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To cite this article:

Xue, L., Ghazali, N., & Mahat, J. (2025). Artificial Intelligence (AI) adoption among teachers: A systematic review and agenda for future research. *International Journal of Technology in Education (IJTE), 8*(3), 802-824. https://doi.org/10.46328/ijte.1191

International Journal of Technology in Education
2025, Vol. 8, No. 3, 802-824 https://doi.org/10.46328/ijte.1191

Artificial Intelligence (AI) Adoption Among Teachers: A Systematic Review and Agenda for Future Research

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Article Info

Article History

Received:
15 January 2025
Accepted:
12 May 2025

Keywords

Artificial Intelligence (AI)
Technology adoption
Teacher
Technology Acceptance Model (TAM)
Systematic review

Abstract

The rapid integration of Artificial Intelligence (AI) in education has led to a surge in research on teachers' adoption of these technologies. However, there is a noticeable lack of comprehensive reviews synthesizing the current state of research on this topic. This study addresses this gap by systematically reviewing 33 studies published since 2015. Our analysis reveals a significant increase in research from 2019 to 2024, with Asian countries, especially China, leading in research output. The majority of these studies focus on in-service teachers and aim to enhance teaching practices. The Technology Acceptance Model (TAM) is the most commonly used theoretical framework, with performance expectancy and effort expectancy identified as key factors influencing AI adoption. Quantitative research methods dominate the current literature. Despite the progress, this review highlights several research gaps. There is a lack of qualitative studies, limited focus on pre-service teachers, and insufficient attention to AI adoption for professional development. Additionally, there is a need for education-specific acceptance models and a deeper exploration of factors unique to the educational context. By providing a comprehensive overview of the current research landscape, this study sets an agenda for future research.

Introduction

The rapid advancement of Artificial Intelligence (AI) is transforming traditional educational paradigms (Molenaar, 2022). Numerous studies have demonstrated AI's positive impact on educational activities. For instance, Wu and Yu (2024) found that AI significantly enhances students' learning outcomes. Similarly, Wu and Li, (2024) reported that AI effectively facilitates language skill development among EFL learners, while Zheng et al. (2023) observed a high effect size of AI on learning achievement and a smaller effect size on learning perception.

Despite these promising outcomes, the successful integration of AI in education depends largely on teachers, who play a pivotal role in incorporating these technologies into their pedagogical practices (Kim, 2024). Understanding teachers' adoption of AI technologies is crucial for their effective and meaningful use in education (Zhang et al., 2023). Since 2023, research on teachers' adoption of AI has been increasing, revealing various insights and trends. However, a comprehensive review of this research is still missing. Addressing this gap is essential to provide a consolidated view of the current landscape, identify critical research gaps, and guide future research directions.

This study aims to fill this gap by conducting a systematic review of teachers' AI adoption. By systematically reviewing existing research, this study seeks to provide a detailed understanding of the current state of AI adoption among teachers, identifying key gaps and suggesting directions for future research. This study seeks to answer the following research questions (RQs):

RQ1: What is the current trend of research in AI adoption among teachers?

RQ2: What is the geographical distribution of research subjects in studies on AI adoption among teachers?

RQ3: What categories of teachers are the subjects of studies on AI adoption?

RQ4: What are the purposes of AI technology acceptance among teachers in the analyzed studies?

RQ5: What AI technologies are examined in research on teachers' AI adoption?

RQ6: What factors are examined influencing teachers' acceptance of AI technologies?

RQ7: What research methodologies are used in studies on AI adoption among teachers?

RQ8: Which moderating factors have been explored in relation to teachers' AI adoption?

RQ9: What theories and models are used in studies on AI adoption among teachers?

This study significantly contributes to the broader field of educational technology. By synthesizing current research trends and identifying gaps, it provides a comprehensive overview of teachers' AI adoption. This systematic review offers valuable insights for educators, policymakers, and researchers, highlighting areas that require further investigation and proposing directions for future research. The findings of this study will facilitate a better understanding of how AI technologies can be effectively integrated into educational practices, ultimately enhancing teaching and learning outcomes.

Literature Review

AI in Education (AIEd)

AI, a concept first introduced in 1956 (Russell & Norvig, 2022), refers to systems that exhibit intelligent behavior by analyzing their environment and autonomously taking actions to achieve specific goals (Sheikh et al., 2023). AI has found applications across various domains, including education (Hwang et al., 2020). The integration of AI technologies into educational practices has given rise to the field of AI in Education (AIEd). This emerging area of educational technology, established for over three decades, focuses on facilitating teaching, learning, and decision-making processes through AI-powered tools and applications (Hwang et al., 2020; Zawacki-Richter et al., 2019).Scholars have proposed different categorizations for AIEd tools. Luckin and Holmes (2016) classify these applications into three categories: personal tutors, intelligent support for collaborative learning, and intelligent virtual reality. Baker and Smith (2019) offer an alternative classification that highlights the educational functions of AIEd tools:

a) Learner-facing AI tools: Software that students use directly to learn subject matter.

b) Teacher-facing systems: Tools that support teachers and reduce their workload by automating tasks.

c) System-facing AIEd: Applications that provide information to administrators and managers at the

institutional level.

These classifications not only categorize AIEd tools but also illuminate their diverse roles and potential impacts within the educational ecosystem.

Technology Adoption

Definitions of technology adoption vary from narrow to broad interpretations. Narrowly, it refers to the initial acceptance or use of a newly emerged technology or product by individuals who have not yet adopted it—termed as non-adopters or non-users (Jeyaraj et al., 2023; Khasawneh, 2008; D. Kim & Ammeter, 2014). Broadly, it encompasses a wider spectrum of acceptance or use of an emerged technology or product, extending beyond non-adopters or non-users. This research adopts the broader definition of technology adoption, and specifically, AI adoption is defined as the acceptance or use of an AI technology or product. The field of technology adoption research has developed numerous theories and models to explain how and why new technologies are adopted. Notable among these are the Theory of Reasoned Action (Fishbein & Ajzen, 1975), the Theory of Planned Behavior (Ajzen, 1991) , the Technology Acceptance Model (TAM; Davis, 1989), TAM2 (Venkatesh & Davis, 2000), TAM3 (Venkatesh & Bala, 2008), and the Unified Theory of Acceptance and Use of Technology (Venkatesh et al., 2003), along with the UTAUT2 model (Venkatesh et al., 2012). These models, particularly the TAM and UTAUT families, have consistently demonstrated their explanatory power across various fields. As AI technology rapidly evolves, its potential to reshape various sectors is increasingly recognized. Realizing this potential, however, hinges on the widespread adoption of AI by users. This dependency has made AI adoption a significant sub-field within technology adoption research.

Prior Review of AI Adoption

Recent years have seen a surge in research on AI adoption, emerging as a key sub-field within technology adoption studies. Existing literature has extensively reviewed AI adoption across various technologies and application domains. Prior systematic reviews have examined a diverse range of AI technologies, including general AI (Kelly et al., 2023), Intelligent Agent Technologies (Sidlauskiene, 2022), AI-Infused Systems (Ismatullaev & Kim, 2024), conversational agents(Ling et al., 2021; Wutz et al., 2023), AI artifacts (Xiong et al., 2024)， Robo-advisors (Nain & Rajan, 2024)， Chatbot (Alsharhan et al., 2023; Gopinath & Kasilingam, 2023). In addition to examining various AI technologies, prior reviews have also explored their adoption across multiple domains, with a strong focus on healthcare (Khanijahani et al., 2022; Lambert et al., 2023; Wutz et al., 2023), finance (Nain & Rajan, 2024), agriculture (Georgopoulos et al., 2023), hospitality and tourism (Goel et al., 2022), and medical science (Eltawil et al., 2023).

Despite these extensive reviews, a notable gap remains—a comprehensive examination of AI adoption in the education sector, particularly among teachers. Given that teachers are key stakeholders in education, understanding their adoption of AI is crucial, as it directly impacts instructional quality and student learning experiences(Al Darayseh, 2023). Addressing this gap will provide valuable insights into the challenges and opportunities associated with integrating AI into educational practice.

Methodology

Search Strategy

The databases used were Web of Science (Core Collection), Scopus, ERIC, and ProQuest™ Dissertations & Theses Citation Index. The search terms were based on previous systematic reviews: acceptance terms from Kelly et al. (2023), AI terms from Bond et al. (2024) and Labadze et al. (2023), and teacher-related terms from Scherer et al. (2019). The search was conducted on July 14, 2024, and included literature published from 2015 onwards. The specifics of these query strings are detailed in Table 1.

Table 1 Search Strategy

Databases	Query string
WOS（Core Collection）	((TS=("technology accept*" OR " user accept*" OR tam OR utaut OR tpb OR "Technology Acceptance Model" OR "Unified Theory of Acceptance and Use of Technology" OR "Theory of Planned Behavior" OR "Theory of Reasoned Action")) AND TS=("artificial intelligence" OR "machine intelligence" OR "intelligent support" OR "intelligent virtual reality" OR "chat bot*" OR "machine learning" OR "automated tutor" OR "personal tutor*" OR "intelligent agent*" OR "expert system" OR "neural network" OR "natural language processing" OR "intelligent tutor*" OR "adaptive learning system*" OR "adaptive educational system*" OR "adaptive testing" OR "decision trees" OR "clustering" OR "logistic regression" OR "adaptive system*" OR "Chatbot*" OR "ChatGPT*")) AND TS=(teacher* OR instructor* OR lecturer*)
ProQuest ™ Dissertations & Theses Citation Index	((TS=("technology accept*" OR " user accept*" OR tam OR utaut OR tpb OR "Technology Acceptance Model" OR "Unified Theory of Acceptance and Use of Technology" OR "Theory of Planned Behavior" OR "Theory of Reasoned Action")) AND TS=("artificial intelligence" OR "machine intelligence" OR "intelligent support" OR "intelligent virtual reality" OR "chat bot*" OR "machine learning" OR "automated tutor" OR "personal tutor*" OR "intelligent agent*" OR "expert system" OR "neural network" OR "natural language processing" OR "intelligent tutor*" OR "adaptive learning system*" OR "adaptive educational system*" OR "adaptive testing" OR "decision trees" OR "clustering" OR "logistic regression" OR "adaptive system*" OR "Chatbot*" OR "ChatGPT*")) AND TS=(teacher* OR instructor* OR lecturer*)
Scopus	TITLE-ABS-KEY-AUTH (("technology accept*" OR " user accept*" OR tam OR utaut OR tpb OR "Technology Acceptance Model" OR "Unified Theory of Acceptance and Use of Technology" OR "Theory of Planned Behavior" OR "Theory of Reasoned Action") AND ("artificial intelligence" OR "machine intelligence" OR "intelligent support" OR "intelligent virtual reality" OR "chat

Databases	Query string
	bot*" OR "machine learning" OR "automated tutor" OR "personal tutor*" OR "intelligent agent*" OR "expert system" OR "neural network" OR "natural language processing" OR "intelligent tutor*" OR "adaptive learning system*" OR "adaptive educational system*" OR "adaptive testing" OR "decision trees" OR "clustering" OR "logistic regression" OR "adaptive system*" OR "Chatbot*" OR "ChatGPT*") AND (teacher* OR instructor* OR lecturer*))
Eric	("technology accept*" OR " user accept*" OR tam OR utaut OR tpb OR "Technology Acceptance Model" OR "Unified Theory of Acceptance and Use of Technology" OR "Theory of Planned Behavior" OR "Theory of Reasoned Action") AND ("artificial intelligence" OR "machine intelligence" OR "intelligent support" OR "intelligent virtual reality" OR "chat bot" OR "machine learning" OR "automated tutor" OR "personal tutor" OR "intelligent agent" OR "expert system" OR "neural network" OR "natural language processing" OR "intelligent tutor" OR "adaptive learning system" OR "adaptive educational system" OR "adaptive testing" OR "decision trees" OR "clustering" OR "logistic regression" OR "adaptive system" OR "Chatbot" OR "ChatGPT") AND (teacher OR instructor OR lecturer)

Criteria for Inclusion

The inclusion criteria for this study are divided into two phases: Initial Literature Screening and Title, Abstract, and Full Text Screening. In the first phase, studies are screened based on the following criteria: only studies published in English are included; the review covers studies published from 2015 onwards; and only peer-reviewed articles from scholarly journals are considered to ensure high-quality research. In the second phase, studies are evaluated in detail based on their titles, abstracts, and full texts. The inclusion criteria at this stage are that the study must focus on the topic of AI adoption, the sample population must consist of teachers, and the study must employ empirical research methods, whether qualitative, quantitative, or mixed methods. Studies are excluded if they do not focus on AI adoption, do not include teachers in the sample population, or are not empirical in nature.

Identification of Relevant Publications

The initial database screening process identified a total of 516 papers: Web of Science Core Collection (n=121), Scopus (n=121), ERIC (n=29), and ProQuest Dissertations & Theses Citation Index (n=13). After the removal of 91 duplicates, 425 unique publications remained. These were then screened by their titles and abstracts based on the established inclusion criteria, leading to the exclusion of 232 papers. The remaining 193 papers underwent full-text screening, from which 160 were further excluded based on the criteria. This rigorous process ultimately yielded 33 studies that met the inclusion criteria. The data extraction process is illustrated in a PRISMA flow diagram (Page et al., 2021) in Figure 1.

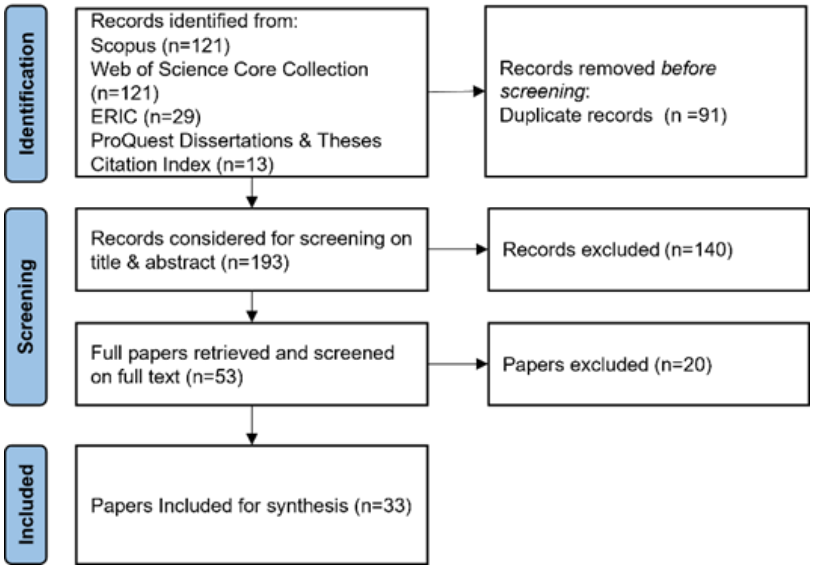


Figure 1. Data Extraction Procedure

Included Publications

The final pool of 33 selected publications for analysis is detailed in Table 2. This comprehensive list represents the studies that have met all the inclusion criteria and are deemed relevant for the research objectives.

Table 2. Characteristics of Selected Publications

Authors and year	Country/ Region	Status	Technology	Theory/ Model
(Abdelmoneim et al., 2024)	Palestine	In-service teacher	AI Edu app	TAM
(Adelana et al., 2024)	Nigeria	Pre-serv Tchr	AI Tch app	TPB
(Al Darayseh, 2023)	Abu Dhabi	In-service teacher	AI	TAM
(Alrishan, 2023)	Oman	Pre-serv Tchr	ChatGPT	TAM
(An et al., 2023)	China	In-service teacher	AI	TPACK, UTAUT
(Becker, 2022)	unclear	Educator	AI	UTAUT
(Beyer & Arndt, 2024)	Germany	In-service teacher	Chatbot	TAM
(Chatterjee & Bhattacharjee, 2020)	India	Lecturers	AI	UTAUT
(Chen & Zou, 2024)	China	Lecturers	Intelligent MRD	ECT; IDT; TAM; TRI
(Choi et al., 2023)	South Korea	In-service teacher	AI Edu app	TAM
(Dahri et al., 2024)	Malaysia	Pre-serv Tchr	ChatGPT	TAM
(Dehghani & Mashhadi, 2024)	lran	In-service teacher	ChatGPT	TAM
(Istenic et al., 2021)	Slovenia	Pre-serv Tchr	AI robots	UTAUT

(Ivanov et al., 2024)	47 countries	Lecturers	GAI	TPB
(Jain & Raghuram, 2024)	India	faculty members	GAI	TAM, TPACK
(Ma & Lei, 2024)	China	Pre-serv Tchr	AI	TAM
(Mnguni, 2024)	South Africa	Pre-serv Tchr	AI	TPB
(Molefi et al., 2024)	Lesotho	In-service teacher	AI	UTAUT
(Mutammimah et al., 2024)	Indonesia	In-service teacher	ChatGPT	TAM
(Nja et al., 2023)	Nigeria	In-service teacher	AI	TAM
(Oyebode, 2024)	United States	instructor	Emotion AI	UTAUT
(Rahiman & Kodikal, 2024)	Countries A	Faculty members	AI	UTAUT
(Roy et al., 2022)	India	Lecturers	AI robots	TAM, TPB, TRI
(Strzelecki et al., 2024)	Poland	Academic	ChatGPT	UTAUT2
(Sun et al., 2024)	China	Pre-serv Tchr	AI	TAM, TPACK
(Urdan & Marson, 2024)	Brazil	In-service teacher	ChatGPT	IDT; TAM, TCMD
(Y. Wang et al., 2021)	China	Lecturers	AI	TAM
(K. Wang et al., 2024)	China	Pre-serv Tchr	GAI	TPACK, UTAUT
(M. Wang et al., 2024)	China	In-serv Tchr	AI Tch app	TAM
(Wijaya et al., 2024)	China	Pre-serv Tchr	AI robots	UTAUT2
(Xiaohong et al., 2024)	China	In-serv Tchr	AI Lea app	UTAUT
(X. Zhang & Wareewanich, 2024)	China	In-serv Tchr	GAI	UTAUT
(C. Zhang et al., 2023)	Germany	Pre-serv Tchr	AI Edu app	TAM3

Acd. work: Academic work; AI Edu app: AI Educational application; AI ITBS: (AI Intelligent Tutoring-Based System); AI Lea app: AI Learning Platform; AI Tch app: AI Teaching Application; Countries A: India, Bahrain, Saudi Arabia, UAE, Oman, Qatar, and Sri Lanka; ECT: Expectation Confirmation Theory; IDT: Innovation Diffusion Theory; IMRD: (Intelligent Mixed Reality Devices); In-serv Tchr: In-service Teacher; Pre-serv Tchr: Pre-service Teacher; TCMD: Theory of Cognitive Moral Development; TRI: Technology Readiness Index

Coding Process of Included Articles

A comprehensive coding scheme was developed for data extraction. To ensure data integrity and reliability, two researchers independently coded the articles, resolving any discrepancies through consensus meetings. The coding scheme included several key elements: the names of the article's author(s), the year of publication, the geographical context (country or region where the study was conducted), the intended purposes for AI technology acceptance, the categorization of teachers (e.g., pre-service, in-service), the specific AI technology or application investigated, the factors influencing teachers' acceptance of AI, the factors moderating the relationship between determinants and AI adoption, the research design (qualitative, quantitative, or mixed methods), and the theories or models used to examine teachers' AI adoption. This systematic approach ensures a thorough and reliable analysis of the included articles, providing a solid foundation for understanding AI adoption among teachers.

Results

What Is the Current Trend of Research in AI Adoption Among Teachers?

The trend of research in AI adoption among teachers has shown a significant increase in recent years (see Figure 2). From 2015 to 2018, there were no published studies on this topic. Scholarly interest began in 2019 with the publication of a single study. The number of studies gradually increased over the following years, with two studies in 2021, three in 2022, and five in 2023. The most notable surge occurred in 2024, with 21 studies published.

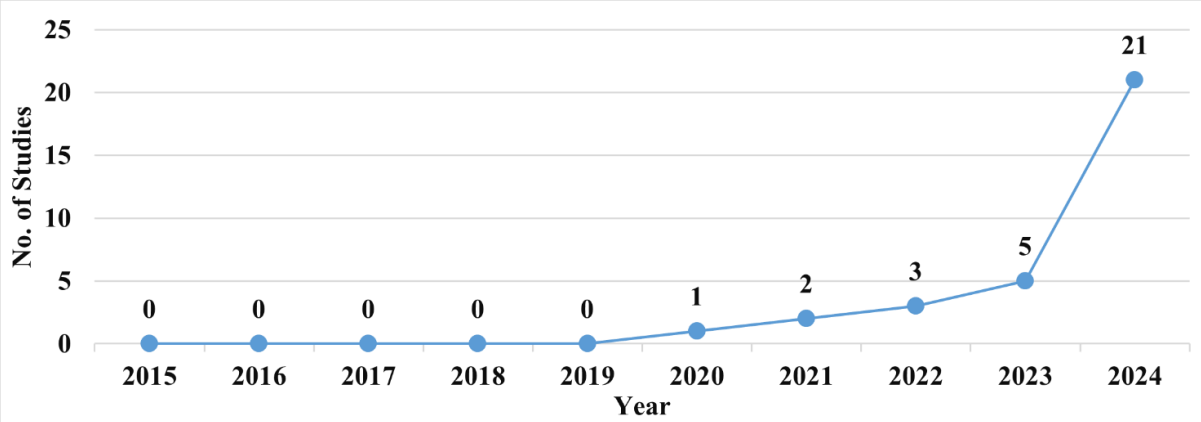
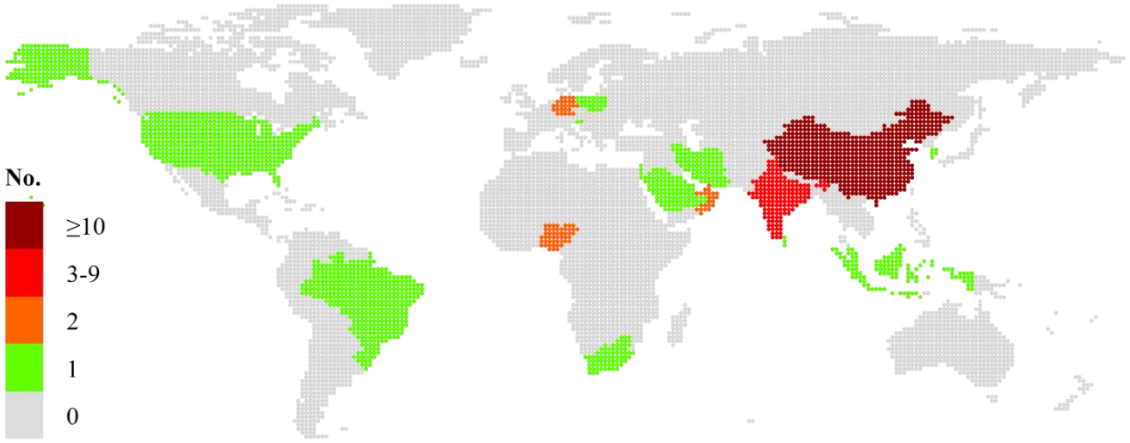


Figure 2. Annual Distribution of Studies on AI adoption Among Teachers (2015-2024)

What Is the Geographical Distribution of Research Subjects in Studies on AI Adoption Among Teachers?

The geographical distribution of research subjects in studies on AI adoption among teachers is given in Figure 3.



Country	No.	Country	No.	Country	No.
China	10	South Africa	1	Brazil	1
India	4	Poland	1	Palestine	1
Nigeria	2	Slovenia	1	Indonesia	1
Germany	2	Lesotho	1	Bahrain	1
Oman	2	Iran	1	Saudi Arabia	1
United Arab Emirates	2	Malaysia	1	Qatar	1
United States	1	South Korea	1	Sri Lanka	1

Figure 3. Geographical Distribution of Research Subjects in Studies on AI adoption Among Teachers

The analysis reveals diverse global interest, with notable concentrations in specific regions. Asia, particularly China, exhibits the highest density of research. Significant research activity is also observed in India, Oman, the United Arab Emirates, Germany, and Nigeria. Moderate levels of research activity are present in the United States, Brazil, South Africa, Lesotho, Indonesia, Malaysia, South Korea, Saudi Arabia, Iran, Bahrain, Qatar, Palestine, and Sri Lanka. European countries like Poland and Slovenia also show emerging interest in this field. In contrast, other countries and regions, especially large parts of Africa and Central Asia, have minimal to no representation in the studies reviewed.

What Categories of Teachers Are the Subjects of Studies on AI Adoption?

The categories of teachers examined in studies on AI adoption are depicted in Figure 4.. Pre-service teachers constitute 30% of the research subjects. The remaining 70% are in-service educators, with the largest group being K-12 in-service teachers, accounting for 40%. Lecturers make up 15% of the subjects, while faculty members represent 6%. Additionally, educators, instructors, and academics each comprise 3% of the subjects.

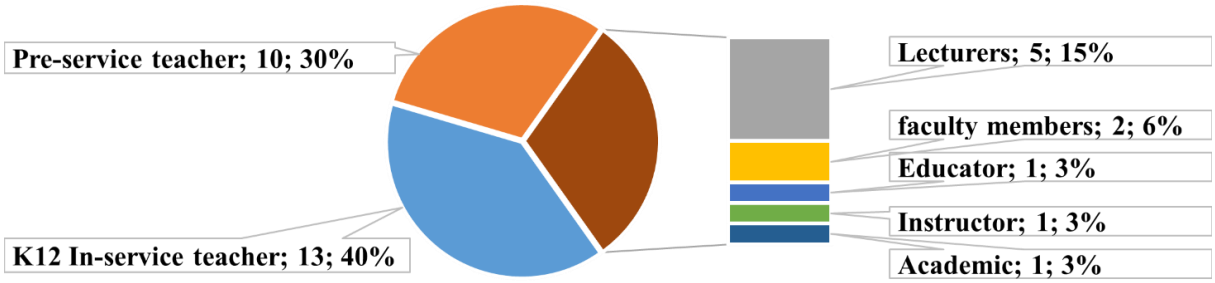


Figure 4. Categories of Teachers in Studies on AI adoption

What Are the Purposes of AI Technology Acceptance among Teachers in the Analyzed Studies?

The purposes of AI technology acceptance among teachers in the analyzed studies are depicted in Figure 5.

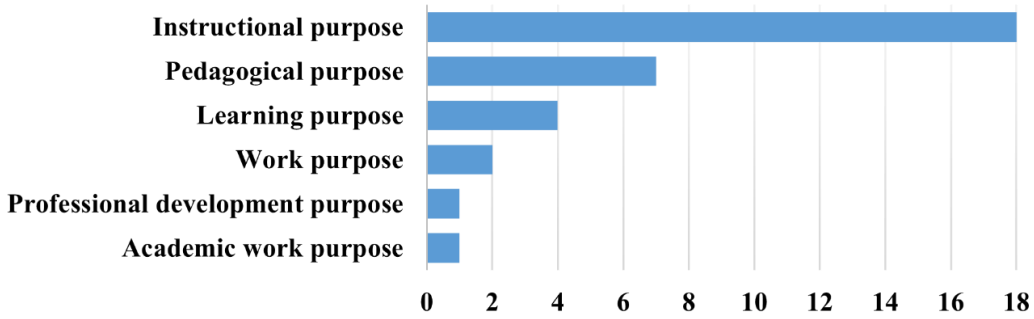


Figure 5. Purposes of AI Technology Acceptance Among Teachers in Analyzed Studies

These purposes can be broadly categorized into three main groups: enhancing teaching, promoting learning, and supporting work-related tasks. The first category, enhancing teaching, includes instructional purposes (n=18) and pedagogical purposes (n=7), representing the highest proportion at approximately 75.76%. The second category,

promoting learning, includes learning purposes (n=4) and professional development purposes (n=1), accounting for approximately 15.15%. The third category, supporting work-related tasks, includes work purposes (n=2) and academic work purposes (n=1), which represent the smallest proportion at approximately 9.09%. This categorization highlights that most studies focus on the acceptance of AI to enhance teaching, followed by promoting learning, and finally supporting work-related tasks.

What AI Technologies Are Examined in Research on Teachers' AI Adoption?

The AI technologies examined in research on teachers' AI adoption are depicted in Figure 6. These technologies can be broadly categorized into general AI technologies and specific AI technologies. General-purpose AI technologies appear far more frequently in the studies than specific-purpose AI technologies. The three most frequently mentioned general AI technologies are AI (n=11), ChatGPT (n=6), and GAI (n=4). In contrast, specific AI technologies, such as AI educational applications (n=3), AI teaching applications (n=2), and AI learning applications (n=1), are mentioned less frequently.

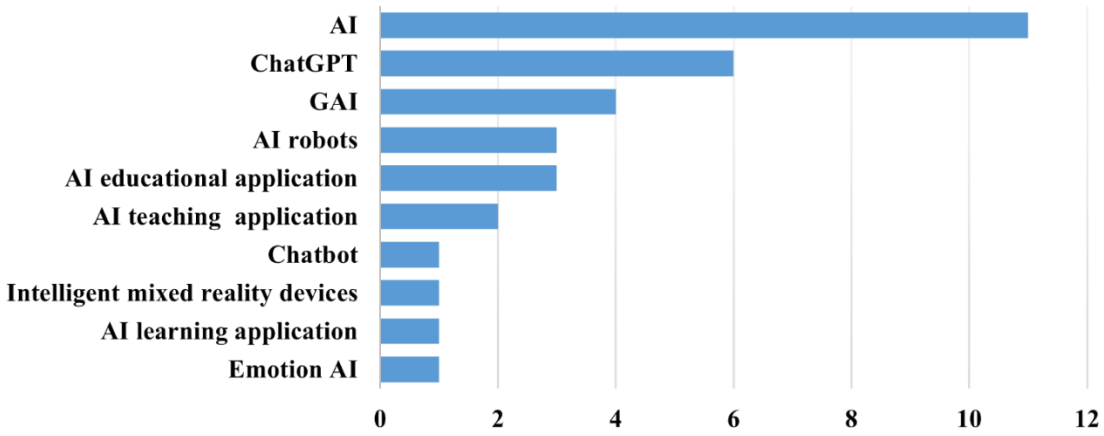


Figure 6. AI Technologies Examined in Teachers' AI Adoption Studies

What Factors Are Examined Influencing Teachers' Acceptance of AI Technologies?

The primary factors examined influencing teachers' acceptance of AI technologies are depicted in Figure 7. These 18 factors, appearing two or more times in the studies, can be categorized into four groups based on their frequency: very high frequency, high frequency, moderate frequency, and low frequency. The very high-frequency factors are core constructs from TAM and UTAUT: Performance Expectancy (n=30) and Effort Expectancy (n=28). The high-frequency factors include constructs from TAM, UTAUT, or TPB: Social Influence (n=16), Attitude (n=14), and Facilitating Conditions (n=13). In the moderate frequency category, besides traditional TAM or UTAUT2 factors such as Self-efficacy, Hedonic Motivation, and Habit, there are factors related to user psychology such as Anxiety (n=6), Trust (n=6), and Perceived Risk (n=5). The low-frequency category includes several education-related factors like Technological Pedagogical Content Knowledge (TPACK) (n=3), Transmissive Pedagogical Beliefs (n=2), and Constructivist Pedagogical Beliefs (n=2).

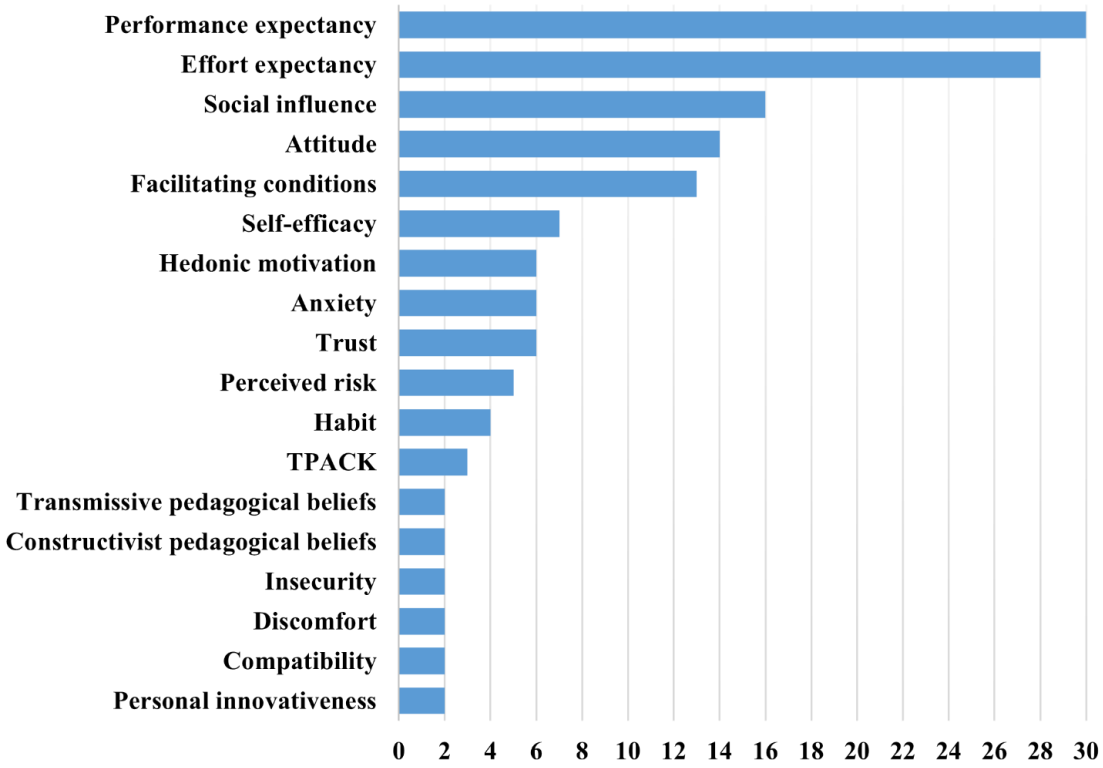


Figure 7. Primary Factors Influencing Teachers' Acceptance of AI Technologies

Which Moderating Factors Have Been Explored in relation to Teachers' AI Adoption?

The moderating factors explored in relation to teachers' AI adoption are depicted in Figure 8.

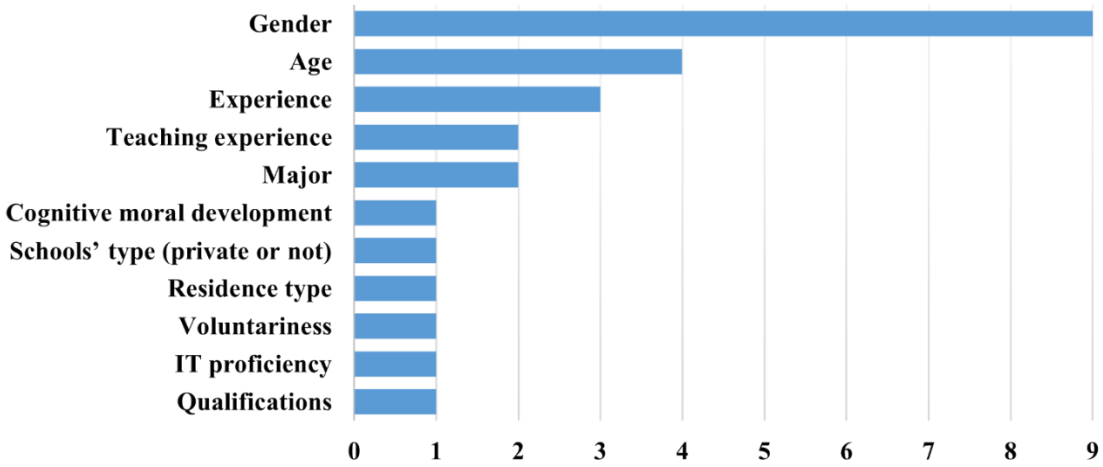


Figure 8. Moderating Factors in Teachers' AI adoption Studies

The most frequently examined moderating factor is Gender (n=9), followed by Age (n=4). Experience is considered in three studies, while Major and Teaching Experience are each examined in two studies. Several other factors, including Qualifications, IT Proficiency, Voluntariness, Residence Type, School Type, and Cognitive

Moral Development, are each investigated in one study.

What Research Methodologies Are Used in Studies on AI Adoption among Teachers?

The research methodologies used in studies on AI adoption among teachers are depicted in Figure 9. Quantitative research is the predominant methodology, appearing in 26 studies and accounting for approximately 79% of the total. Qualitative research is used in five studies, making up about 15%. Mixed methods research is employed in two studies, representing around 6%.

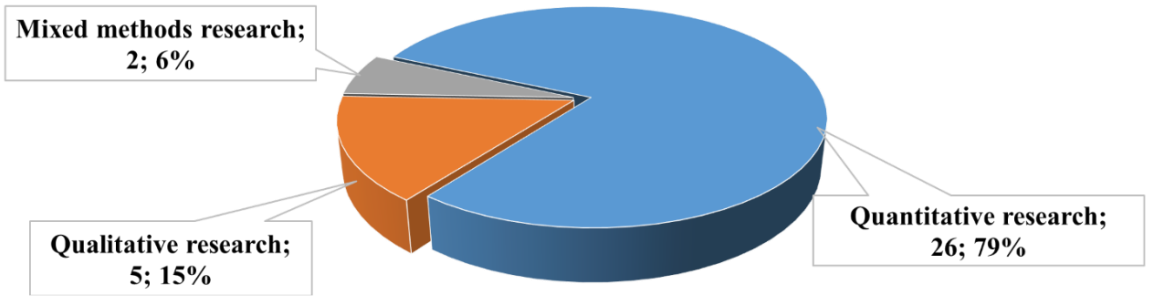


Figure 9. Research Methodologies in Studies on AI adoption Among Teachers

What Theories and Models Are Used in Studies on AI Adoption among Teachers?

The theories and models used in studies on AI adoption among teachers are depicted in Figure 10. The most frequently used theory is TAM, appearing in 17 studies. UTAUT is the second most common, used in 10 studies. Other frequently used theories include TPB and TPACK, each appearing in four studies. Less commonly used theories include UTAUT2 (n=2), the Technology Readiness Index (TRI) (n=2), Innovation Diffusion Theory (IDT) (n=2), TAM3 (n=1), Expectation Confirmation Theory (ECT) (n=1), and the Theory of Cognitive Moral Development (n=1).

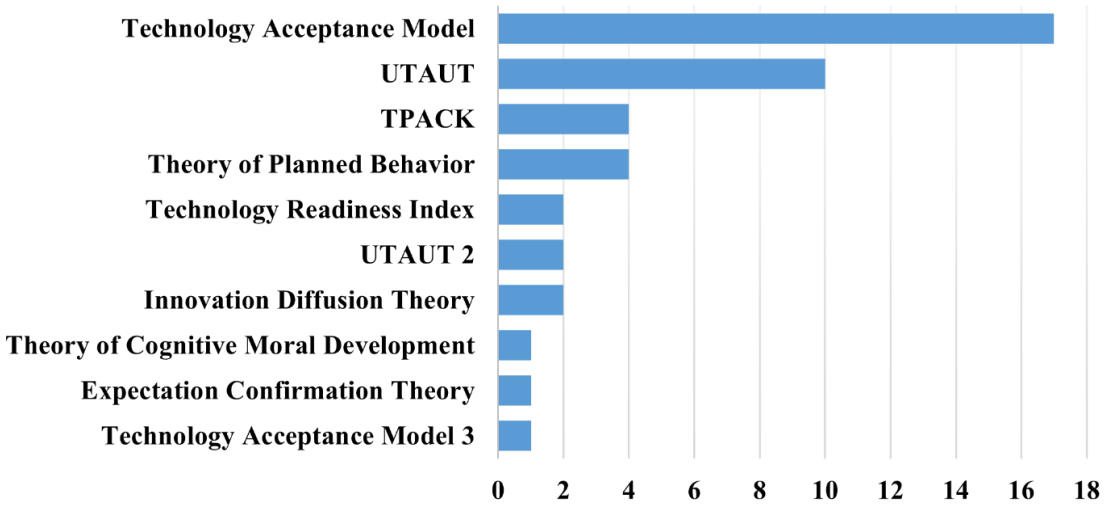


Figure 10. Most Frequently Used Theories and Models in Studies on AI adoption Among Teachers

Discussion and Agenda for Future Research

The systematic review assessed the current state of AI adoption among teachers and identified gaps in the existing literature. By examining 33 studies published between 2019 and 2024, the review aimed to understand trends, geographical distribution, teacher categories, purposes for AI adoption, types of AI technologies, theoretical frameworks, moderating factors, research methodologies, and factors influencing AI adoption in educational settings. Key findings indicate that most studies are from Asia and focus on in-service teachers. General-purpose AI technologies are prevalent, and performance expectancy and effort expectancy emerged as the primary influencing factors. Quantitative research methods dominate, with TAM being the most frequently used theoretical framework. The discussion highlights several research trends and gaps, providing insights into the current research landscape. Areas for future study are proposed to address these gaps and enhance the understanding of AI adoption in educational contexts.

Research Trend Analysis

The significant increase in AI adoption studies among teachers from 2019 to 2024, peaking at 21 publications in 2024. This upward trend in AI adoption studies aligns with other AI research trends in education (Crompton & Burke, 2023; Ilham et al., 2023; Kavitha & Joshith, 2024; Zhai et al., 2021), indicating a rapidly evolving educational landscape. Factors such as increased policy support, funding, interdisciplinary collaboration, and the impact of the COVID-19 pandemic on remote learning have likely driven this surge. The consistent growth in publications highlights the education sector's keen interest in leveraging AI technologies to enhance learning experiences and outcomes, positioning AI adoption in education as a critical area for future research and development.

Geographical Distribution Analysis

The geographical distribution of AI adoption studies among teachers reveals a significant imbalance, with Asian countries, particularly China, dominating the research landscape. This finding aligns with Xue et al. (2024) and Guo et al. (2024), who also identified China as a major contributor to research samples in technology acceptance and AI in education. This suggests that Chinese educational institutions are heavily involved in researching AI technologies in their educational practices. This imbalance in geographical distribution highlights several key points: the need to expand research to include a wider range of regions and countries to enhance the generalizability of findings; the importance of conducting cross-cultural comparative studies to explore how cultural, economic, and educational system differences influence AI adoption among teachers; the value of encouraging international collaborative research, especially with underrepresented regions, to gain a more comprehensive global perspective; the necessity of addressing unique challenges and opportunities in AI adoption within different contexts to inform more inclusive policies; and the benefit of examining the factors that contribute to certain countries' leadership in AI education research to provide insights for other regions. By addressing these aspects, we can better understand the prospects of AI application in global educational settings and provide more valuable references for educational policy-making in diverse contexts.

Categories of Teachers Analysis

The analysis reveals a significant focus on in-service teachers (70%) compared to pre-service teachers (30%) in AI adoption studies. Within the in-service category, 40% are K-12 teachers, while the remaining 30% are primarily from higher education institutions. This distribution reflects the immediate need to understand AI integration in current educational practices. However, the underrepresentation of pre-service teachers highlights a critical gap in preparing future educators for AI-enhanced classrooms. Future research should aim for a more balanced representation, including longitudinal studies tracking pre-service teachers' AI adoption as they transition into their careers. Comparative studies across teacher categories could provide valuable insights into how career stage and educational context influence AI adoption, leading to more targeted strategies for AI integration in teacher education and professional development programs.

AI Adoption Purposes Analysis

The analysis reveals that the purposes of AI technology acceptance among teachers can be categorized into three main areas: enhancing teaching, promoting learning, and supporting work-related tasks. This distribution highlights the multifaceted potential of AI in education, ranging from direct instructional support to broader pedagogical activities. However, current research primarily focuses on enhancing teaching, with significantly less attention given to promoting learning and supporting work-related tasks. Future research should explore how these diverse purposes interact and potentially conflict, to provide a more comprehensive understanding of AI technology acceptance in education. Longitudinal studies could analyze how AI adoption aimed at promoting learning in pre-service teachers influences their AI adoption for enhancing teaching as in-service teachers. Additionally, exploring the interaction between in-service teachers' AI adoption for enhancing teaching and other purposes could provide valuable insights.

AI Technology Type Analysis

The analysis reveals a predominant focus on general AI technologies, with fewer studies examining specific educational AI applications. This trend may be attributed to the broader applicability and accessibility of general AI tools, their rapid development, and high-profile nature. However, this focus potentially overlooks the unique benefits and challenges presented by specialized educational AI applications. To address this research gap and provide a more comprehensive understanding of AI in education, future studies should conduct comparative analyses between general and specific AI technologies, investigate the effectiveness of specialized AI educational tools, explore potential synergies between different AI types, examine factors influencing the development and adoption of specialized tools, and assess their long-term impact on teaching and learning outcomes.

Influencing Factors Analysis

The analysis of influencing factors in AI technology acceptance among teachers reveals a predominant focus on constructs derived from established models, particularly UTAUT. Performance expectancy, effort expectancy,

social influence, and facilitating conditions emerge as the most frequently examined factors, aligning with recent findings by Xue et al. (2024). This consistency underscores the robustness and relevance of UTAUT in this context. Notably, attitude, though not part of the original UTAUT, also features prominently, reflecting an ongoing debate about whether attitude should be included in UTAUT as highlighted by Dwivedi et al. (2019). Future research could employ meta-analysis and structural equation modelling (MASEM) to examine the integration of attitude into UTAUT in the context of AI technology acceptance, providing a more nuanced understanding of its role and impact. Beyond these model-based factors, trust and perceived risk emerge as significant considerations. The emphasis on trust likely stems from the variable nature of AI-generated outputs, which can affect user confidence. Perceived risk encompasses concerns about data privacy, security, and potential misuse of AI technology. These factors highlight the complexities inherent in AI adoption and suggest critical areas for future investigation. Interestingly, education-specific influencing factors receive limited attention, with TPACK being the most frequently cited but appearing only three times. This limited attention to education-specific factors suggests a gap in the current research. Future studies should explore a wider range of educational factors to provide a more comprehensive understanding of AI technology acceptance in educational settings.

Moderating Factors Type Analysis

The analysis reveals a significant focus on gender, age, and experience as moderating variables in studies on teachers' AI adoption, aligning with traditional technology acceptance models such as AM (Davis, 1989; Venkatesh & Bala, 2008; Venkatesh & Davis, 2000) and UTAUT(Venkatesh et al., 2012, 2003). However, education-specific variables like teaching experience, major, and school type (private or public) are less frequently examined. Notably, the variable of voluntariness, despite being included in traditional technology acceptance models, appears only once in the studies. This imbalance suggests a potential oversimplification of the complex dynamics influencing AI adoption in education and highlights a significant research gap. To address these gaps, future research should prioritize education-specific factors such as teaching experience, subject area expertise, school type, leadership support, resource availability, and educational stage. Additionally, there is a notable absence of studies exploring moderating variables related to geographical regions, national income levels, and cultural types. This gap likely stems from the current lack of cross-national or cross-regional comparative studies in the field. The rapid development and adoption of AI technology in education may exacerbate existing global inequalities. To mitigate this risk, future research should investigate the moderating effects of national income levels, geographical regions, and cultural types on teachers' AI adoption. Such studies would provide valuable insights into the nuanced factors influencing AI adoption across diverse global contexts and help identify potential disparities in AI implementation.

Research Methodology Analysis:

The analysis reveals a strong preference for quantitative methodologies (79%) in AI adoption studies among teachers, with qualitative research approaches accounting for 15% of studies and mixed-methods approaches making up 6%. This significant imbalance indicates a prevailing trend toward data-driven, statistically-oriented investigations in the field. While quantitative methods offer valuable insights into broad patterns and correlations,

this heavy reliance on numerical data potentially oversimplifies the complex, context-dependent nature of AI adoption by teachers. Future studies should prioritize mixed-methods designs to address this research gap and gain a more comprehensive understanding of AI adoption among teachers. By integrating qualitative data, researchers can explore the contextual factors influencing AI adoption in diverse educational settings and uncover themes or variables not captured by existing models (Venkatesh et al., 2023).

Theoretical Framework Analysis

The analysis reveals that TAM and UTAUT were the models most commonly employed in studies on AI adoption among teachers. This finding aligns with the results of Kelly et al. (2023) in the general domain, indicating a consistent trend across different domains. The prevalence of TAM and UTAUT reflects their proven utility in explaining technology acceptance but also highlights a potential gap in addressing AI-specific factors in educational contexts. Future research should consider developing or integrating AI-specific constructs into these models, such as AI anxiety, trust in AI, and ethical considerations. Additionally, exploring the integration of education-specific frameworks like intelligent-TPACK could provide a more comprehensive understanding of AI adoption in teaching. This approach would build on the strengths of established models while addressing the unique challenges and opportunities presented by AI in education, leading to more nuanced and context-specific insights.

Theoretical and Practical Implications

This study offers both theoretical and practical implications. By providing the first systematic review of AI adoption among teachers, it fills a significant research gap. Theoretically, it identifies research gaps and suggests future directions for AI adoption research among teachers. Practically, the findings offer valuable insights for stakeholders in education. Schools can use these insights to design targeted professional development programs that address teachers' needs and enhance their confidence in using AI technologies. Policymakers can leverage these findings to develop teacher-centered AI initiatives that consider the unique challenges and dynamics of educational contexts, ultimately improving teaching and learning outcomes.

Limitations and Future Research Directions

This study has several limitations. The review was restricted to English-language publications, potentially overlooking valuable insights from non-English research. It focused on studies published from 2015 onwards, potentially missing earlier relevant research. Additionally, only four databases were searched, which might have led to the omission of some pertinent literature. The rapid evolution of AI technologies also means that recent developments may not be fully captured in the reviewed studies. Furthermore, the geographical concentration of studies, predominantly from Asia, may affect the generalizability of findings. The study also only reported the frequency of influencing and moderating factors without analyzing hypothesis test results, effect sizes, or moderating effects in detail. Future research should address these limitations by expanding the scope of the

literature search to include non-English studies and research published before 2015. To mitigate the geographical concentration issue, future studies could use meta-analysis to conduct moderating analyses across different regions or countries. Meta-analyses could also combine effect sizes from quantitative studies to quantify the relationships between influencing factors and AI adoption, enabling multi-group analyses to test moderating effects of factors such as gender and age.

Conclusion

This systematic review comprehensively analyzes AI adoption among teachers, addressing a significant gap in the existing literature. The findings indicate a notable increase in research from 2019 onwards, with a predominance of studies from Asian countries, particularly China. The majority of research focuses on in-service teachers and predominantly utilizes quantitative methodologies, with TAM being the most frequently used theoretical framework. Performance expectancy and effort expectancy emerge as the primary factors influencing AI adoption, with trust and perceived risk also playing significant roles. Additionally, the primary purpose of investigating AI adoption is to enhance teaching practices. The review contributes theoretically by identifying critical research gaps and suggesting future research directions. These include the need for more qualitative studies, a focus on pre-service teachers, and the development of education-specific acceptance models. Practically, the findings offer valuable insights for educators, policymakers, and researchers, supporting the design of targeted professional development programs and the creation of teacher-centered AI initiatives. Future research should address the identified gaps by including more diverse geographical contexts, incorporating mixed-methods approaches, and developing new theoretical frameworks that capture AI-specific constructs in educational settings.

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