

Science and Mathematics Teachers' Perceptions of the Use of Artificial Intelligence (AI) in Teaching: A Systematic Literature Review (SLR)

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Abstract: *This study aims to explore the perceptions of Science and Mathematics teachers towards the use of Artificial Intelligence (AI) in the teaching and learning process. A Systematic Literature Review (SLR) approach was used to analyse and synthesise findings from 15 articles published between 2022 and 2025. These articles were systematically selected using the PRISMA protocol which included searches in three major databases namely Scopus, Google Scholar and ERIC. The inclusion criteria set ensured the relevance of the context, scope and validity of the sources relevant to the focus of the study. The results of the thematic analysis of the selected articles produced four main themes: (i) teachers' positive acceptance and openness towards AI, (ii) challenges related to technological skills, ethics and implementation, (iii) the impact of AI on teaching strategies and classroom interactions and (iv) the level of teacher readiness and the need for continuous professional development. The findings show that although teachers show a progressive attitude towards AI, concerns about data security, pedagogical suitability and lack of training are major barriers to effective implementation. The study also identifies research gaps in the local context and the need for holistic and contextual solutions. The implications of this study are important in helping stakeholders such as policymakers, researchers and educational institutions to develop policies, training and technologies that are aligned with the real needs of teachers in the digital education era. This study contributes to the current literature on AI in education and suggests future research directions.*

Keywords: Artificial Intelligence, Teacher Perception, Science and Mathematics Teaching, Education System, Systematic Literature Review

1. Introduction

Artificial Intelligence (AI) has emerged as one of the most transformative innovations shaping various sectors globally, including education. Its ability to provide adaptive learning, intelligent tutoring support, and real-time data analytics has strengthened the effectiveness of teaching and learning processes (Khan & Vice, 2022). In the context of Science and Mathematics education, AI enables teachers to design more systematic instructional strategies, deliver personalized materials responsive to students' needs, and enhance understanding of abstract and complex concepts.

However, the successful implementation of AI in classrooms does not solely depend on technical sophistication but also on teachers' acceptance and readiness as primary users within the education system. Teachers' perceptions play a vital role in determining the extent to which they adopt and integrate AI in daily pedagogy. Previous studies have shown that factors such as digital competence, attitudes toward technology, professional readiness, and institutional support significantly influence teachers' acceptance of AI (Alshorman, 2024; Woodruff et al., 2023). In developing countries such as Malaysia, disparities in infrastructure and technological literacy between urban and rural schools continue to limit effective integration of educational technology (Tashtoush et al., 2024).

This digital divide contributes to unequal opportunities among teachers to utilize AI effectively, particularly in under-resourced or rural schools. Therefore, it is crucial to understand how Science and Mathematics teachers perceive, respond to, and employ AI within real classroom settings. A notable research gap exists, as few studies have systematically examined teachers' perceptions of AI using comprehensive and comparative approaches across different contexts.

This study employs a Systematic Literature Review (SLR) approach guided by the PRISMA framework to collect, evaluate, and synthesize current empirical findings related to teachers' perceptions of AI in Science and Mathematics education. The SLR approach provides a transparent and evidence-based method for identifying patterns, themes, and research gaps in existing studies.

Furthermore, STEM education plays a pivotal role in cultivating a highly skilled workforce essential for the demands of the Fourth Industrial Revolution. In the post-pandemic era, where digital learning has become integral to education, teachers' ability to understand and effectively utilize AI is more critical than ever (Lima et al., 2024).

This study contributes new insights to the field of social science education by providing a comprehensive synthesis of Science and Mathematics teachers' perceptions of AI use in teaching. It consolidates recent empirical evidence to reveal interconnections among teachers' acceptance, implementation challenges, and continuous training needs. The findings are expected to guide policymakers, teacher-training institutions, and researchers in developing contextualized professional development strategies and strengthening AI integration in STEM education.

The objectives of this study are to:

1. Identifying Science and Mathematics teachers' perceptions of the use of AI in teaching based on the findings of past studies.
2. Analyze the factors that influence teachers' perceptions of the use of AI in the context of STEM education.
3. Identify the main themes that have been identified in previous studies related to the use of AI in education.
4. Examine the research gaps that have not yet been explored in studies related to the use of AI in Science and Mathematics teaching.

In this regard, this study is driven by the following questions:

1. What are the perceptions of Science and Mathematics teachers towards the use of AI in teaching based on the findings of past studies?
2. What are the factors that affect teachers' perceptions of the use of AI in the context of STEM education?

3. What are the main themes that have been identified from previous studies related to the use of AI in education?
4. What research gaps have not yet been explored in studies related to the use of AI in Science and Mathematics teaching?

2. Methodology

This study was conducted using the Systematic Literature Review (SLR) approach which functions as an analytical and objective process to collect, evaluate and synthesize past research results relevant to a specific topic in a planned manner. This approach allows researchers to identify key themes, research gaps and suggest meaningful suggestions for future studies. The implementation of SLR is guided by the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) protocol as the main framework. Huang et al. (2024) in the study, PRISMA is globally recognized to ensure transparency, accuracy and effectiveness of the systematic review process. This study was conducted in phases to ensure transparency and repeatability of the process as follows:

2.1 Phase 1: Study Planning

The initial phase of this study emphasized the critical basic steps in conducting a Systematic Literature Review (SLR). These included determining the relevant topic, setting comprehensive research objectives and questions, and selecting a methodological framework that was appropriate to the context of the study. According to Park et al. (2022), clarity and thoroughness in the process of selecting and excluding certain studies are important elements in ensuring the integrity and reliability of the overall research findings.

The title “Science and Mathematics Teachers’ Perceptions of the Use of Artificial Intelligence (AI) in Teaching” was chosen to explore the level of acceptance of innovative technologies such as AI in the context of school STEM education. This study aimed to explain how teachers understand and respond to such technologies in classroom practice. To ensure a systematic and evidence-based approach, the researchers used the PRISMA model as a methodological framework for conducting SLR. This model has proven effective in organizing and analyzing the literature carefully and comprehensively.

To ensure clarity and direction of the study, two important elements are determined at this stage, namely:

- **Research Questions:** Research questions were constructed to explore teachers' perceptions of AI in teaching, identify factors that influence these perceptions, and clarify key themes and research gaps in this field.
- **Study Protocol:** This study was not formally registered in a database such as PROSPERO as the field of education does not yet mandate such registration. However, a systematic approach was still applied through thorough adherence to PRISMA elements. A thorough internal documentation process and ongoing evaluation were implemented to ensure methodological integrity and accuracy of study synthesis.

2.2 Phase 2: Research Search and Selection

This phase includes the process of searching for articles, screening and selecting relevant studies for systematic analysis. The PRISMA method was used to ensure that the screening and documentation process was carried out thoroughly and transparently (Putra et al., 2023). The search process was carried out carefully using three main databases, namely Scopus, Google Scholar and ERIC. The selection of these databases was based on the breadth of coverage,

quality of articles and accessibility to education and technology studies. Stepwise verification steps were also implemented to reduce researcher bias and ensure accuracy in article selection (Chan et al., 2022). According to Sim and Maat (2022), a systematic literature selection approach is the basis for reliability in review studies.

The search keywords used have been designed and combined with Boolean operators such as AND and OR to produce relevant and comprehensive search results. Some of the key keyword combinations are:

- ("artificial intelligence" OR "AI") AND ("teachers' perception" OR "teachers' attitude") AND ("science" OR "mathematics") AND ("STEM education")

The search criteria are set as follows:

- Publication year: 2020 to 2025
- Source type: Journal article published in a peer-reviewed journal
- Language: Articles in English or Malay only

The inclusion and exclusion criteria were set to ensure that all articles analyzed had a context, participant, and topic scope that was consistent with the study objectives. By limiting the study to the period 2020–2025 and the requirement to access full articles, the researcher was able to ensure that the synthesized findings were based on authentic, up-to-date sources and relevant to the development of AI technology in Science and Mathematics education. The selection of studies that focused on teacher perceptions and the STEM context at the school level also allowed for an in-depth analysis of the practical readiness, constraints, and potential for implementing AI in the classroom in a transparent manner.

Table 1: Article Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
Empirical study on teachers' perceptions of AI.	Articles that only discuss AI technology without the element of teacher perception.
Studies in the context of Science or Mathematics education.	Studies in fields other than Science or Mathematics.
The full article is available and accessible.	Articles without full text or only abstracts.
Articles published in the period 2020–2025.	Articles published before 2020.

By setting clear criteria as in Table 1, the filtering process becomes more objective, systematic and consistent. It not only makes it easier for researchers to identify the most relevant articles, but also increases the reliability and transparency of the overall SLR implementation. This process produces a large initial number of articles that are then filtered step by step according to the PRISMA flow chart that will be presented in the next section.

2.3 Phase 3: Data Analysis and Synthesis

Once suitable articles were identified, each article was systematically analyzed using a thematic analysis approach. This process involved active reading, data coding, pattern recognition, and clustering information into key themes. O'Connor and Joffé (2020) emphasized that reading is a fundamental qualitative activity that bridges qualitative and quantitative approaches in analysis. In addition, thematic analysis applications span multiple domains such as education, sociology, and psychology so that all benefit from the structured data patterns that emerge through expected and emergent themes (Mohammed, 2022). The purpose of this thematic analysis was to demonstrate the effectiveness of this method in synthesizing complex data into

structured and clear themes, thus facilitating deeper interpretation of participants' experiences (Zhang et al., 2025).

In addition, descriptive content analysis was also applied to record the frequency of each main theme. According to Kandal and Baş (2022), the ability of thematic analysis to examine qualitative and quantitative data simultaneously allows researchers to identify basic patterns and themes that serve as a guide to the formation of future research agendas. This approach not only strengthens the understanding of the issues studied, but also contributes to the formation of a theoretical and practical framework that is more in line with current and future educational needs. Subsequently, the study results were synthesized using a narrative synthesis approach that allows for the systematic and holistic integration of findings and takes into account the diversity of contexts in previous studies.

Graham and Porter (2024) argue that the increasing prevalence of misinformation has created an urgent need for the development of more effective and reliable fact-checking mechanisms. Although the implementation of fact-checking methods has been reported to significantly address the issue of information inaccuracy, the existence of a significant gap between the recipients of misinformation and individuals actively involved in the verification process remains a major obstacle. This gap not only undermines the effectiveness of fact-checking initiatives, but also poses serious challenges to efforts to ensure the accuracy of information circulating in society. This situation also affects the effectiveness of communication intervention strategies and information literacy programs, especially in addressing information manipulation in an increasingly complex and dynamic social context.

The checklist serves to guide researchers in presenting their findings clearly which increases the credibility and utility of the review (Okorn & Vauhnik, 2023). To ensure the quality of the findings, a quality assessment is performed on each article using a checklist based on four main criteria:

1. Clarity of study objectives
2. The accuracy of the methodology used
3. Robustness of data analysis
4. Reliability and validity of findings

Uzun et al. (2025) emphasized the role of the PRISMA checklist in ensuring consistency and clarity of methodological reporting, thereby minimizing bias and strengthening the reliability of conclusions drawn from data analysis. Each article was scored based on its adherence to the criteria. Only articles that met the minimum quality level were included in the final synthesis. Findings were analyzed according to recurring themes such as teachers' understanding of AI, level of readiness for use, enabling and hindering factors, and implications for pedagogy.

2.4 Phase 4: Reporting and Documentation

The final phase of this study involved the systematic collection and organization of findings and the preparation of a final report according to the structure set out in the Systematic Literature Review (SLR). Reporting was carried out according to the PRISMA guidelines which included the use of the PRISMA Flowchart to visualize the number of articles screened and selected at each stage of the selection process (Li & Maat, 2022). Figure 1 serves to demonstrate the transparency and traceability of the review process and the removal of articles based on the established inclusion and exclusion criteria.

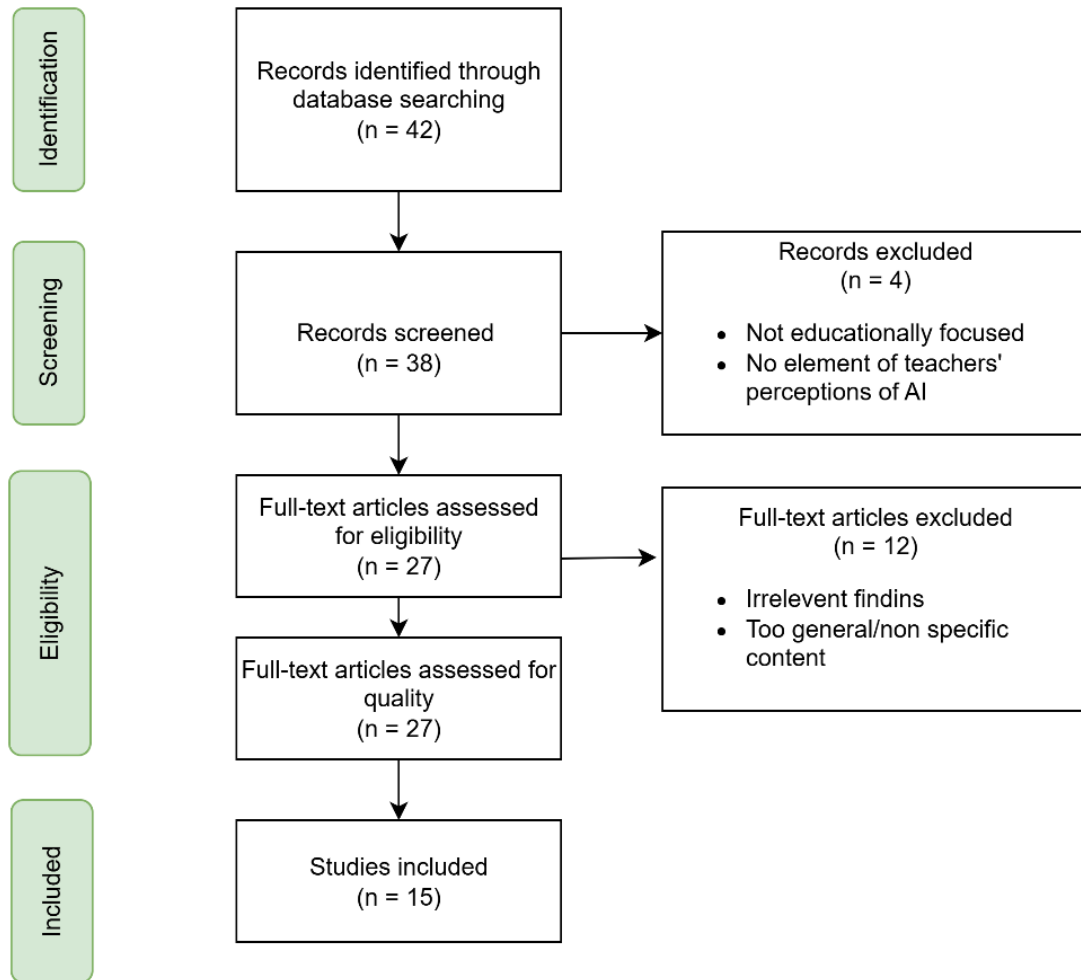


Figure 1: Article Screening and Selection Process Flowchart

In Figure 1, a total of 42 articles were identified through an initial search in the Scopus, Google Scholar and ERIC databases. After removing duplicate articles, a total of 38 articles were screened based on title and abstract. Of these, 4 articles were excluded because they did not focus on education or did not address the aspect of teachers' perceptions of AI use. Subsequently, 27 articles were fully reviewed but 12 articles were dropped because their content was too general or did not align with the study objectives. Finally, a total of 15 articles met all inclusion criteria and were analyzed in depth in a qualitative synthesis.

The findings of this study are presented through a structured narrative approach supported by a literature synthesis table to ensure comprehensive, clear and meaningful presentation of information. Each selected article was analyzed thematically and organized in a table displaying important information such as author name, year of publication, study location, research design, number and type of participants, and a summary of key findings. Presentation in tabular form not only facilitates cross-comparison between studies, but also clarifies patterns and trends in the research area studied. As suggested by Crowley et al. (2024), the use of narrative synthesis reinforced with data visualization has proven effective in increasing understanding and impact of scholarly communication, especially when involving multiple dimensions of empirical research.

Therefore, this approach was used in this study to enable readers to identify research gaps, consistency of findings, and general trends that have emerged in previous studies related to teachers' perceptions of the use of AI in Science and Mathematics teaching. In addition, the quality assessment of the articles was systematically carried out using instruments aligned with the PRISMA guidelines. This assessment step ensured that only articles that met valid methodological standards and relevant content were selected as the basis for analysis. This step is important in ensuring the accuracy, validity, and reliability of the overall study findings in line with the principles of transparent and evidence-based literature review (Cohen et al., 2021).

The final report is structured in APA style, seventh edition, with clarity in terms of references, subheadings, and visual integration such as tables and figures that support the narrative. Each finding is directly linked to the study objectives to demonstrate empirical contributions to understanding teachers' perceptions of the use of AI in teaching Science and Mathematics. This paper also highlights how the findings can influence current educational practices. Finally, this report summarizes practical implications that can be applied by stakeholders such as policymakers, school administrators, and teacher training providers. This study also presents recommendations for further research based on the knowledge gaps identified throughout the literature synthesis process, so that the future education agenda is better prepared to embrace technologies such as AI ethically and effectively.

3. Findings and Discussion

A total of 15 articles were identified and comprehensively analyzed based on the criteria set out in this study. The articles covered the publication period from 1 January 2022 to 31 December 2025, in line with the study's focus on the latest developments in the field of artificial intelligence (AI) in education. The literature selection and filtering process was carried out systematically based on the PRISMA guidelines, thus reflecting a high level of transparency, accuracy and methodological integrity.

Analysis of the articles shows that in general, Science and Mathematics teachers exhibit a diversity of perceptions towards the use of AI. The majority of studies report positive attitudes, especially when AI is used to enhance data-driven teaching, personalize learning and automate assessment. However, there are also studies that highlight teachers' concerns over issues such as lack of professional training, difficulty in adapting AI to existing curricula, as well as concerns over student data privacy and the risks of technology dependency.

Although article selection was rigorous to ensure the quality and accuracy of findings, it is possible that some relevant innovative studies were excluded because they did not meet the overly specific inclusion criteria. This situation highlights the need to balance methodological quality and breadth of perspective in systematic literature reviews so that the findings obtained are more holistic and reflect the real context of AI use in the classroom.

Table 2: Article Analysis – Teachers' Perceptions and Implications of AI Use

No	Title and Author	Country	Research Methods	Research Participants	Teacher Perceptions Towards AI	Related impacts
1	Perceptions and Barriers to Adopting Artificial Intelligence in K-12 Education: A Survey of Educators in Fifty States (Woodruff, Hutson, & Arnone, 2023)	United States	Mixed method	4528 teachers	<ul style="list-style-type: none"> • High interest and readiness for AI integration in teaching • Concerns about technology access, comfort level and training and support needs 	Improve the effectiveness of the curriculum and support teaching through teacher aids
2	Exploring Teachers' Perception of Artificial Intelligence: The Socio-emotional Deficiency as Opportunities and Challenges in Human-AI Complementarity in K-12 Education (Oh & Ahn, 2024)	United States	Mixed method	100 primary school teachers participated in the survey and 12 of them were selected for interviews	<ul style="list-style-type: none"> • AI helps with administrative tasks and personalized learning • Concerns about socio-emotional deficiencies • AI has difficulty reading complex communication and relationship signals • Emotion-free AI seen as able to increase objectivity of evaluation 	<ul style="list-style-type: none"> • AI has the potential to reduce the burden of teachers' routine tasks • The need for a cautious approach due to AI's socio-emotional constraints • AI can help with fairer and less biased assessments • Decisions on the use of AI need to align with teachers' needs and concerns
3	Attitudes towards and expectation on the role of artificial intelligence in the classroom among digitally skilled Finnish K-12 mathematics teachers (Pörn et al., 2024)	Finland	Mixed method	85 K-12 mathematics teachers	<ul style="list-style-type: none"> • Teachers are interested, open and aware of the potential of AI in education • There are doubts about AI's ability to accurately adapt and assess • Concerns about the risk of dependency in teaching 	<ul style="list-style-type: none"> • Teachers interested in using AI early in teaching Mathematics • There is concern about disruption in learning basic mathematical concepts and skills.
4	Educators' Perception of Artificial Intelligence as Instructional Tool (Sadykova & Kayumova, 2024)	Russia	Mixed method	132 teachers	<ul style="list-style-type: none"> • AI is considered useful, but is quite complex and not yet fully intelligent. • Many teachers are not yet proficient in using AI and rarely use it. • Teachers are ready to undergo training to 	There is an urgent need for professional development courses to change the stigma and increase practical skills in AI in education.

					become proficient in the use of AI	
5	AI in STEM education: The relationship between teacher perceptions and ChatGPT use (Beege, Hug, & Nerb, 2024)	Germany	Quantitative methods	102 STEM teachers	<ul style="list-style-type: none"> Confidence in the benefits and competence of ChatGPT encouraged its use ChatGPT is seen as a teaching and student engagement level Risks such as accuracy and ethical bias are acknowledged but do not preclude use. 	<ul style="list-style-type: none"> AI helps increase cognitive activation and classroom management The use of AI encourages student engagement and a positive learning atmosphere The benefits of AI are believed to outweigh concerns about student motivation and performance.
6	Education 4.0 and the application of Artificial Intelligence (AI) in teaching (Lima et al., 2024)	Portugal	Quantitative methods	102 teachers	<ul style="list-style-type: none"> Majority of teachers believe AI can enhance learning that suits students' needs There are concerns about ethical issues, information quality and training requirements for the use of AI 	<ul style="list-style-type: none"> Positive perceptions encourage the use of AI to improve teaching Concerns exist, need for ongoing dialogue and cautious approach in AI integration
7	Didactic Activities On Artificial Intelligence: The Perspective Of Stem Teachers (Fissore al., 2022)	Italy	Mixed method	52 teachers	<ul style="list-style-type: none"> Teaching AI topics is rare Obstacles: time constraints, lack of experience, and concerns about topics outside of expertise Realize the importance of AI in computer science and daily life Support teaching AI, ethical issues, digital skills to students 	<ul style="list-style-type: none"> Emphasis on AI issues in education Teacher training requirements for AI activities Continuous exposure helps students understand the risks and benefits of AI Encourage active and diverse learning approaches

8	Exploring chemistry teachers' knowledge and perceptions of AI: Opportunities and challenges (Hammoud, 2025)	Lebanon	Quantitative methods	285 Chemistry teachers	<ul style="list-style-type: none"> • Chemistry teachers show a positive perception of AI • AI is seen as capable of making teaching more interactive and innovative • AI helps prepare materials, customize learning and increase pedagogical effectiveness 	<ul style="list-style-type: none"> • Helps simulate complex chemical phenomena. • Improve students' creativity, pedagogical skills, and assessment capabilities. • Lack of technical skills related to AI. • The risk of over-reliance on AI and the possible loss of teacher creativity.
9	Acceptance of artificial intelligence in teaching science: Science teachers' perspective (Al Darayseh, 2023)	United Arab Emirates	Quantitative methods	83 science teachers	<ul style="list-style-type: none"> • The level of acceptance of AI in teaching is high (mean 3.90) • Influenced by self-confidence, positive attitude and expected benefits • Stress and guidance have the lowest and most significant impact 	<ul style="list-style-type: none"> • Confidence and positive perceptions increase teachers' tendency to use AI in teaching • Ease of use encourages an open attitude towards technology • Professional training is essential for skill level and continued use • Teachers' attitudes towards AI impact the quality of STEM education
10	Analysis of Science Group Teachers' Use of Artificial Intelligence in the Distance Education Process (Yazıcı & Erkoç, 2023)	Turkey	Qualitative methods	44 Science teachers	<ul style="list-style-type: none"> • 25% of teachers don't know about AI • Teachers who understand AI think it mimics human abilities • Lack of knowledge and experience makes teachers hesitant to use AI • Distance education encourages the use of AI 	<ul style="list-style-type: none"> • Distance learning spurs use of AI in teaching • Lack of understanding causes teachers' objections and uncertainty • Positive experiences and technological awareness increase confidence in the use of AI

11	The level of Science and Mathematics Teachers' Employment of Artificial Intelligence Applications in the Educational Process (Alissa & Hamadneh, 2023)	Jordan	Quantitative methods	358 teachers	<ul style="list-style-type: none"> • The level of use of AI in education by Science and Mathematics teachers is moderate • AI usage is higher among female teachers than male teachers 	<ul style="list-style-type: none"> • While AI is acknowledged to be important, its implementation in schools is still weak • Teacher training and awareness need to be increased for effective use of AI
12	The readiness to use ai in teaching science: science teachers' perspective (Alshorman, 2024)	Jordan	Quantitative methods	136 science teachers	<ul style="list-style-type: none"> • Optimistic about the potential of AI in science education and learning tailored to student needs • Concerns about replacing the human element as well as privacy and data security issues • Teachers are interested and open to trying AI in teaching 	<ul style="list-style-type: none"> • AI helps personalized learning, improving student engagement and outcomes • Automating important tasks allows teachers to focus more on teaching • Students are more active and critical with AI learning materials • Challenges in access to resources and training hinder effective AI integration
13	Teachers' familiarity, perceptions, and training needs on the use of ChatGPT in mathematics instruction (Magat & Sangalang, 2024).	Philippines	Mixed Method	110 Mathematics teachers	<ul style="list-style-type: none"> • Still neutral about the effectiveness of ChatGPT in teaching • Not yet used to using it and not convinced of the direct pedagogical benefits • Recognize the potential of ChatGPT to help save time in teaching preparation 	<ul style="list-style-type: none"> • Improves personalized learning and student engagement. • Improves mathematics teaching when applied effectively. • Challenges include limited training and concerns about the role of teachers.

14	Game-Based Learning: Current Practices and Perceptions of Secondary School Physics Teachers in Malaysia (Low, Balakrishnan, & Yaacob, 2024)	Malaysia	Quantitative methods	211 physics teachers	<ul style="list-style-type: none"> • High interest in game-based learning • Low implementation due to technical constraints, time and gamification training 	<ul style="list-style-type: none"> • Limited training and knowledge slow down GBL implementation, especially in physics. • Training and support boost teacher confidence and motivate STEM students
15	Perceptions of Chemistry and Mathematics Trainee Teachers towards the Use of ChatGPT in Education (Kaswadi & Tien, 2024)	Malaysia	Quantitative methods	245 Chemistry and Mathematics trainee teachers	<ul style="list-style-type: none"> • Chemistry and Mathematics trainee teachers highly value the advantages and acceptance of ChatGPT • Perception of weakness is at a moderately high level 	<ul style="list-style-type: none"> • Trainee teachers view ChatGPT positively as a helpful tool for learning and solving problems. • Issues like cheating and plagiarism require attention, and improvements are needed to ensure safe and effective use in education

Table 2 details the information for each article, including the country of study, research methods applied, number of participants involved, teachers' perceptions of AI and the impact of its use. This study analyzed 15 empirical articles and systematic reviews related to teachers' perceptions of the use of artificial intelligence (AI) in education, particularly in the fields of Science and Mathematics. The information obtained from various countries such as Jordan, Lebanon, Finland, Russia, Turkey, Philippines, Malaysia, Germany, Portugal, United Arab Emirates, Italy and the United States paints a global picture of the readiness, constraints and opportunities for implementing AI in the classroom. This diversity of contexts is important because it allows for meaningful cross-cultural comparisons.

Table 3: Types of Research Methods Studied

Research Methods	Frequency	Percentage %
Quantitative	8	53.3
Qualitative	1	6.7
Mixture	6	40.0

Table 3 shows that an analysis of 15 articles published between 2022 and 2025 was conducted to examine the form of research methods used by researchers in studying teachers' perceptions of the use of artificial intelligence (AI) in the fields of Science and Mathematics. The quantitative method is the most dominant approach among researchers, where this method is used in 8 out of 15 articles (53.3%). According to Ghanad (2023), quantitative research based on real experience and scientific principles emphasizes the collection of numerical data as the main approach to testing hypotheses.

This approach aims to produce findings that can be observed and measured objectively. This approach usually involves the use of questionnaires or numerical instruments to measure the level of acceptance, perception and attitude of teachers towards the use of AI. Studies such as

those by Alissa and Hamadneh (2023), Al Darayseh (2023), Alshorman (2024) and Lima et al. (2024) are examples of research that uses a descriptive quantitative design to obtain data from hundreds of teachers in various countries.

Meanwhile, 6 articles (40%) used mixed methods, which is a combination of quantitative and qualitative approaches. Guetterman and Perez (2023) emphasized that mixed methods allow for a more comprehensive exploration of research issues through the integration of numerical and descriptive data, thus producing deeper insights compared to the use of a single methodological approach that may be limited in terms of understanding the context and impact of the study. For example, studies by Pörn et al. (2024), Sadykova and Kayumova (2024), Woodruff et al. (2023) and Oh and Ahn (2024) combined statistical analysis with teacher interviews to explore their perceptions comprehensively.

Only 1 article (6.7%) used a fully qualitative approach. According to Babar and Ahmed (2023), qualitative methods allow for the formation of a more balanced relationship between researchers and participants, which in turn encourages intellectual intimacy and strengthens the understanding of the phenomenon being studied in depth and contextually. Through case study methods or in-depth interviews such as in the study by Yazıcı and Erkoç (2023) in Turkey, it focuses on teachers' experiences and pays attention to the context and individual narratives of teachers about the use of AI in the classroom. Overall, the selection of research methods in these studies illustrates that the issue of teachers' perceptions of AI is often analyzed using large-scale and structured data, but there is also a tendency to understand the context and experiences of teachers through mixed and qualitative designs. This shows the importance of combining both approaches in an effort to produce more comprehensive and contextual findings.

4. Main Themes and Synthesis of Findings

The synthesis of 15 selected journal articles allowed the identification of four main themes that describe various dimensions of teachers' perceptions and experiences of the use of artificial intelligence (AI) in the teaching and learning of Science and Mathematics. Each of these themes encompasses the positive dimensions, challenges and support needs that arise when AI is introduced in a real classroom context. The following explanation comprehensively describes each theme based on the findings of previous studies.

1. Positive Perception and Early Acceptance of Teachers towards AI

Most studies report that teachers show high interest and positive attitudes towards the integration of AI in teaching. AI is seen as an innovative tool that can support modern pedagogical strategies and empower student-centered learning. Studies by Hammoud (2025), Magat and Sangalang (2024), and Kaswadi and Tien (2024) show that teachers consider AI to be able to speed up the preparation of teaching materials, personalize the learning experience according to the level of students and increase student motivation and active engagement. Moreover, AI also contributes to more systematic monitoring of learning. Beege et al. (2024) and Lima et al. (2024) reported that the use of AI that is able to provide immediate and automatic feedback to students has improved the effectiveness of formative assessment and supported students' self-development in complex subjects such as Mathematics and Science.

2. Challenges of AI Use: Skills, Ethics and Technology Constraints

Although AI is welcomed, a number of practical and ethical barriers have been identified that hinder its widespread implementation. Teachers have expressed concerns about a lack of technical training, digital infrastructure constraints and data security issues. Sadykova

and Kayumova (2024), Woodruff et al. (2023), and Oh and Ahn (2024) have highlighted that teachers are not fully confident in their ability to apply AI without strong training and professional development support. Furthermore, there are concerns that excessive use of AI will reduce face-to-face interaction between teachers and students, thus weakening the emotional connection that is important in the educational process. Pörn et al. (2024) have also highlighted that AI may not be fully aligned with current curriculum objectives, especially in approaches that require high levels of critical thinking, empathy and creativity.

3. The Impact of AI on the Teaching and Learning Process

The use of AI has been found to have a direct impact on the structure and approach to teaching in the classroom. AI not only speeds up the teaching process, but also enriches the student learning experience through interactive and adaptive elements. A study by Alshorman (2024) shows that AI can help teachers identify patterns of student weaknesses and dynamically adjust teaching methods. However, there is a risk that reliance on this technology can reduce the human element in education. Oh and Ahn (2024) emphasize that important aspects of learning such as empathy, intrinsic motivation and interpersonal relationships risk being marginalized if AI is applied without careful control. Therefore, a balance between the use of technology and the role of the teacher as an emotional and moral facilitator still needs to be maintained.

4. Teacher Readiness and the Need for Continuous Training

Teachers' readiness to integrate AI into teaching is influenced by individual and institutional factors including prior experience, attitudes towards the technology and the level of support from school administration. Al Darayseh (2023) and Sadykova and Kayumova (2024) found that teachers who have attended training or have exposure to AI show higher confidence and openness to trying new approaches. However, many studies emphasize the need for continuous, structured and relevant training and access to professional communities of practice. Training should include aspects of AI pedagogy, ethical understanding and applicability in real classroom contexts. Without appropriate interventions, the digital competence gap between experienced and new teachers can undermine the effectiveness of AI integration.

As visual support for the findings described, Figure 2 shows a synthesis thematic map that illustrates the relationships between the main themes identified in this study.

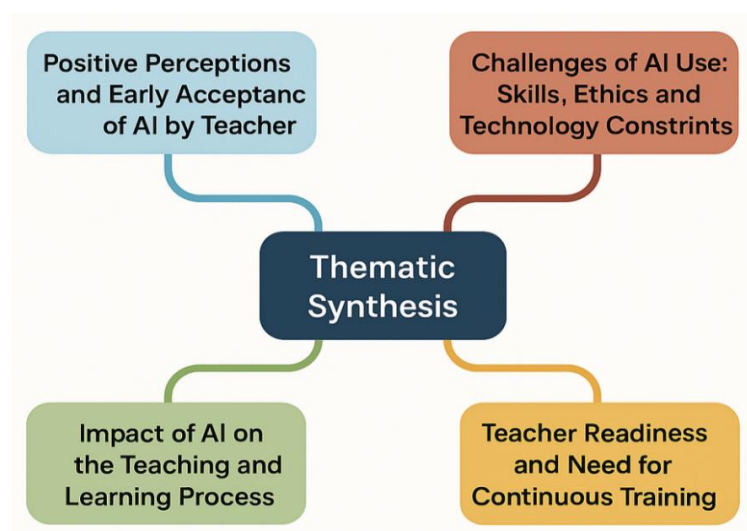


Figure 2: Thematic Map Synthesis of Teachers' Perceptions on the Use of AI in Science and Mathematics Education

5. Discussion

The findings of this study reinforce previous studies that show that teacher perceptions are a key element in ensuring the successful implementation of educational technology, including Artificial Intelligence (AI). While the level of openness and interest of teachers in the use of AI in the teaching process can be considered a positive development, there are several key concerns that continue to hinder effective implementation. Among these concerns are issues related to the complex implementation process, ethical dilemmas that have not been fully addressed, and the lack of reliable technical support. These concerns indicate the urgent need to create a more planned and comprehensive teacher training program, in addition to introducing clear and easy-to-follow ethical guidelines. Guarantees for data security and protection of student privacy also need to be given serious attention. Furthermore, significant differences between several countries, especially in terms of access to digital infrastructure and professional development opportunities for teachers, demand an approach to implementing AI that is inclusive and responsive to local contexts. Therefore, efforts to implement AI in education should involve close collaboration between all stakeholders including the Ministry of Education, policymakers, technology experts, and educators themselves. This approach is important to ensure that the solutions developed are not only transparent and ethical, but also relevant to the pedagogical needs and realities of the 21st century classroom.

5.1 Teachers' Perceptions of AI Use: Positive Tendencies Interspersed with Concerns

Overall, Science and Mathematics teachers show a positive tendency towards the use of artificial intelligence (AI) technology in teaching. Based on the findings of studies by Beege et al. (2024) and Hammoud (2025), educators generally welcome the potential of AI technology in improving the quality of learning. Among the most valued features are the ability of AI to tailor content to the personal needs of students, automate the assessment process more efficiently, and support more systematic and responsive classroom management. This perception is in line with the perceived usefulness element in the TAM model (Davis, 1989), which explains that the level of confidence in the benefits of technology is a key driver of its adoption in professional practice.

While AI is increasingly accepted as a tool to support the teaching process, this perception is not without critical challenges. Some teachers have expressed concerns about the long-term impact of AI use on social interactions in the classroom, in particular the reduction of interpersonal relationships between teachers and students and the potential replacement of the teacher's role by intelligent systems (Oh & Ahn, 2024). These concerns reflect the need to maintain human values in education, including empathy, face-to-face communication, and meaningful pedagogical relationships.

5.2 Factors Influencing Perception: The Importance of Digital Literacy and Systemic Support

Analysis shows that teachers' perceptions of AI are influenced by various factors, including individual and institutional aspects. Among the main factors are the level of digital skills, previous experience with technology, support from school administration, and exposure to related training (Al Darayseh, 2023; Sadykova & Kayumova, 2024). Teachers with high technological literacy are usually more confident and willing to explore the use of AI in their teaching. This competence not only allows them to understand the basic functions of AI, but also enhances their ability to assess the suitability of AI applications in different pedagogical contexts. In the framework of the Technology Acceptance Model (TAM), the component of perceived ease of use plays an important role, where teachers' readiness depends on the extent

to which they feel that AI is easy to use and can be seamlessly integrated into daily teaching routines. Furthermore, perceptions of ease of use are often influenced by direct experience with technology and available technical support, which indirectly shape positive attitudes towards digital innovations in the classroom.

Many teachers are still hesitant to use AI in the classroom due to several key barriers. These include a lack of appropriate professional training, uncertain or unstable access to technology, and a lack of clear guidance on how to effectively incorporate AI into teaching (Woodruff et al., 2023; Pörn et al., 2024). These barriers not only raise doubts among teachers about the effectiveness of AI use, but also hinder efforts to create an educational ecosystem that is ready to accept and integrate technological innovations comprehensively. In addition, ethical issues also affect the acceptance of AI in education. Many teachers have expressed concerns about the privacy of student data, the transparency and reliability of algorithms, and the fairness of automated feedback (Oh & Ahn, 2024). These concerns indicate an urgent need to create clearer, more comprehensive ethical guidelines and data protection policies that are appropriate to the current digital education context.

5.3 Key Themes: The Reality of Implementing AI in the Classroom

The synthesis of findings summarizes four main themes that encompass the landscape of perceptions and implementation of AI among teachers:

1. Optimistic early acceptance of AI

Teachers are open to the use of new technologies, especially when AI is seen as having the potential to save time and facilitate the process of monitoring student learning (Kaswadi & Tien, 2024). This positive response reflects a growing professional awareness among teachers of the need to innovate, in line with the demands of increasingly complex and dynamic classrooms. It also indicates that teachers are willing to adapt their teaching approaches when technology is proven to add value to pedagogical practice.

2. Implementation constraints: Competency, infrastructure and ethical issues

Teachers face challenges in mastering AI functions, due to lack of training, technical support and exposure. At the same time, ethical issues such as algorithmic transparency, data security and the imbalance of control between humans and machines are also critical considerations (Woodruff et al., 2023; Sadykova & Kayumova, 2024).

3. The influence of AI on the teaching and learning process

AI has the potential to enhance the learning process by tailoring curriculum content to individual student needs, thus supporting a more personalized and responsive learning approach. However, teachers also emphasize the importance of maintaining an element of human interaction in the classroom so that the learning process does not become too mechanistic or dehumanized (Alshorman, 2024; Beege et al., 2024). Interaction between teachers and students is seen as an important component in building relationships, empathy, and motivation, which technology cannot fully replace.

4. The need for continuous training and professional development

Teachers need training that is not only technical but also pedagogical in strategically leveraging AI. Emphasis should be placed on designing training based on subject context, teacher needs, and school realities (Sadykova & Kayumova, 2024; Al Darayseh, 2023). This is important to increase teachers' self-efficacy in exploring new technologies ethically and effectively.

5.4 Research Gaps and Future Recommendations: Towards Empirical and Contextual Research

This study found several important gaps in existing research on the use of AI in education. Many studies only explore general or early-stage views of AI without designing interventions or directly evaluating its use in the classroom. In addition, few studies have looked at the long-term effects of AI on teachers' teaching practices and its impact on student achievement and development. This situation suggests that understanding of the true potential of AI is still limited and further research is urgently needed to identify implementation strategies that are effective, ethical, and relevant to real-world classroom contexts.

Another gap identified is the lack of research that takes into account differences in teachers' perceptions of AI based on demographic factors such as age, teaching experience, school location and socio-cultural background. These factors can influence teachers' level of readiness and acceptance of new technologies. In addition, comparative studies across countries are also limited, although the education system, government policies and level of technological advancement in a country play an important role in shaping attitudes and practices related to AI. This lack of cross-country research makes it difficult to have a more comprehensive understanding of how national contexts influence the acceptance of AI in education.

Therefore, future research recommendations include:

- Development of relevant and contextual AI training modules based on the real needs of STEM teachers.
- Implementation of an action study that evaluates the impact of AI use on pedagogy and student learning outcomes.
- An in-depth qualitative study of teachers' experiences interacting with AI technologies in various school contexts.
- Policy-based research that assesses the level of readiness of the education system in supporting digital transformation through AI.

6. Summary and Recommendations

This Systematic Literature Review has provided a comprehensive picture of Science and Mathematics teachers' perceptions of the use of Artificial Intelligence (AI) in education. Overall, teachers showed a positive bias towards the potential of AI, particularly in improving teaching effectiveness, facilitating assessment and personalising student learning. However, this positive response was also accompanied by concerns over issues such as data security, infrastructure constraints and lack of training and professional support.

Thematic analysis revealed four main categories that shaped teachers' perceptions, namely: (i) initial acceptance of AI, (ii) implementation constraints at the classroom and system levels, (iii) changes in pedagogical approaches and (iv) the need for ongoing training and support. Factors such as ease of use and usefulness of AI as stated in the Technology Acceptance Model (TAM) framework, were found to play an important role in influencing teachers' acceptance of AI. In addition, the study also identified significant research gaps, including a lack of large-scale and longitudinal studies, as well as a lack of focus on action research or developmental design in the context of Science and Mathematics education. This highlights the need for a more comprehensive and practice-based research agenda to support the holistic transformation of digital education.

7. Study Limitations

Although this Systematic Literature Review (SLR) was conducted with a systematic and thorough approach, there are several limitations that need to be acknowledged. Firstly, this study only included articles published between 2020 and 2025 and was limited to English and Malay. This may limit exposure to findings from high-quality studies published in other languages. Secondly, the selection of articles was limited to three major databases, namely Scopus, Google Scholar and ERIC. It is possible that some relevant studies were missed from the analysis because they were not included in these databases.

In addition, the focus of the study on Science and Mathematics teachers at the school level may not fully represent the perceptions of teachers in other fields or at different educational levels. Furthermore, the thematic analysis conducted is based on the researcher's interpretation of the literature findings which has the potential to lead to an element of subjectivity despite the careful coding and synthesis process. Therefore, the results of this study need to be interpreted taking into account the limitations of this methodology and supported by further empirical studies in the future.

8. Suggestions

Based on the findings of this study, several strategic recommendations are proposed to strengthen the implementation of Artificial Intelligence (AI) in Science and Mathematics teaching and to stimulate further research in this field. These recommendations touch upon aspects of teacher professional development, educational policy, curriculum development and future research directions.

To address the teacher confidence gap in the implementation of artificial intelligence (AI) despite positive perceptions, the study recommends the development of a structured and holistic professional training program. This program should include technical training, technology-based pedagogy, and practical approaches that support the integration of AI into teaching and learning strategies. Ongoing support through serial workshops, digital professional learning communities, and micro-credentials are suggested as mechanisms to improve teacher competence. This suggestion is supported by Ulfah et al. (2022) who assert that high-quality training can spark innovation in teaching techniques and empower educators to adapt to the digital education landscape.

To strengthen the ethical and responsible implementation of artificial intelligence (AI) in education, this study proposes the development of an inclusive national policy centered on the principles of Responsible AI and human values in line with the aspirations of the Malaysian Education Blueprint. According to Foltýnek et al. (2023), academic integrity needs to be upheld through responsible and transparent use of AI. Therefore, this policy should involve collaboration between teachers, policymakers, technology experts and the education community to develop clear guidelines regarding student data privacy, information security and the ethical responsibilities of educators. This direction is not only in line with technological advances but also maintains the principles of human-centered pedagogy to ensure fairness, accessibility and digital well-being of future generations.

Adaptation of the Science and Mathematics curriculum needs to be implemented flexibly and responsively to technological advances, especially artificial intelligence (AI) in order to meet the demands of 21st century learning. The introduction of basic AI content in the syllabus and

the encouragement of the use of AI applications as teaching aids can strengthen interactive, data-based learning methods and support the development of technological literacy and critical thinking skills from an early stage. The findings of Weiland and Engledowl (2022) also show that the integration of data science in the Mathematics curriculum can increase the relevance of education with real-world applications, thus strengthening students' overall digital competence.

Strengthening interdisciplinary approaches to the development and research of artificial intelligence (AI) is a complementary element that supports the effectiveness of technology integration in education as a whole. Collaboration across the fields of education, information technology, educational psychology and sociology is able to produce AI systems that are more responsive to real learning needs and guided by pedagogical principles and human values. Holmes and Tuomi's (2022) study shows that understanding pedagogical assumptions and the structure of the education system is important in ensuring that AI is implemented ethically and effectively. The combination of recommendations that include teacher professional training, ethical education policies, curriculum improvements and interdisciplinary approaches forms a strong foundation towards a more comprehensive educational transformation. This approach not only supports innovation in the classroom, but also strengthens the role of teachers and improves student learning achievement ethically and effectively in the context of today's smart technology.

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Conflict of Interest Statement

The authors declare that there is no conflict of interest regarding the publication of this study.

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