



THE INFLUENCE OF KNOWLEDGE AND SKILLS ON SELF-EFFICACY IN USING CHATGPT FOR MATHE- MATICS INSTRUCTION

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Abstract/Izvleček

This study examined the influence of knowledge and skills on mathematics teachers' self-efficacy in using ChatGPT for mathematics instruction. A total of seventy-three primary school mathematics teachers in Tambunan, Sabah, were selected through stratified sampling. Data were collected using a validated questionnaire measuring knowledge, skills, and self-efficacy and analysed using descriptive statistics, Pearson correlation, and multiple linear regression. Results showed high levels of knowledge but moderate levels of skills and self-efficacy. Significant positive correlations existed between knowledge and self-efficacy and between skills and self-efficacy. Regression findings showed both knowledge and skills significantly predicted self-efficacy, with skills being the stronger predictor.

Keywords:

knowledge, skills, self-ef-
ficacy, ChatGPT, mathe-
matics instruction.

Vpliv znanja in spretnosti na samoučinkovitost pri uporabi ChatGPT pri poučevanju matematike

V študiji smo proučevali vpliv znanja in spretnosti na samoučinkovitost učiteljev matematike pri uporabi ChatGPT pri poučevanju. Z metodo stratificiranega vzorčenja je bilo izbranih 73 osnovnošolskih učiteljev matematike v Tambunanu, v malezijski zvezni državi Sabah. Podatki so bili zbrani z validiranim vprašalnikom, ki je meril znanje, spretnosti in samoučinkovitost, ter analizirani z deskriptivnimi statistikami, Pearsonovo korelacijo in večkratno regresijo. Rezultati so pokazali visoko raven znanja, a zmerno raven spretnosti in samoučinkovitosti. Ugotovljene so bile pomembne pozitivne korelacije. Izsledki regresijske analize so pokazali, da sta znanje in spretnosti statistično značilna napovednika samoučinkovitosti, pri čemer imajo spretnosti večjo napovedno moč.

Ključne besede:

znanje, spretnosti, samo-
učinkovitost, ChatGPT,
poučevanje matematike.

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Introduction

As artificial intelligence (AI) continues to revolutionize industries around the world, it is also creating new possibilities for how educators teach and engage with their students (Yeruva, 2023). In recent years, the integration of AI in education has grown rapidly, driven by the potential benefits of using AI in teaching and learning. AI tools, which include software applications, platforms or systems that use artificial intelligence technologies to perform tasks that typically require human intelligence, have transformed education by providing innovative and creative learning experiences such as increased efficiency in administrative tasks, personalized learning experiences, and enhanced student engagement (Monib, Qazi, and Mahmud, 2025). Generative AI (GenAI), particularly ChatGPT, has been increasingly used because of its capacity to generate content such as text, images, videos, or other forms of academic material (Pinaya et al., 2023). By being able to generate explanations, examples, and timely responses to questions, while delivering tailored feedback, ChatGPT has the potential to be effectively integrated into educational contexts, supporting teachers in planning lessons, delivering instruction, and conducting assessment. However, contemporary research emphasizes that meaningful and effective integration of GenAI into education requires more than technical familiarity with AI tools. According to Zawacki-Richter et al. (2019) and Holmes et al. (2022), teachers need to have a solid conceptual understanding, pedagogical awareness of and ethical competence in AI to ensure its effective integration in education. Therefore, recent research has highlighted AI literacy as the key framework for understanding teachers' readiness to use AI. According to Long and Magerko (2020) and Ng et al. (2021), AI literacy refers to teachers' knowledge of how AI tools function and their limitations, skills in using AI tools, as well awareness of ethical, social, and pedagogical issues. Therefore, the frameworks of AI literacy and teacher's readiness to use AI conceptualize AI competence as including an understanding of how AI functions and its limitations, the ability to use AI effectively for teaching and learning, and awareness of its ethical, legal and pedagogical implications (Nazaretsky et al., 2022; Nguyen and Nguyen, 2025). Based on this framework, teachers are expected not only to use AI but also to evaluate the accuracy and suitability of AI-generated output, make appropriate teaching decisions and guide students to use AI responsibly. This aligns with ethical approaches towards using AI in education, which stress the importance of transparency, fairness, accountability, and teacher

supervision when AI is used in classrooms (Holmes et al., 2022). Furthermore, this approach is in line with Bandura's Social Cognitive Theory, which emphasizes self-efficacy as a key factor in shaping individuals' willingness to try new practices, persist through challenges, and adapt to complex situations (Bandura, 1997). Research shows that, in technology-enhanced teaching, teachers' self-efficacy is closely related to their knowledge and practical skills, which suggests that teachers who possess solid knowledge and practical skills are more likely to develop confidence in integrating new technologies (Tschannen-Moran and Woolfolk Hoy, 2001; Ertmer and Ottenbreit-Leftwich, 2014). From this perspective, teachers' knowledge of and skills in AI are key factors that build their confidence in using AI tools such as ChatGPT. Mathematics plays a central role in developing conceptual understanding and problem-solving skills, which are essential for providing students with the necessary skills to face the challenges of an increasingly complex and technology-driven world (OECD, 2023). However, the abstract nature of mathematics often brings challenges in ensuring its effective teaching and learning. According to Pepin, Buchholtz, and Salinas-Hernández (2025), students tend to encounter difficulty in making sense of abstract mathematical concepts, while teachers need to continuously find effective ways to engage and support during mathematics lessons. In this context, AI tools such as ChatGPT offer promising support to address these issues by simplifying complex concepts, providing solutions to problems, and tailoring explanations to student needs, making these tools a reliable and valuable pedagogical assistant rather than a direct replacement for the teacher (Asare and Boateng, 2025). Digital technologies in mathematics education have long been shown to influence not only efficiency but also the nature of mathematical thinking, representation, and reasoning (Drijvers and Sinclair, 2024). However, it is important to note that previous studies have indicated that AI-generated output may contain inaccuracies, oversimplifications, or unclear reasoning, which can mislead students if teachers lack the disciplinary and pedagogical judgement required to critically evaluate those outputs (Magat and Sangalang, 2024). These findings show that the effective use of AI, particularly in mathematics instruction, is not just a required technical skill but one that depends heavily on teachers' content knowledge and instructional judgement. Consequently, mathematics teachers' self-efficacy in using ChatGPT is shaped not just by how they feel about AI in general, but by how comfortable and capable they are in using it to support the delivery of lessons. According to Li et al. (2024) and Kiryakova (2024), the role of ChatGPT in mathematics instruction, which includes lesson planning, task design, development of assessment, and provision of real-time feedback, have

expanded considerably in recent years. However, the effectiveness of ChatGPT in mathematics instruction still depends on teachers' ability to formulate effective prompts, critically interpret AI-generated responses and guide students toward responsible and ethical use of AI for learning purposes. This reinforces the idea that using AI in mathematics education is less about the technology itself and more about how teachers use it, both thoughtfully and ethically, guided by their professional judgment and confidence in using AI in the classroom (Zawacki-Richter et al., 2019). In Malaysia, the Ministry of Education (MOE) launched the Digital Education Policy in 2023 with the aim of preparing Malaysia's education system to face the challenges of the digital era. Building on national initiatives such as the Malaysia Digital Economy Blueprint (MyDIGITAL), the Twelfth Malaysia Plan, and the Fourth Industrial Revolution (IR4.0), the policy emphasizes AI integration to promote innovation, adaptability, and supportive environments (Ministry of Economy, 2021; MOE, 2023). This aligns with the Malaysian government's emphasis on fostering awareness, competence, and innovation through AI. However, empirical studies have shown that a number of mathematics teachers remain insufficiently prepared to integrate AI into their instructional practice. While these initiatives promote innovation and technological advancement, recent studies indicate that many teachers, particularly in mathematics, remain insufficiently prepared to integrate AI confidently into their instructional practices (Abdullah et al., 2025; Ahmad and Ratha-krishnan, 2025). This gap between policy aspirations and classroom readiness is concerning, given Malaysia's continued challenges in international mathematics performance, as highlighted by the TIMSS 2023 results (Bahagian Perancangan dan Penyelidikan Dasar Pendidikan, 2024).

Despite growing interest in AI readiness, empirical research examining how knowledge and skills influence mathematics teachers' self-efficacy in using ChatGPT for instructional purposes remains limited. Studies tend to focus more on teachers' general acceptance of technology or attitudes toward AI but to pay less attention to the specific demands of teaching different subjects or to factors that shape teachers' confidence in using AI effectively. Therefore, this study intends to examine how mathematics teachers' knowledge and skills in regard to ChatGPT influence their self-efficacy in using ChatGPT for mathematics instruction.

Problem Statement

The integration of ChatGPT into mathematics instruction is gaining momentum worldwide, showing potential for enhancing teaching effectiveness by supporting

personalized learning, scaffolding problem solving, and generating diverse instructional resources to help teachers design lesson plans (Kehoe, 2023), generate differentiated learning exercises (Li et al., 2024), create assessment questions (Kiryakova, 2024), explain abstract concepts and create interactive activities (Kılınc, 2023).

Although ChatGPT has been widely recognized for its potential to revolutionize education, many mathematics teachers still feel unprepared and lack the confidence to integrate it into their teaching practices (Kim, 2025; Magat and Sangalang, 2024; Uğraş et al., 2024), with the key contributor being low self-efficacy (Njiku et al., 2022; Xie and Luo, 2025). Self-efficacy, defined as the belief in one's ability to successfully perform a specific task (Bandura, 1997), influences persistence, problem solving and innovation. High self-efficacy fosters adoption of technology, while low self-efficacy leads individuals to shy away from challenges and abandon efforts when difficulties occur (Bandura, 1997; Bandura et al., 2023). Therefore, according to Tschannen-Moran and Woolfolk Hoy (2001), knowledge and skills play a vital role in enabling teachers to integrate new technologies effectively.

In Malaysia, studies by Abdullah et al. (2025), Ahmad and Rathakrishnan (2025) and Chan et al. (2024) highlighted that self-efficacy plays a significant role in shaping teachers' willingness to use technology. However, mathematics teachers were found to be unprepared in using these technologies confidently in their instructional practices (Abdullah et al., 2025; Ahmad and Rathakrishnan, 2025; Yazid and Abdul Aziz, 2025). This is particularly concerning in light of Malaysia's continued challenges in raising its performance on international assessments, particularly on the Trends in International Mathematics and Science Study (TIMSS). TIMSS 2023 highlighted Malaysian students' declining achievements in the assessment (Bahagian Perancangan dan Penyelidikan Dasar Pendidikan, 2024; von Davier et al., 2024), which further emphasize the urgency to strengthen Malaysian teachers' confidence in integrating technology in the classroom (Omar and Ismail, 2022).

Research has proven that knowledge and skills in AI can improve motivation (Cukurova, Miao, and Brooker, 2023), trust (Nazaretsky et al., 2022) and readiness (Nguyen and Nguyen, 2025). However, research concerning their influence on mathematics teachers' self-efficacy in using ChatGPT for instructional practices remains limited. Therefore, this study aims to examine the influence of knowledge of and skills in AI on mathematics teachers' self-efficacy in using ChatGPT for instructional practices. By addressing this gap, the study intends to provide insights into the preparedness of teachers to integrate AI-based tools in mathematics education, particularly within the Malaysian education context. In this study, in regards to ChatGPT,

knowledge and skills are treated as two related but distinct aspects of teachers' AI competence. Knowledge refers to teachers' understanding of what ChatGPT is and how it works, including its capabilities, limitations and ethical implications for teaching and learning. This includes knowing how ChatGPT generates responses, being aware that its output may contain errors, inconsistencies, or bias and understanding issues such as academic integrity, transparency and responsible instructional delivery use (Chiu, 2023; Kovari, 2025). In contrast, skills refer to the ability of teachers to use ChatGPT effectively in their daily practice, which includes writing effective prompts, generating and adapting instructional materials, evaluating the quality of AI-generated content, integrating ChatGPT into lesson planning and assessment, and guiding students in using the tool appropriately. Research on AI literacy highlights that these skills are developed through hands-on use and real classroom experience (Chiu, 2023; Kovari, 2025) This distinction aligns with established educational technology frameworks such as the TPACK model, which differentiates between what teachers know and how they apply that knowledge in their instructional practice (Mishra and Koehler, 2006). In AI-supported instruction, understanding ChatGPT alone does not guarantee effective classroom use. Teachers need to have practical skills to translate that understanding into meaningful instructional practices.

Research Questions

The aim of the study is to examine the influence of knowledge and skills on self-efficacy in using ChatGPT for mathematics instruction. Therefore, the study poses the following questions:

1. What are the levels of knowledge, skills, and self-efficacy of mathematics teachers in using ChatGPT for mathematics instruction?
2. Is there a significant relationship between mathematics teachers' knowledge of ChatGPT and self-efficacy in using ChatGPT for mathematics instruction?
3. Is there a significant relationship between mathematics teachers' skills in using ChatGPT and self-efficacy in using ChatGPT for mathematics instruction?
4. To what extent do knowledge and skills predict mathematics teachers' self-efficacy in using ChatGPT for mathematic instruction?

Research Hypotheses

Based on the research questions, four null hypotheses were developed as follows to guide the analysis of the relationships and influences of the key concepts:

H₀1: There is no significant relationship between knowledge of ChatGPT and self-efficacy in using ChatGPT for mathematics instruction.

H₀2: There is no significant relationship between skills in using ChatGPT and self-efficacy in using ChatGPT for mathematics instruction.

H₀3: Knowledge of ChatGPT does not significantly predict mathematics teachers' self-efficacy in using ChatGPT for mathematics instruction.

H₀4: Skill in using ChatGPT does not significantly predict mathematics teachers' self-efficacy in using ChatGPT for mathematics instruction.

Method

This study uses a quantitative descriptive approach with a survey research design to examine the influence of mathematics teachers' knowledge and skills on their self-efficacy in using ChatGPT for mathematics instruction. This research design was selected for this study to enable systematic collection of numerical data to identify the levels of the variables, explore relationships, and test predictive models using statistical analysis (Creswell and Creswell, 2018). The target population comprised ninety-two primary school mathematics teachers in the district of Tambunan, Sabah. By using the Krejcie and Morgan (1970) sample size determination table, seventy-three respondents were selected as the required sample for this study. A stratified random sampling technique was used, with years of teaching experience chosen as the stratification criterion. This sampling technique was used to ensure proportional representation of teachers across dissimilar experience levels, thereby reducing sampling bias. Teaching experience was chosen as the stratification criterion as it is widely recognized as a key factor influencing teachers' instructional practices and their adoption of educational technologies. Previous research has shown that teachers at various stages of their career often differ in their pedagogical beliefs, confidence, and willingness to experiment with new tools, including digital and AI-based technologies (Ertmer and Ottenbreit-Leftwich, 2014). In addition, research on teacher self-efficacy also indicates that teachers' confidence in implementing complex instructional innovations often develops as they gain more teaching experience. In the context of integrating AI into instructional practices, teaching experience may

shape how teachers perceive instructional control, risk, and the value of adopting AI tools such as ChatGPT. Respondents were divided into five groups: (i) 1-5 years, (ii) 6-10 years, (iii) 11-15 years, (iv) 16-19 years, and (v) more than 20 years of teaching experience. Respondents were randomly selected from each group using a random number generator. This approach would ensure that respondents with diverse levels of teaching experience were fairly represented in the study. Although this study provides useful insight into mathematics' teachers self-efficacy in using ChatGPT for mathematics instruction, the findings are based on a relatively small number of respondents drawn from a single district in Tambunan, Sabah, which limits the extent to which the findings can be generalized to another educational context.

Research Instrument

The research instrument is a questionnaire adapted from Barakat et al. (2025), Tondeur et al. (2017) and Bandura (2006), with modifications made to ensure suitability and cultural appropriateness for the Malaysian mathematics education content and specific focus on ChatGPT. The modifications include contextualizing terminology, refining item wording to reflect mathematics teaching practices and incorporating items addressing ethical and responsible use of AI. Content and face validity were determined through expert review involving subject matter experts in mathematics education and educational technology. The reviewers evaluated the relevance, clarity, and cultural appropriateness of each item to ensure suitability for the Malaysian education context. The questionnaire consists of four sections shown in Table 1.

Table 1

Sections of the questionnaire

Section	Content	Number of items
A	Demographics (Gender, age, academic qualifications, teaching experience)	-
B	Knowledge in using ChatGPT for mathematics instruction	10
C	Skills in using ChatGPT for mathematics instruction	10
D	Self-efficacy in using ChatGPT for mathematics instruction	12

Responses were collected using a five-point Likert scale, ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). The level of knowledge, skills, and self-efficacy in using ChatGPT for mathematics instruction was determined based on the mean int-

erpretation score as suggested by Nyutu et al. (2021) and shown in Table 2. In addition, correlation strength between the variables was determined using the correlation coefficient interpretation table by Schober et al. (2018), shown in Table 3.

Table 2

Mean score interpretation table

Mean Score	Interpretation
1.00 – 1.80	Very low
1.81 – 2.60	Low
2.61 – 3.40	Moderate
3.41 – 4.20	High
4.21 – 5.00	Very high

Source: Nyutu et al. (2021)

Table 3

Correlation coefficient interpretation table

Correlation coefficients	Interpretation
0.90 to 1.00 (-0.90 to -1.00)	Very Strong
0.70 to 0.89 (-0.70 to -0.89)	Strong
0.50 to 0.69 (-0.50 to -0.69)	Moderate
0.30 to 0.49 (-0.30 to -0.49)	Low
0.00 to 0.29 (0.00 to -0.29)	Negligible

Source: Schober, Boer, and Schwarte (2018)

Validity and Reliability

Content validity was determined through expert review by four evaluators: three lecturers from an Institute of Teacher Education who are Subject Matter Experts (SMEs) in mathematics education and educational technology, and one experienced primary school mathematics teacher. Using the Polit and Beck (2006) four-point relevance and clarity scale, the Scale-level Content Validity Index (S-CVI/Ave) was calculated at 0.80, indicating a satisfactory level of content validity. For relevance, items were rated as, (i) highly relevant, (ii) quite relevant, (iii) somewhat relevant, or (iv) not relevant. For clarity, items were rated as, (i) very clear, (ii) clear but requiring minor revision, (iii) requiring some revision, or (iv) not clear. Face validity was determined by the same evaluators to ensure the items were comprehensible, relevant, and culturally appropriate for the Malaysian education context.

Reliability was determined using a pilot test involving thirty mathematics teachers, a number suggested by Totton et al. (2023), who share demographic characteristics

like those of the respondents. Data collected from the pilot test were analysed using Cronbach's Alpha, with the values shown in Table 4. As noted by Nyutu et al. (2021), a Cronbach's Alpha value of 0.60 or higher is considered acceptable, indicating that the items in the questionnaire are reliable for use in the study.

Table 4

Reliability of questionnaire based on Cronbach Alpha coefficient value

Section	Construct	Cronbach Alpha Coefficient Value
B	Knowledge to use ChatGPT in mathematics instruction	0.86
C	Skills to use ChatGPT in mathematics instruction	0.84
D	Self-efficacy to use ChatGPT in mathematics instruction	0.81

Data Collection Procedure

The questionnaire was administered to all primary school mathematics teachers in the district of Tambunan using Google Forms, which were shared via the teachers' official school email addresses. Google Forms was used instead of paper-based methods as it allows respondents to respond at their own convenience, helping to increase response rates and minimize non-response bias (Raju and Harinarayana, 2016). Respondents were given two weeks to complete the survey, with a reminder sent after one week. Participation was voluntary, and consent was obtained before the survey was conducted.

Data Analysis

Descriptive statistics were used to analyse the respondents' demographics, using percentages as well as the levels of knowledge, skills and self-efficacy using mean and standard deviation. Pearson's correlation analysis was used to examine the relationship between the variables, while multiple linear regression was used to determine the predictive influence of knowledge and skills on self-efficacy. Given that all constructs in this study were measured using self-report questionnaires, the potential risk of common method bias was assessed using Harman's single-factor test, following recommendations for survey research. An exploratory factor analysis was conducted on all measurement items without rotation. The results showed that no single factor explained most of the variance, indicating that common method bias was unlikely.

Results

Normality Test

Data were evaluated for normality to ensure the assumptions of parametric tests were met before conducting the correlation and regression analyses. The Shapiro-Wilk test was applied to each variable (knowledge, skills, and self-efficacy). The results presented in Table 5 show that all the variables have p-values greater than .05, indicating that their distribution is normal. This was supported by the skewness and kurtosis values, which fall within the acceptable range of ± 2 , as suggested by George and Mallery (2010). These results confirmed that the normality assumptions were satisfied, and the data were suitable for Pearson correlation and multiple regression analysis.

Table 5

Normality test

Variable	Shapiro-Wilk Statistic	df	p-value	Skewness	Kurtosis	Interpretation
Knowledge	0.982	73	.347	-0.45	0.62	Normal
Skills	0.977	73	.215	-0.39	0.51	Normal
Self-efficacy	0.981	73	.302	-0.42	0.58	Normal

p > .05 indicates the data are normally distributed

Respondent Demographics

Based on the demographic analysis, 43.83% of the respondents were male mathematics teachers while 56.17% of the respondents were female mathematics teachers. In terms of teaching experience, the largest group or 36.99% of the mathematics teachers had between 16 to 19 years of teaching experience, followed by 26.03% with more than 20 years, 20.55% with 11 to 15 years, 9.59% with 6 to 10 years and 6.84% with 1 to 5 years. These results indicate that most respondents are experienced mathematics teachers, a factor that may influence their confidence to adopt technology in their instructional practices (Paetsch et al., 2023).

Knowledge to use ChatGPT in Mathematics Instruction

Based on the findings presented in Table 6, the respondents displayed a high level of knowledge in using ChatGPT for mathematics instruction ($M = 3.80$, $SD = 0.19$).

The highest mean score was recorded for student self-learning ($M = 4.04$, $SD = 0.53$), while the lowest mean score was for ethical use ($M = 3.79$, $SD = 0.57$).

Table 6

Knowledge in using ChatGPT for mathematics instruction

No.	Item	Mean	Standard Deviation
1.	I know how to use ChatGPT to plan effective mathematics lessons.	3.80	0.68
2.	I know how to prompt ChatGPT to create mathematics questions.	3.98	0.56
3.	I know how to integrate ChatGPT into mathematics lessons.	3.98	0.63
4.	I know how to use ChatGPT to provide step-by-step solutions.	4.01	0.51
5.	I know how to use ChatGPT in an ethical and responsible way.	3.79	0.57
6.	I know that ChatGPT may make mistakes in generating mathematical content.	3.83	0.64
7.	I know when ChatGPT is most useful during mathematics lessons.	3.94	0.62
8.	I know how to use ChatGPT to provide instant feedback to student questions.	4.00	0.52
9.	I know ChatGPT can be used by students to learn on their own.	4.04	0.53
10.	I know how to help other teachers to use ChatGPT in mathematics instruction.	3.95	0.58
	Average	3.80	0.19

Skills in using ChatGPT for mathematics instruction

Based on the findings presented in Table 7, the respondents displayed a moderate level of skill in using ChatGPT for mathematics instruction ($M = 3.20$, $SD = 0.16$). The highest mean score was recorded for using ChatGPT to prepare tests and quizzes ($M = 3.46$, $SD = 0.57$), while the lowest was for writing good prompts ($M = 3.26$, $SD = 0.60$).

Table 7

Skills for using ChatGPT in mathematics instruction

No.	Item	Mean	Standard Deviation
11.	I can write good prompts to get proper output from ChatGPT.	3.26	0.60
12.	I can create mathematics questions using ChatGPT.	3.37	0.54
13.	I can use ChatGPT to generate examples that explain complex mathematical concepts.	3.27	0.53
14.	I can use ChatGPT to help plan mathematics lessons.	3.32	0.60

15.	I can use ChatGPT to prepare test and quizzes.	3.46	0.57
16.	I can use ChatGPT to brainstorm lesson ideas and classroom activities.	3.43	0.52
17.	I can use ChatGPT to personalize learning materials for students with diverse learning needs.	3.41	0.66
18.	I can integrate ChatGPT's output with other tools such as Google Classroom.	3.37	0.56
19.	I can teach students how to write effective prompts using ChatGPT.	3.28	0.53
20.	I can guide students to use ChatGPT responsibly for learning purposes.	3.28	0.56
	Average	3.20	0.16

Self-efficacy in using ChatGPT for mathematics instruction

Based on the findings presented in Table 8, the respondents' displayed a moderate level of self-efficacy in using ChatGPT for mathematics instruction ($M = 3.00$, $SD = 0.12$). The highest mean score was recorded for feeling capable of explaining mathematical concepts with support from ChatGPT ($M = 3.61$, $SD = 0.51$), while the lowest was feeling capable of guiding students to use ChatGPT ethically and responsibly. ($M = 3.11$, $SD = 0.54$).

Table 8

Self-efficacy in using ChatGPT for mathematics instruction

No.	Item	Mean	Standard Deviation
21.	I feel capable of explaining mathematical concepts with support from ChatGPT.	3.61	0.51
22.	I feel capable of using ChatGPT to help students explore and solve complex mathematics problems.	3.15	0.65
23.	I feel capable of using ChatGPT to make mathematics lessons more interesting.	3.31	0.52
24.	I feel capable of using ChatGPT to personalize mathematics activities for my students.	3.26	0.68
25.	I feel capable of using ChatGPT to create materials for mathematics lessons.	3.32	0.60
26.	I feel capable of applying new features in ChatGPT to enhance my mathematics lessons.	3.34	0.53
27.	I feel capable of finding new ways to use ChatGPT to fit my teaching style.	3.52	0.60
28.	I feel capable of using ChatGPT in different situations, such as group tasks or class discussions.	3.35	0.63
29.	I feel capable of managing classroom activities that involve students interacting with ChatGPT.	3.23	0.56
30.	I feel capable of guiding students to use ChatGPT ethically and responsibly.	3.11	0.54

31.	I feel capable of timing my use of ChatGPT within a class period.	3.15	0.56
32.	I feel capable of guiding my colleagues in learning how to use ChatGPT.	3.38	0.65
	Average	3.00	0.12

Relationship between knowledge and self-efficacy of mathematics teachers in using ChatGPT for mathematics instruction

Table 9 presents the results of the correlation analysis between knowledge and self-efficacy of mathematics teachers in using ChatGPT for mathematics instruction, which indicates a statistically significant and strong positive correlation ($r = .834$, $p < .01$).

Table 9

Correlation between knowledge and self-efficacy in using ChatGPT for mathematics instruction

	Self-Efficacy	
	r	Sig.
Knowledge	.834**	.001

***Correlation is significant at the 0.01 level (2-tailed)*

Relationship between skills and self-efficacy of mathematics teachers in using ChatGPT for mathematics instruction

Table 10 presents the results of the correlation analysis between skills and self-efficacy of mathematics teachers in using ChatGPT for mathematics instruction, which indicates a statistically significant and strong positive correlation ($r = .880$, $p < .01$).

Table 10

Correlation between skills and self-efficacy in using ChatGPT for mathematics instruction

	Self-Efficacy	
	r	Sig.
Skills	.880**	.001

***Correlation is significant at the 0.01 level (2-tailed)*

The influence of knowledge and skills on self-efficacy of mathematics teachers in using ChatGPT for mathematics instruction

The correlation analysis revealed strong positive relationships between knowledge and self-efficacy ($r = .834$) and between skills and self-efficacy ($r = .880$). Correlations of this magnitude are considered strong to very strong and therefore require careful interpretation. In this study, these results reflect the close theoretical relationship between teachers' knowledge, skills, and self-efficacy in the context of AI integration. Self-efficacy develops through both conceptual understanding and mastery experiences, which are directly related to teachers' understanding of ChatGPT and their ability to use it in their instructional practices. Multicollinearity diagnostics indicated no statistical concern, with low VIF values ($VIF = 1.008$), suggesting that knowledge and skills functioned as related but distinct predictors of self-efficacy. However, future studies may further examine the distinctiveness of these constructs through confirmatory factor analysis.

Table 11

Regression analysis for Knowledge and Skills as predictors of Self-Efficacy in using ChatGPT for mathematics instruction

Predictor	Unstandardized B	Standardized Beta (β)	t	Sig.	VIF
Knowledge	0.437	0.270	3.488	.001	1.008
Skills	0.514	0.690	8.913	.001	1.008

$R\ square = 0.587; F(2, 70) = 87.45, p < .001$

A multiple linear regression analysis was conducted to examine the extent to which knowledge and skills predict mathematics teachers' self-efficacy in using ChatGPT for mathematics instruction. The results presented in Table 11 show that both predictors are statistically significant, indicating that the overall regression model is statistically significant, $F(2, 70) = 87.45, p < .001$. Knowledge ($B = 0.437, \beta = 0.270, p < .001$) and skills ($B = 0.514, \beta = 0.690, P < .001$) each contributed significantly to predicting self-efficacy. Between the two, skills proved to be the stronger predictor, with a higher standardized beta coefficient ($\beta = 0.690$) compared to knowledge ($\beta = 0.270$). The model explained 58.7% of the variance in mathematics teachers' self-efficacy, indicating that knowledge and skills are important factors influencing teachers' confidence in using ChatGPT for mathematics instruction.

Discussion

This study examined the influence of knowledge and skills on mathematics teachers' self-efficacy in using ChatGPT for mathematics instruction, an analysis including correlations between knowledge and self-efficacy as well as between skills and self-efficacy. The findings showed that mathematics teachers recognized ChatGPT's role in supporting self-directed learning, highlighting its potential to foster independent study. This aligns with Kehoe (2023) and Li et al. (2024), who emphasized AI's capacity to deliver real-time feedback, personalized explanations, and adaptable content. The finding is further supported by Flogie et al. (2025), who stated that digital technologies can enhance learning effectiveness compared with traditional instructional approaches, particularly when they are used to facilitate student-centred learning environments. However, lack of understanding in ethical and responsible use of ChatGPT in mathematics instruction was identified. Although teachers understood ChatGPT's instructional benefits, they lacked the ethical elements necessary to ensure safe and responsible use in the classroom. Understanding the concepts of AI and their ethical implications is a condition for acting in accordance with them and for their introduction in education, as established by Gartner and Krašna (2023). Given concerns regarding academic honesty, accuracy, and bias (Estaityeh and McQuirter, 2024), professional development must integrate training on responsible AI practices (Zawacki-Richter et al., 2019). Therefore, conceptual understanding of how to use ChatGPT in mathematics instruction must be balanced with awareness about the ethical and responsible use of ChatGPT.

Mathematics teachers demonstrated some ability to use ChatGPT for assessment, particularly quizzes and tests, though their prompting skills need improvement. This reliance on basic prompting highlights the need to improve proficiency to maximize ChatGPT's potential. Li et al. (2024) and Kiryakova (2024) highlighted ChatGPT's value in streamlining formative assessment, and adaptability to diverse classroom needs through proper prompting. Enhancing prompting skills could lead to more accurate, relevant, and engaging instructional materials.

Respondents reported confidence in using ChatGPT to explain mathematical concepts, citing its ability to simplify complex ideas into more understandable steps. Similar findings were reported by Kehoe (2023), Nautiyal et al. (2023) and Zhu et al. (2023), who highlighted ChatGPT's ability to generate structured explanations for complex topics. Teachers can thus reframe content to meet diverse learner needs. However, they were least confident in guiding students on how to use ChatGPT

ethically and responsibly. Zawacki-Richter et al. (2019) stated similar challenges, highlighting that many teachers lack the ethical competences required to integrate AI responsibly and effectively into classroom practice. Since teachers play a key role in shaping students' attitudes toward ethical technology use, professional development should thus focus on both practical and ethical competence (David and Maroma, 2025).

The study also indicated that knowledge significantly enhances self-efficacy, consistent with Bandura's Social Cognitive Theory (1997). Teachers who are familiar with ChatGPT's functions, limitations and applications are more confident to integrate it when delivering lessons. This aligns with Taimalu and Luik (2019), who stated that knowledge directly impacts technology integration. Similarly, skill in using ChatGPT strongly influences self-efficacy. Bandura (1997) highlighted that mastery experiences build confidence, a point supported by Chan and Lee (2023) and Denison et al. (2024).

The findings of this study are consistent with international research showing that although teachers often possess basic awareness of AI tools, their practical readiness and confidence to integrate these tools into classroom instructions remain limited. Studies in mathematics and primary education consistently highlight variation in teachers' preparedness to adopt tools such as ChatGPT, particularly when it comes to instructional implementation rather than conceptual understanding. The stronger influence of skills on self-efficacy aligns with global evidence indicating that teachers' confidence in using AI is primarily built through hands-on experience. Teachers who can formulate effective prompts, evaluate AI-generated responses, and integrate ChatGPT into lesson planning and assessment are more likely to feel confident using it in their instructional practice. This helps explain why skills emerged as a stronger predictor of self-efficacy than knowledge. The findings also reflect international concerns regarding teachers' ethical readiness to use AI. While respondents recognized ChatGPT's potential to empower the delivery of lessons, lower confidence in guiding ethical and responsible use highlights the need for greater emphasis on issues such as accuracy, bias, transparency, and academic integrity. These results reinforce demands for professional development that prioritizes practical skills and ethical competence alongside conceptual understanding.

Thus, there is a need to continuously equip teachers with practical, hands-on skills that empower them to use and integrate AI tools into their instructional practice. Having the skills to use ChatGPT effectively can make a significant impact in enhancing mathematics teachers' confidence to use ChatGPT in their instructional

practices. This is in line with Bandura (1997) and Ayanwale et al. (2022), who cited hands-on experience as one of the ways to build self-efficacy. The TPACK framework (Mishra and Koehler, 2006) further emphasized that without practical skills, theoretical knowledge alone may not foster effective adoption of technology.

Conclusion

This study examined the relationship between mathematics teachers' knowledge and skills related to ChatGPT and their self-efficacy in using these AI tools in mathematics instruction. The findings showed that while mathematics teachers reported strong conceptual knowledge, their practical skills and confidence were moderate. Both knowledge and skills were positively related to self-efficacy, with skills emerging as the stronger predictor. The findings do not directly indicate instructional effects of ChatGPT in mathematics instruction but instead highlight teachers' perceived confidence and how it is associated with knowledge and skills, where teachers with stronger practical skills tended to feel more confident using ChatGPT in mathematics instruction. These results suggest that professional development should emphasize hands-on training, ethical awareness, and guided practice rather than merely focusing on conceptual knowledge.

Data Availability Statement

The article is based on data fully presented and discussed within the article itself; therefore, no additional data archiving is required.

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