational backgrounds. To address this challenge, ChatGPT was incorporated into the numerical component through project-based learning. Through this support, students were observed to be able to explore real-world applications modelled by differential equations. Furthermore, the study showed that students managed to develop coding skills and learned how to modify the code to suit their applications. In this study, students' perspectives on using ChatGPT were explored. Findings revealed that ChatGPT was viewed by students as an effective learning tool that supports self-paced and personalised learning. They also valued its user-friendliness and practical application, particularly in coding. Nevertheless, limitations were noted, including the tendency of ChatGPT to generate inaccurate information or produce hallucinations.

4.2 Challenges and Opportunities

The opportunities associated with integrating AI into mathematics learning in universities are investigated by some studies (Engelbrecht & Borba, 2024; Govender, 2024; Inoferio, Espartero & Asiri, 2024; Borah & Borah, 2024; Filiz, 2025). One key opportunity is that AI has the potential to foster an optimal learning environment that allows students to progress at their own pace. The study in Engelbrecht and Borba (2024) reported that adaptive AI-driven learning platforms can identify and address students' learning gaps, thereby fostering critical thinking and problem-solving skills. These platforms are capable of dynamically adjusting the lesson through providing more explanations, practice problems or visual aids

1* Corresponding author: ngkokshien@uitm.edu.my

in order to align with a student's specific learning needs and areas of difficulty. Examples of AI packages discussed in the study are such as the Brainquake (https://brainquake.com/) and ChatGPT-powered Tutor Eva (https://www.tutoreva.com/). Govender (2024) also discussed some AI platforms such as Aleph, DreamBox and Mathway, that enable students to work through problems at their own pace while providing guidance when difficulties arise. Moreover, Inoferio, Espartero and Asiri (2024) emphasized that college students experience mathematics anxiety and lack of confidence when dealing with advanced and complex mathematical topics like algebra and calculus. Utilizing AI models like ChatGPT and Bard, they provided students with step-by-step explanations and simplified mathematics concepts. Consequently, the students can actively participate in the subjects and perform well academically.

Meaningful learning in mathematics extends beyond the rote memorisation of formulae or the application of algorithms. It involves cultivating a deep understanding of mathematical concepts and establishing connections across different ideas. The concept of meaningful learning in mathematics has been discussed by Govender (2024). The study revealed that integrating AI in mathematics learning has the potential to foster meaningful learning by providing an interactive and dynamic environment, whereby students can explore various approaches and obtain immediate feedback. AI-based graphing calculators and algebra systems are examples given in the study that offer interactive experiences to students. The AI-based tools help students to visualise complex functions and explore geometric transformations. Such interactive experiences can strengthen conceptual understanding by rendering abstract ideas more concrete. A similar view was also found in the study by Engelbrecht and Borba (2024), which reported that AI-powered visualisations and interactive simulations have become a novel use of AI within mathematics education. It can help students understand complex concepts, foster deeper engagement through gamification, and provide targeted AI-assisted remediation for weaker students.

On the other hand, challenges arising from the use of AI in mathematics education were discussed in studies by Filiz (2025), Govender (2024), as well as Engelbrecht and Borba (2024). For instance, Engelbrecht and Borba (2024) emphasised the need for careful consideration of human roles, data privacy, and ethical implications in the adoption of AI technologies in mathematics education. Meanwhile, Govender (2024) highlighted that while AI can automate specific tasks, the human aspects of teaching, such as nurturing critical thinking, offering emotional support, and promoting collaboration, remain irreplaceable. Oftentimes, students use AI to seek instant answers in solving mathematics problems, which does not promote critical thinking or knowledge retention. This highlights the role of educators as crucial for motivating student interest and guiding the process of learning in mathematics.

Regarding the issue of data privacy and ethical implications, Filiz (2025) and Govender (2024) both addressed that AI tools frequently collect extensive data on students' performance and behaviour. This has raised concerns regarding the purpose of data usage and the individuals with access to the data. Therefore, ensuring the responsible use of data and protecting students' privacy are essential considerations when integrating AI into mathematics education.

4.3 Teaching Practices in Mathematics Education

A study by Wardat et al. (2023) examined the use of artificial intelligence, specifically ChatGPT, in teaching mathematics through students' and educators' perspectives. A qualitative case study approach was adopted with two stages: content analysis of interviews and user experience investigation. The findings in the first stage revealed ChatGPT's improved mathematics capabilities and ability to increase educational success by providing users with basic knowledge of mathematics and various topics. Participants in the study recognised ChatGPT as a resource for mathematical problem-solving and geometry instruction owing to its vast knowledge base and advanced language processing abilities. However, although ChatGPT might

1* Corresponding author: ngkokshien@uitm.edu.my

offer insights into geometry subjects, researchers should always validate the accuracy of the data. Or else, students would only engage in surface learning when they over-rely on automated answers generated by ChatGPT (Walkington, 2025).

Concerning the use of ChatGPT in mathematics education, Udias et al. (2024) conducted an experiment to evaluate the performance of ChatGPT to solve university admission tests in different mathematics topics. The topics analysed were Algebra, Calculus, Probability, and Statistics. The result showed that the performance of ChatGPT varied across these topics. The experiment also indicated that ChatGPT outperformed students in all these mathematics topics except Algebra. The study concluded that ChatGPT has the potential to be introduced as a valuable AI tool in certain mathematical problem-solving scenarios. As there is a major concern in the risk of inaccuracies where the AI tool might unintentionally present compelling yet incorrect information to users in mathematics learning, Udias et al. (2024) highlighted that students and educators need to acquire the literacies and competencies to help them understand the technology and recognise its limitations.

According to Awang, Yusop, and Danaee (2025), there are two types of AI tools: generative AI tools (like problem solvers) and pedagogical AI tools (such as adaptive learning platforms). A total of 28 AI tools or applications were identified in their study. Pedagogical AI tools were seen to enhance teaching and learning by offering adaptive, immersive, and interactive experiences. Meanwhile, tools using augmented and virtual reality, such as GeoGebra AR, cleARmaths, and Vuforia, allow students to explore and visualise math concepts interactively, especially in geometry. Similarly, 3D tools like CalcVR and NeoTrieVR allow learners to comprehend three-dimensional mathematical objects, helping them to understand concepts such as volume, area, and spatial relationships.

Overall, the use of AI offers valuable opportunities to enhance teaching practice in mathematics education. As reported by Filiz (2025), data on students' performance were often collected from AI-based mathematics learning platforms such as Smart Tutoring and Century AI. The data has enabled educators to analyse mistakes made by the students in the learning process. As a result, the analysis findings could help educators improve their instructional strategies by providing guidance or instruction that is sensitive to students' needs and offering relevant feedback.

5. Conclusion

Summary of Review Results

This section presents the summary of the findings of this study in relation to the research questions. The research questions were outlined as follows.

RQ1: What are the AI-based platforms used in mathematics learning at the university?
RQ2: What are the challenges and opportunities associated with integrating AI into mathematics learning in universities?
RQ3: How can AI technologies transform teaching practices in mathematics education at the university level?

To RQ1: Through this review, it has been discovered that many AI-based platforms are being used in mathematics learning in higher education. ChatGPT was reported as the most explored AI tool by researchers in mathematics learning (Delima, Kusuma & Paulus, 2024; Gouia-Zarrad & Gunn, 2024; Wardat et al., 2023; Udias et al., 2024; Engelbrecht & Borba, 2024; Inoferio, Espartero & Asiri, 2024; Borah& Borah, 2024; Wang et al., 2024; Hossein Mohand et al., 2025; Walkington, 2025). Apart from

1* Corresponding author: ngkokshien@uitm.edu.my

ChatGPT, various AI tools that were investigated by mathematics researchers include KnowRe Math, Khan Academy, Khanmigo, ALEKS (Cho & Kim, 2025), Aleph, DreamBox, Mathway (Govender, 2024), and Brainquake (Engelbrecht & Borba, 2024). In general, the AI tools have been promoting personalised learning experiences for learning mathematics in higher education. The tools are suitable for university students as they exhibit moderate to high levels of self-regulated learning.

To RQ2: From this review, two key opportunities and two major challenges associated with integrating AI into mathematics learning in universities were identified: (a) First opportunity: AI tools foster an optimal learning environment that allows students to progress at their own pace. As most AI-based platforms provide step-by-step explanations, simplify mathematics concepts with more explanations, and are capable of dynamically adjusting the lesson, the students can actively participate in the mathematics learning and perform well academically. (b) Second opportunity: AI tools help cultivate a better understanding of complex concepts in mathematics with AI-powered visualisations and interactive simulations. The interactive experiences with the AI tools can help students visualise complex functions and explore geometric transformations. Furthermore, they can foster deeper student engagement in learning and strengthen conceptual understanding by rendering abstract ideas more concrete. (c) First challenge: The adoption of AI technologies in mathematics education requires careful consideration of the human role. Although AI can automate some specific tasks, the role of educators in the aspects of teaching, such as nurturing critical thinking, offering emotional support, and promoting collaboration, remains crucial. (d) Second challenge: The responsible use of data and protecting users' privacy are essential considerations when integrating AI in mathematics education. The data collected by AI tools, such as students' data on learning performance, unpublished students' research writing, and results, need to be carefully protected in consideration of data privacy and ethical implications.

To RQ3: This review has revealed that the integration of AI provided significant opportunities for transforming teaching practices in mathematics education at higher education. As AI tools possess advanced language processing abilities and a vast knowledge base, it has become a resource for mathematical problem-solving tools as well as providing explanations on basic mathematics concepts. Hence, the ethical and appropriate use of AI technologies in teaching mathematics allows educators to better leverage their limited classroom period while fostering meaningful learning experiences for students in higher education.

Future Perspectives for AI in Mathematics Learning and Teaching Practices

Promising innovations in the use of AI for mathematics learning and teaching have emerged across various higher education mathematics subjects. However, it remains uncertain (a) to what extent such applications can be effectively integrated within diverse curriculum structures in mathematics subjects; (b) whether AI tools or platforms are equitably accessible to all students given differences in internet connectivity and levels of digital literacy; and (c) how effectively students can utilise them in contexts where ethical considerations and data privacy issues related to AI are yet to be widely addressed. Hence, further research on these aspects is crucial to build the evidence base that can guide and encourage educators and policymakers in adopting innovative AI applications in mathematics teaching and learning practices.

Given the rapid evolution of AI technology, there is growing recognition that AI holds the potential to personalise mathematics learning by serving as a problem-solving resource and offering interactive features that provide real-time feedback that fosters a better understanding of mathematical concepts. However, its implementation must be approached thoughtfully. By treating AI as a complementary tool rather than a replacement for traditional teaching methods, there is an emerging trend that AI can contribute to the transformation of mathematics education by creating a more dynamic and student-centred learning experience in higher education.

1* Corresponding author: ngkokshien@uitm.edu.my

Acknowledgments

The authors would like to express our sincere appreciation to Universiti Teknologi MARA for the support in research and publications.

Funding Details

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Authors Contributions

All the authors contributed to conception and design of the paper.

Conflict of Interest

There is no conflict of interest associated with this publication.

References

Alrakhawi, H. A., Jamiat, N., & Abu-Naser, S. S. (2023). Intelligent tutoring systems in education: a systematic review of usage, tools, effects and evaluation. *Journal of Theoretical and Applied Information Technology*, *101*(4), 1205–1226.

Awang, L. A., Yusop, F. D., & Danaee, M. (2025). Current practices and future direction of artificial intelligence in mathematics education: A systematic review. *International Electronic Journal of Mathematics Education*, *20*(2), em0823.

Azevedo, B. F., Pacheco, M. F., Fernandes, F. P., & Pereira, A. I. (2024). Dataset of mathematics learning and assessment of higher education students using the MathE platform. *Data in Brief*, *53*, 110236.

Borah, P., & Borah, A. C. (2024). A Review of use of Artificial Intelligence in Teaching and Learning of Mathematics. *IJSAT-International Journal on Science and Technology*, *15*(4).

Cho, M. K., & Kim, S. (2025). Analyzing AI-based educational platforms for supporting personalized mathematics learning. *International Electronic Journal of Mathematics Education*, *20*(4), 1–13.

Delima, N., Kusuma, D. A., & Paulus, E. (2024). The students' mathematics self-regulated learning and mathematics anxiety based on the use of Chat GPT, music, study program, and academic achievement. *Infinity Journal of Mathematics Education*, *13*(2), 349–362.

Engelbrecht, J., & Borba, M. C. (2024). Recent developments in using digital technology in mathematics education. *ZDM–Mathematics Education*, *56*(2), 281–292.

Filiz, A. (2025). The use of digital tools in mathematics teaching: Bibliometric approach. *International Electronic Journal of Mathematics Education*, *20*(4), 1–12.

Gouia-Zarrad, R., & Gunn, C. (2024). Enhancing students' learning experience in mathematics class through ChatGPT. *International Electronic Journal of Mathematics Education*, *19*(3), 1–9.

1* Corresponding author: ngkokshien@uitm.edu.my

Govender, R. (2024). A reflection on the use of artificial intelligence tools for the meaningful learning of mathematics. *Pythagoras-Journal of the Association for Mathematics Education of South Africa*, *45*(1), 831–834.

Hossein Mohand, H., Hossein Mohand, H., Albanese, V., & Olmos Gómez, M. D. C. (2025). AI in mathematics education: A bibliometric analysis of global trends and collaborations (2020-2024).

Inoferio, H. V., Espartero, M. M., & Asiri, M. S. (2024). Coping with math anxiety and lack of confidence through AI-assisted learning. *Environment and Social Psychology*, *9*(5), 2228.

Jafari, F., & Keykha, A. (2024). Identifying the opportunities and challenges of artificial intelligence in higher education: a qualitative study. *Journal of Applied Research in Higher Education*, *16*(4), 1228–1245.

Khairy, D., Abougalala, R. A., Areed, M. F., Atawy, S. M., Alkhalaf, S., & Amasha, M. A. (2020). Educational robotics based on artificial intelligence and context-awareness technology: A framework. *Journal of Theoretical and Applied Information Technology*, *98*(13), 2227–2239.

Lee, D., & Yeo, S. (2022). Developing an AI-based chatbot for practicing responsive teaching in mathematics. *Computers & Education*, 191, 104646.

Liberati, A., Altman, D. G., Tetzlaff, J., Mulrow, C., Gøtzsche, P. C., Ioannidis, J. P., Clarke, M., Devereaux, P. J., Kleijnen, J., & Moher, D. (2009). The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. *Journal of Clinical Epidemiology*, *62*(10), e1–e34.

O'Dea, X., & O'Dea, M. (2023). Is artificial intelligence really the next big thing in learning and teaching in higher education? A conceptual paper. *Journal of University Teaching & Learning Practice*, *20*(5), 1–17.

Otero, N., Druga, S., & Lan, A. (2025). A Benchmark for math misconceptions: Bridging gaps in middle school algebra with AI-supported instruction. *Discover Education*, *4*(1), 1–31.

Son, T. (2024). Intelligent tutoring systems in mathematics education: A systematic literature review using the substitution, augmentation, modification, redefinition model. *Computers*, *13*(10), 270.

Udias, A., Alonso-Ayuso, A., Alfaro, C., Algar, M. J., Cuesta, M., Fernández-Isabel, A., ... & Ortega, F. (2024). ChatGPT's performance in university admissions tests in mathematics. *International Electronic Journal of Mathematics Education*, *19*(4), 1–14.

Walkington, C. (2025). The implications of generative artificial intelligence for mathematics education. *School Science and Mathematics*.

Wang, S., Wang, F., Zhu, Z., Wang, J., Tran, T., & Du, Z. (2024). Artificial intelligence in education: A systematic literature review. *Expert Systems with Applications*, *252*, 124167.

Wardat, Y., Tashtoush, M. A., AlAli, R., & Jarrah, A. M. (2023). ChatGPT: A revolutionary tool for teaching and learning mathematics. *Eurasia Journal of Mathematics, Science and Technology Education*, *19*(7), 1–18.

1* Corresponding author: ngkokshien@uitm.edu.my

UNIVERSITI TEKNOLOGI MARA

eISSN: : 2682-7840