

Impact of Artificial Intelligence on the Roles of Mathematics Teachers: A Systematic Literature Review



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Abstract

Artificial Intelligence (AI) is rapidly transforming educational practices and redefining the professional responsibilities of teachers across diverse learning environments. While substantial research has examined AI adoption, learning outcomes, intelligent tutoring systems, and generative AI applications, limited attention has been devoted to understanding how AI is reshaping the roles of mathematics teachers. This systematic literature review aims to synthesize existing evidence on the evolving roles of mathematics teachers within AI-enhanced educational contexts and to develop a comprehensive framework explaining role transformation. Following the PRISMA 2020 guidelines, a systematic search was conducted across major academic databases, including Scopus, Web of Science, ERIC, ScienceDirect, SpringerLink, Taylor & Francis Online, Wiley Online Library, IEEE Xplore, and Google Scholar. Studies published between 2022 and 2026 were screened using predefined inclusion and exclusion criteria. A total of 41 empirical studies met the eligibility requirements and were subjected to thematic synthesis. The findings reveal that AI-driven transformation of mathematics teachers' roles occurs across seven interconnected domains: (1) traditional roles retained due to inequitable access to AI, (2) human-centred roles that remain uniquely human, (3) existing roles enhanced through AI, (4) emerging AI-related roles, (5) corrective roles necessitated by limitations of AI-generated content, (6) protective roles addressing challenges arising from AI use, and (7) professional partnership roles extending beyond classroom boundaries. Based on these findings, an AI-Driven Mathematics Teacher Role Transformation Framework is proposed. The review contributes a holistic conceptualization of teacher role transformation and provides implications for teacher education, educational policy, school leadership, and future human-AI collaboration in mathematics education.

Keywords: *AI, Mathematics Education, Mathematics Teachers, Human-AI Collaboration, AI Literacy, Generative AI, Education Technology.*

1. Introduction

The fast pace of AI growth is changing educational systems globally and re-defining the processes of teaching and learning at all levels [1-3]. Machine learning, natural language processing, intelligent tutoring systems, learning analytics, and generative AI technologies are some of the advancements that have enabled educational technologies to go beyond traditional digital systems. Technologies like Generative AI, adaptive learning systems, AI tutoring, and analytic AI systems are becoming common in classes as they help in the process of delivering instruction, providing personalized learning, assessment, feedback, and making decisions in academia [2, 4]. With continued efforts in digital transformation, AI stands out among other technological inventions that are shaping education in the future [5-8].

Education in Mathematics has been one of the leading fields where AI applications can be implemented due to its systematic character, problem-solving approach, and use of continuous feedback and individualized learning [9, 10]. With the help of AI technology, educational programs can be created in order to produce mathematical explanations, create practice questions, recommend individualized learning material, assess student performance, and provide immediate feedback on student answers. Recent research shows that mathematics learning environments based on the use of AI technology improve mathematical reasoning, problem-solving skills, modelling, and self-regulated learning of students [11, 12]. Growing availability of generative AI applications enables teachers to design differentiated learning materials and create

mathematical problems depending on their interests and level of abilities.

The introduction of AI in mathematics education has led to much optimism in regard to the ways AI can be applied to increase the effectiveness of education and the success of learning outcomes [10, 13]. The possibilities of automating routine operations, decreasing the burden of paperwork, making decisions based on data analysis and implementing adaptive learning systems have been identified as possible advantages of using AI in education. In addition, AI-assisted educational environment has been proved to be effective in improving learning efficiency, raising the level of students' engagement and implementing inclusive educational approaches via personalized learning.

However, along with the above-mentioned benefits, the increased use of AI in education has raised a number of important issues related to the impact on the teaching profession. In view of the fact that AI systems are becoming able to perform tasks which used to belong only to teachers, issues arise regarding the future place of the educators in AI-supported educational processes. Indeed, many teachers worry about the fact that AI technologies can undermine the significance of the educator's professional competence, redefine the roles performed by the teacher in the classroom, or even replace some elements of the educators' job performance [14, 15]. Such concern has been reported among pre-service as well as in-service teachers when considering issues related to professional identity, instructional authority, pedagogical autonomy, and professional longevity. Moreover, current research findings indicate that mathematics teachers' anxiety toward AI is linked to low AI literacy levels and less willingness to use AI technologies in classroom practice [16]. Such concerns may eventually stop both teachers and learners from making the most out of educational opportunities provided by AI. In this respect, a clear understanding of how mathematics teachers can reshape and fortify their professional roles becomes essential. Instead of perceiving AI as a substitute for themselves, mathematics teachers should re-imagine their professional activities to retain their pedagogical relevance and capitalize on the educational potential that AI-driven teaching and learning offer. This issue creates a good basis for conducting a systematic review of the roles of mathematics teachers in the age of AI.

Despite the increasing popularity of scientific research dedicated to the impact of Artificial Intelligence on education, the current body of literature on the topic is still highly fragmented due to the changing professional roles of mathematics teachers. Existing studies have focused mostly on the integration of AI in education, intelligent tutoring

systems, the application of generative AI, students' learning outcomes, ethical issues, and technology acceptance. There is a lack of studies exploring the changes taking place in the professional roles and identity of mathematics teachers in the context of AI-enhanced learning. The relevant literature is scattered and does not provide any unified conceptual framework regarding the changes in teachers' roles in the era of AI integration in education. There is a necessity for synthesizing empirical data related to this topic in order to explore the existing and newly developed professional roles of mathematics teachers in the era of AI integration. This is the main purpose of the present systematic literature review. Accordingly, this study addresses the following questions:

RQ1: What traditional roles of mathematics teachers are retained in the age of AI, and why do these roles remain important?

RQ2: Which existing roles of mathematical teachers have been strengthened or improved through the integration of AI in mathematics educations?

RQ3: What new and emerging roles have been created for mathematics teachers as a result of AI-supported teaching and learning?

RQ4: What responsibilities have emerged due to the limitations, risks, and challenges associated with AI-generated content and AI usage in education settings?

RQ5: How can the transformation of mathematics teacher's roles in AI-enhanced educational environments be conceptualized within an integrated framework?

Three primary contributions arise from the present study. Firstly, the review delivers a detailed synthesis of the latest studies focused on the changing roles of mathematics teachers in the educational context involving the use of AI technologies. Secondly, the multidimensional categorization of mathematics teachers' roles is elaborated taking into consideration such aspects as retention, enhancement, emergence, correction, and collaboration. Finally, an AI-Driven Mathematics Teacher Role Transformation Framework is suggested for the effective integration of human experience and AI for future mathematics education.

2. Survey Methodology

For this study, the Systematic Literature Review (SLR) methodology was employed for the systematic review of the evolving roles of mathematics teachers in an AI-enabled learning environment. The SLR methodology was adopted based on the PRISMA 2020 statement that provides guidance on conducting systematic reviews using the process of identification, screening, eligibility, and synthesis of relevant literature in Figure 1

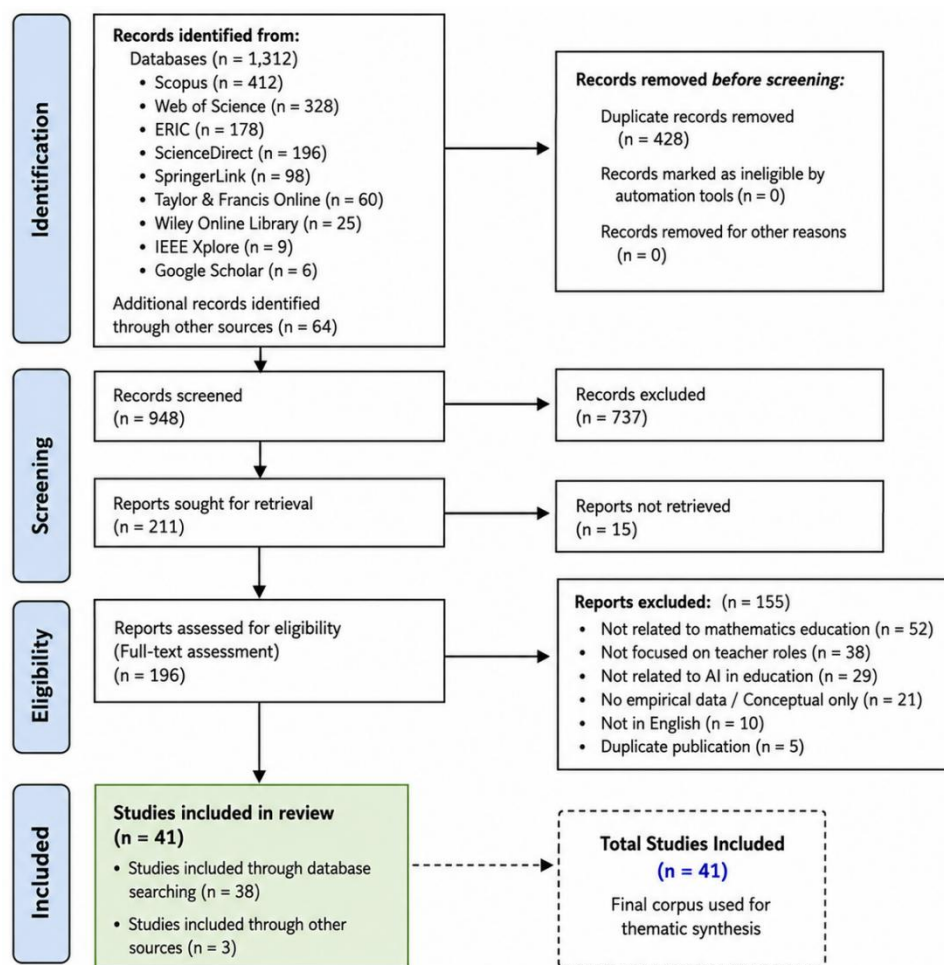


Figure 1. PRISMA

2.2 Data Sources

The literature review included databases in order to obtain a complete range of references. These databases include Scopus, Web of Science, ERIC, ScienceDirect, SpringerLink, Taylor & Francis Online, Wiley Online Library, IEEE Xplore, and Google Scholar. Articles from January 2022 to January 2026 were considered, which is when there was a rapid growth of the use of generative AI in education. The backward reference method was also applied to find more studies.

2.3 Search Strategy

The search strategy was formed on the basis of key phrases and Boolean operators relating to such concepts as Artificial Intelligence, Mathematics Education, Teachers' Roles, Transformation of Professionals, Artificial Intelligence Literacy, and Human-AI Cooperation. The process of forming the search strategy took place throughout the screening process.

("AI" OR "Generative AI" OR "ChatGPT" OR "AI Tools" OR "Intelligent Tutoring Systems" OR "Machine Learning in Education") AND ("Mathematics Education" OR "Mathematics Teaching" OR "Mathematics Teachers" OR "Mathematics Classroom") AND ("Teacher Role" OR "Teacher Identity" OR "Teacher Competencies" OR "Teacher Transformation" OR "Teacher Professional Development") AND ("AI Literacy" OR "Human-AI Collaboration" OR "Educational Technology" OR "AI Integration") The search process was iterative, and keywords were refined throughout preliminary screening to ensure that highly relevant studies were retained while reducing the inclusion of unrelated records.

2.4 Inclusion Criteria

Predefined inclusion and exclusion criteria were employed to ensure the rigor and relevance of the methodological approach in screening. The criteria assisted in the identification, screening, and eligibility assessment of studies that were included in the

review. Inclusion and exclusion criteria are provided in Table 1 below.

Table 1. Study Selection Criteria

Criterion	Inclusion Criteria	Exclusion Criteria
Publication Period	Published between 2022 and 2026	Published before 2022
Publication Type	Peer-reviewed journal articles	Conference proceedings, review articles, editorials, book chapters, reports, theses, and dissertations
Language	English-language publications	Non-English publications
Research Design	Qualitative, quantitative, or mixed-method empirical studies	Conceptual papers without empirical evidence
Research Context	AI applications in educational settings	Technical AI development studies without educational application
Research Focus	Teacher roles, teacher competencies, AI literacy, teacher identity, AI adoption, human-AI collaboration, and mathematics education	Studies focusing exclusively on student outcomes without teacher-related dimensions
Accessibility	Full-text articles available	Full-text unavailable
Methodological Quality	Clear research objectives, methodology, and findings	Insufficient methodological transparency or unclear findings

2.6 Study Selection Process

The study selection process followed the PRISMA 2020 guidelines and comprised four sequential phases: identification, screening, eligibility, and inclusion. A comprehensive literature search across the selected databases identified 1,312 records, with an additional 64 records obtained through other sources, resulting in 1,376 records for initial consideration. Following the removal of 428 duplicate records, 948 unique records were screened based on their titles and abstracts. Of these, 211 reports were sought for full-text retrieval, while 15 reports could not be retrieved. Consequently, 196 full-text articles were assessed for eligibility against the predefined inclusion and exclusion criteria. After the eligibility assessment, 41 empirical studies satisfied all selection criteria and were included in the final thematic synthesis, as illustrated in Figure 1.

2.7 Quality Assessment

The methodology used by each of the selected studies was evaluated using the following criteria: clarity of research aims, suitability of research methods employed, clear data collection methods, relevance to the topic on mathematics teacher role transformation, and reliability of the results obtained.

2.8 Data Extraction Process

Information related to the topic was then obtained from each study, which comprised the following:

author(s), year of publication, country of origin, context of education, purpose of the study, research method used, subjects studied, AI technology analyzed, major results, teachers' role, and educational implications.

2.9 Thematic Synthesis and Framework Development

The analysis technique adopted in this study was the combination of inductive and deductive thematic analysis. In the first step, open coding was conducted to determine the different roles of mathematics teachers as indicated in the selected studies. This was then followed by categorization of similar concepts into themes. Thematic analysis was guided by Human-AI collaboration theory, Teacher Professional Identity Theory, and Technology Acceptance theory. Seven major categories of mathematics teachers' roles were identified through thematic analysis. The thematic synthesis of the categories helped create the conceptual basis for the framework described in this paper.

3. Literature Review Findings: Impact of AI on the Roles of Mathematics Teachers

The reviewed literature indicates that implementation of AI technology in mathematics education not only impacts teaching techniques but also redefines the professional duties of mathematics educators. Although some of the classic duties still

play an important role, especially in situations when the use of AI technology is not uniform, some of the existing duties have been reinforced while new duties have also been added. In addition, the constraints and issues associated with AI content have generated some other responsibilities that require the professional skills, leadership and teaching experience of math educators. According to the thematic analysis of the reviewed studies, the roles of mathematics teachers may be classified into two main types: retained and emerging.

The findings also show that several theoretical approaches can be used to support this claim. Human-AI Partnership Theory suggests that the best possible educational results will be gained only through cooperation between teachers and AI instead of competition. Teacher Professional Identity Theory discusses the fact that teachers constantly reinvent themselves as professionals due to the changes in education and the emergence of new technologies. In turn, Technology Acceptance Theory says that teachers' readiness to implement AI into the educational process is based on the usefulness, reliability, and usability of AI for them. Taken together, these theories prove that Artificial Intelligence transforms and expands the professional role of mathematics teachers [17].

3.1. Traditional Roles Retained Due to Inequitable Access to AI

In spite of great achievements in the field of AI technology, its integration into education has not been uniform. The lack of infrastructure, internet connection, readiness of institutions, availability of finances, technological knowledge, and preparation of teachers have continued to affect the level at which these technologies could be used in the teaching of mathematics [17]. In many places, therefore, schools still depend on human teachers for traditional responsibilities of instruction, assessment, and growth of learners.

3.1.1 Instructor

The role of mathematics teachers as educators is still essential regardless of the growing number of educational technologies based on AI. Despite the capabilities of AI software in providing explanations, solving problems, and offering personalized learning materials, the process of teaching mathematics involves context-driven approaches that are necessary to meet the individual needs and misconceptions of the learners as well as their level of

competence. Research proves that teachers still have an important role in structuring the learning process, delivering mathematical ideas, engaging students in classroom discussions, and helping them to solve problems [18].

3.1.2 Knowledge Provider

AI technologies have opened new avenues for making math-related information more accessible; however, the significance of teachers as experts of knowledge cannot be underestimated. Mathematics education entails more than just accessing information, as learners are required to develop understanding, fluency and mathematical reasoning skills. The role of teachers in transforming abstract mathematical ideas into understandable learning experiences and explanations that meet the level of cognitive abilities and circumstances is still relevant. Research demonstrates that teaching expertise plays an especially crucial role when dealing with students' misconceptions, conceptual problems or ambiguities in AI-derived explanations [19].

3.1.3 Curriculum Implementer

Curriculum objectives implementation is still considered the teachers' duty. The AI may be used in preparation of lessons and development of educational materials but it does not have sufficient professional knowledge to make sure that the instruction corresponds to curriculum objectives and learner requirements. Studies show that the teachers are still in charge of choosing adequate teaching strategies, ordering the content of the mathematics subject, carrying out the assessment activities and making sure that the learning outcomes are attained successfully [20].

3.1.4 Assessor of Students' Learning

Evaluating is still an essential task for math teachers professionally. Despite the ability of AI systems to assess and give feedback on their responses instantly, there are still several elements that need human evaluation and interpretation. Math teachers assess the concepts and skills, problem-solving techniques, reasoning and mathematical communication abilities of students in such a way that cannot be done by automated assessment systems. Research shows that math teachers are critical in evaluating higher-level cognitive skills of students that AI systems cannot properly interpret [18, 20].

3.1.5 Evaluator of Student Performance

Besides grading students, teachers perform another important function connected with assessing their

overall progress and development. Efficient assessment needs considering personal learning paths, the level of motivation, participation in class activities, and other contextual factors that impact students' performance. According to studies, teachers use both quantitative and qualitative data while performing assessments of their students, thus being able to offer full-fledged educational assistance that cannot be provided by AI tools only [17, 19].

3.2. Human-Touch Roles That Machines Cannot Fulfil

Despite the fact that AI technologies are becoming more complex in terms of content generation, evaluation, and personalization of learning, they lack the capacity to duplicate the range of human feelings, social interaction, empathic behaviour, and professional discretion. Teaching mathematics goes well beyond knowledge transfer and includes such aspects of the human dimension as mentoring, motivation, emotions, classroom relationships, behavior interpretation, ethical advice, and situation-based pedagogical decisions. These aspects cannot be fully automated yet by current AI technology. Therefore, the discussed literature implies that the future of mathematics education is associated with the change in emphasis of teachers' professional roles rather than replacement by AI technology [1,13].

3.2.1 Human Connector in the Classroom

The inability of AI to form true connections with human beings is one of the key drawbacks of AI. Mathematics educators play the crucial role of social and emotional support providers in classes since they form the relationships of trust, a sense of belonging, and communication among their students. It was found that children are highly reliant on interpersonal relationships when it comes to motivation, engagement, self-confidence, and emotional well-being [21]. Educators are able to communicate using not only verbal communication but also body language, including facial expressions, body language, intonation, and emotional intelligence.

3.2.2 Interpreter of Classroom Dynamics

Effective teaching is dependent on constant monitoring and interpretation of classroom dynamics. The teacher constantly observes the engagement level of the students, their degree of confusion, their mode of participation, their emotional state, and their interaction, thus being able to make immediate modifications to the way they teach. In contrast to machines, which function according to algorithms and

data input, teachers have the capability to understand the context and act accordingly. This capability allows the teacher to deal with misunderstandings, control discussion, change teaching methods, and help individuals based on what happens in class [22, 23].

3.2.3 Mentor & Guide

It is noteworthy that all the aforementioned studies have emphasized that mentoring remains to be one of the most important human-related functions which teachers are still supposed to perform within AI-enabled educational settings [21, 22]. Although it is possible for an AI system to make recommendations and give automatic assistance, it is impossible for an AI technology to create trust relations required for effective mentoring. The role of a mathematics teacher involves assisting learners in coping with academic problems, growing as personalities, being resilient and fostering self-confidence in mathematics.

3.2.4 Motivator and Role Model

Motivation is one of the main factors of success in math learning. The teachers play an important part in motivating the students to continue their studies, creating interest in the subject, and developing positive attitudes towards math. According to different researches, the support of teachers has a great effect on students' motivation to work with new technologies in studying and performing mathematical tasks. In addition, teachers are role models demonstrating critical thinking skills, ethics, lifelong learning, and proper technology usage. In their behavior and communication, teachers can motivate their students in their future professional development and education. Unlike AI technologies, teachers have the ability to motivate and inspire students [24, 25].

The results of this analysis indicate that while the role of AI in mathematics education is growing, a number of tasks which are traditionally performed by teachers cannot be done without human skills. The teaching, assessing, implementing the curriculum, mentoring, motivating, and interaction tasks depend mostly on human experience and professional judgment. Such duties serve as the basis for new AI-advanced roles of teachers which will emerge in the future. Thus, it seems that AI is reshaping the field of teacher's activity but not replacing it completely.

3.3. Existing Roles Enhanced Through AI

In addition to removing the teaching burden from the shoulders of mathematics teachers, AI has played an

important role in enhancing some of the already existing roles of the teacher. According to the analyzed literature, the application of AI in the classroom has mainly helped teachers as a cognitive and instructional tool for dealing with deeper learning issues. In particular, through automated content creation, preparation of teaching materials, provision of feedback and monitoring of performance, AI has provided teachers with more time for engaging in more complex learning activities.

3.3.1 Higher-Order Thinking Skills and Mathematical Thinking Skills Facilitator

One of the most important ways through which AI helps improve mathematics education is by eliminating the instructional load that comes along with carrying out procedural activities. AI can be used to create exercises for students, provide instructions step by step, and give immediate feedback to the students so that the instructor can direct their attention to other activities that involve high-level cognition. Mathematics instructors are increasingly being concerned about reasoning, analysis, mathematical communication, problem solving, and conceptual learning in addition to procedure [26, 27].

The use of AI-based mathematical environments offers opportunities to involve the learners in performing tasks which are complex and demanding intellectually. Generative AI tools are capable of offering various ways to solve problems and explain their solutions, as well as generating different scenarios related to solving them. In such a way, the teachers of mathematics more and more often act as facilitators of mathematical reasoning helping their students to assess, compare, justify solutions, and build arguments. In addition, the solutions generated by AI systems need to be interpreted and verified, giving another opportunity for the teachers to encourage reflective thinking in their students. Instead of teaching students how to find solutions to problems, the teachers begin to teach them why one or another mathematical approach can be applied and why other solutions may be rejected.

3.3.2 Differentiated Learning Facilitator

AI technologies are shown to be effective in making teachers better at using differentiated instruction. The implementation of differentiation typically consumes a lot of time and energy from teachers because they have to adapt learning materials and activities to cater to diverse learners. The use of AI makes it easier for teachers to develop custom

learning materials, practice activities, and other recommendations depending on the individual students' profile [28, 29].

As a result, math teachers find themselves able to accommodate differences in the learners' readiness, interests, prior knowledge, and pacing. AI technologies help math teachers learn more about their students' progress and thus provide additional assistance where necessary. Instead of adopting a single approach towards their learners, teachers are able to adopt tailored approaches for each learner. It should be noted that the teacher is still crucial in the process of personalizing education. Recommendations made by AI technologies can be used by teachers but interpreted from a wider perspective. Therefore, math teachers become differentiated learners [24, 30].

3.3.3 Creative Learning Designer

Furthermore, the reviewed research also shows how AI increases the teacher's ability to develop innovative and exciting learning experiences in mathematics. Generative AI technologies can quickly generate mathematical problems, realistic scenarios, exploratory tasks, and inter-disciplinary learning assignments that could be very time-consuming otherwise [25, 27]. These capabilities allow teachers to go beyond book-centred learning and create more engaging experiences by connecting mathematics to real-life.

One of the important aspects that can be developed through the application of AI in task generation is the development of creativity in teaching mathematics. Teachers can use AI technologies to develop open investigative tasks, mathematical modelling, creative mathematical writing, and scenario-based problem-solving assignments. These kinds of tasks can promote creativity in mathematics learning.

As a result, the new role of the mathematics teacher is changing from a content provider to the designer of creative learning experiences. The reviewed literature confirms that AI does not replace creativity in the design of learning but allows enhancing it.

3.4. Emerging Roles due to New Possibilities Created by AI

Whereas AI enhances various pre-existing professional duties of a teacher, research clearly shows that AI has created some entirely new professional duties that were previously non-existent in the context of mathematics teaching. New duties

have emerged due to the increasing use of AI systems in teaching and learning practices. With the integration of AI in instructional design, evaluation, personalisation, and creation of knowledge, teachers are expected to acquire new skills in relation to AI literacy, ethical surveillance, mediation through technology, and supporting learners.

3.4.1 AI Expert and Prompt Designer

The increasing prevalence of generative AI necessitates the training of teachers in the effective utilization of the various AI systems. It is increasingly imperative for math teachers to comprehend the strengths, weaknesses, and underlying processes of the AI systems while acquiring the necessary competence for generating accurate and appropriate outputs. The effectiveness of interacting with generative AI systems is largely influenced by the quality of the prompts employed. Prompting is thus becoming one of the emerging competencies [31, 32]. Mathematics teachers are therefore becoming AI experts capable of designing good prompts, assessing the responses, and optimizing AI outputs.

3.4.2 Teachers' AI Coach

With the increased use of AI in schools, there is an increasing number of mathematics teachers who become leaders in terms of helping their peers integrate AI. According to the examined research articles, math teachers with high levels of competence in AI are those who can give guidance and provide professional assistance and training to their fellow teachers in integrating AI [32-34]. This newly emerged role of mathematics teachers involves being a mentor and a leader for integrating AI and includes the development of organizational skills as well as professional learning communities.

3.4.3 Students' AI Coach

In addition to mentoring other teachers, mathematic teachers nowadays are expected to assist their students in interacting properly with AI systems. The students are often lacking experience needed to critically assess the output produced by AI or to make productive use of AI in educational settings. As a result, the teachers today often play the role of AI coaches, showing how, when, and why AI should be used during mathematical learning sessions [35, 36]. In particular, the task is to teach the students how to pose proper questions, check AI output for correctness, understand its limitations and utilize AI assistance properly in solving problems.

3.4.4 Ethical AI Educator

Ethical awareness is an essential aspect in AI-assisted learning in all of the reviewed studies. Such aspects as bias, transparency, accountability, fairness, authorship, and ethical AI usage became important issues [32, 36, 37]. For that reason, mathematics teachers are now becoming ethical AI teachers who teach their students to comprehend the ethical and social significance of AI technologies. This implies not only knowledge transfer but also developing an understanding of the limitations of AI systems and their social implications. The teachers assist their students in considering various ethical issues related to AI-produced information.

3.4.5. Self-Regulated Learning Facilitator

AI-enabled learning environments have been known to foster learner autonomy through personalized suggestions, feedback, and self-directed learning. Nevertheless, learners need to have certain self-regulation abilities to engage successfully in these environments, namely the ability to set goals, monitor themselves, reflect on their actions and make strategic decisions [33, 36, 38].

Consequently, teachers who teach mathematics have become more and more facilitators of self-regulated learning process. This is because they help their students interpret feedback received from AI system, monitor their performance, evaluate their success and make learning decisions.

3.4.6. Personalized Learning Pathway Designer

The emergence of learning analytics and AI-derived performance data has enabled personalized learning processes. Mathematics teachers have started using AI-derived information to discover learners' strong points, detect misinterpretations, and design personalized learning pathways [31, 34, 37]. Unlike standard one-size-fits-all instruction, personalized learning pathways enable teachers to adjust education based on learners' needs. In this capacity, teachers become architects of personalized mathematics learning processes, leveraging their pedagogical knowledge together with AI-derived advice.

3.4.7 Feedback Interpreter

AI tools are able to produce massive amounts of feedback and performance data. Nevertheless, learners find it hard to understand how this information should be used. As a result, the role of mathematics teachers as interpreters of feedback becomes more and more significant [39, 40].

It requires teachers to interpret the feedback and suggest actions on the basis of it. Rather than giving feedback directly, the role of teachers is to turn data into something useful for students. The described situation proves the continuing significance of human interpretation and professionalism in the era of AI. The evidence reviewed above shows that AI does not

decrease the significance of teachers' profession. On the contrary, it makes the role of mathematics teachers grow and change. In addition to traditional instructional roles, there appears a set of additional roles related to technology, ethics, autonomy, and decision-making. Table 2, shows the impact in AI and transformation of teacher's roles.

Table 2. AI Impact and Teacher Role Transformation

AI Capability	Educational Impact	Emerging Teacher Role
Generative Content Creation	Automated lesson materials	AI Content Curator
Personalized Learning Algorithms	Adaptive instruction	Personalized Learning Pathway Designer
Learning Analytics	Student performance insights	Feedback Interpreter
Intelligent Tutoring Systems	Continuous learner support	Students' AI Coach
Prompt-Based AI Interaction	AI-generated outputs	AI Expert and Prompt Designer
Automated Feedback	Immediate assessment support	Mathematical Reasoning Validator
AI Decision Systems	Ethical concerns and bias	Ethical AI Educator
Data-Driven Recommendations	Self-directed learning	Self-Regulated Learning Facilitator

3.5. Roles Necessitated Due to Shortcomings in AI-Generated Content

Despite all the achievements of the generative AI in terms of creating new content, providing solutions to different tasks, and helping with teaching activities, the literature reviewed above reveals that there are some flaws of the AI-generated content that include being inaccurate, creating hallucinations, lacking of full reasoning, and being mistaken with context. In particular, these issues become especially important in the field of math education since all the processes should be exact and logical.

3.5.1 Fact Checker of Mathematics Information

Among many other new tasks that have emerged in connection with the use of AI by the students, one of them is fact checking. Despite the capabilities that AI technologies have to provide fast answers to mathematical questions and solutions to exercises and problems in the form of formulas and explanations, at times, they make calculation mistakes or interpret problems incorrectly, making logically incorrect decisions [41, 42]. The error made by AI programs may be not always clear to students, especially to beginners. In this regard, the need to serve as fact-checkers for the sake of providing instructional material that does not contain any errors has emerged for mathematics educators. The

importance of this task was proved in the analyzed studies.

3.5.2 AI Content Curator

Moreover, the increase in the amount of educational content produced using generative AI technology has increased the significance of the teacher's role as an educational content curator. Multiple explanations, examples, assessment questions, and learning materials can be generated using generative AI tools; however, not everything is equally relevant to education purposes due to different levels of alignment to curriculum requirements, cognitive, contextual, and pedagogical relevance [39, 41]. Therefore, the mathematics teacher curates the educational content produced by AI by selecting, adapting, modifying, and arranging the material for learning goals. The role of a teacher in the process of content curation consists of discerning the educationally relevant and meaningful content.

3.5.3 Mathematical Reasoning Validator

From the above review of literature, one gets to realize that AI systems will give correct solutions but through an invalid, inaccurate, or opaque process of reasoning. In mathematics, knowing how reasoning was used to solve problems is much more important than knowing the right answer to the problem. The role of a teacher becomes to validate the

mathematical reasoning process. This involves checking on the validity, completeness, and accuracy of the mathematical reasoning provided by the system. The role of a teacher entails teaching the students on how to validate AI-reasoning and whether it is mathematically acceptable [43, 44].

3.5.4 Ethical Compass including Data Bias Corrector

Moreover, the existing literature also raises issues related to the problem of bias, fairness, transparency, and accountability in AI systems [39, 41, 42]. Datasets used for the training of AI models may be imperfect and contain inaccuracies and cultural bias. The biases in the system affect the quality and impartiality of the AI-generated content. Thus, the mathematics teachers have to play the role of the moral compass and bias corrector. Mathematics teachers teach students how to find the limitations of the system and its potential biases. Besides, they raise the issues related to the societal impacts of the use of AI systems.

3.6. Roles Necessitated Due to Challenges Created by AI Usage

In addition to the restrictions related to AI-generated content, the growing trend in AI technologies has created new educational issues connected with dependency, integrity, privacy, critical thinking, and access equality. From the results presented in the studies under review, it is evident that these issues necessitate new responsibilities from mathematics teachers regarding protection, supervision, and regulation.

3.6.1 AI Use Mediator

With increasing accessibility of AI tools, there are significant differences in how learners work with such technological advancements. While some students employ AI tools effectively as a means of learning, other students tend to be overly reliant on the use of automated help. Therefore, the modern mathematics teacher becomes an AI mediator, who helps students develop the right relationship with AI tools [45, 46]. The mediation process includes setting the rules of proper AI use, assessing when the use of automated help is justified, and making sure that technology complements, not substitutes, cognitive processes.

3.6.2 Critical Thinking Facilitator

One of the issues that is most commonly associated with AI usage is students' possible readiness to believe in AI-generated information without analysis. Based on the reviewed literature, there is a chance

that AI may lead to decreased possibilities for independent thinking and analysis [47]. Thus, in recent years, mathematics teachers have started acting as facilitators of critical thinking by making their students ask questions, analyze, compare, and critically evaluate AI-generated answers. Instead of accepting AI-generated content as ultimate truth, students learn how to identify assumptions, see limitations, and formulate evidence-based conclusions. This issue is especially relevant to mathematics as this subject requires logical reasoning and problem solving.

3.6.3 Academic Integrity Guardian

The advent of generative AI has brought into focus questions of plagiarism, cheating, and academic integrity. AI systems are used by students to produce solutions, explanations, tasks, and tests with little effort on their part. Although AI may help with learning, improper usage may lead to the violation of academic integrity [40, 48]. For this reason, math teachers are becoming the guardians of academic integrity in the realm of AI usage by forming ethical principles for the proper use of technology and encouraging academic integrity among students.

3.6.4 Safe AI Use Mentor

According to the studied literature, there are many cases where the students have limited knowledge about possible dangers connected with the use of AI tools, such as spreading misinformation, manipulation, offensive material, and being too dependent on these tools [43, 48]. Hence, math teachers are becoming mentors for proper AI use. As mentors, teachers give advice about the appropriate ways of using technology. In particular, the teachers help students learn about the benefits and limitations of using AI tools.

3.6.5 Data Privacy Protector

The application of the AI systems implies the necessity to gather, analyse, and store huge amounts of learner's data. As it can be seen from the reviewed studies, privacy protection is becoming an urgent issue in AI-based educational environment [40, 43, 48]. Learners share personal data, learning history, and behavioural data via digital platforms, without being aware of all privacy risks. In view of this situation, the role of mathematician teachers is changing as they have to take care of learner's data protection and privacy education. Mathematicians train learners to share data responsibly, estimate privacy risks of the AI-based tool, and promote

responsible use of technologies in the educational process.

3.6.6 Equitable Access Advocate

Despite the potential of AI in the field of education, not all institutions have equal access to technologies. Different levels of infrastructure, connectivity, digital literacy, and organizational support can lead to the formation of new forms of educational inequities [45]. For this reason, math teachers take on the role of equity champions. The duties include the detection of existing gaps in the availability of AI technologies, promotion of their equal implementation and making sure that all pupils get the same chances of AI-assisted learning.

3.7. Professional Partnerships Beyond the Classroom

According to the reviewed literature, incorporation of AI technologies is expanding the role of mathematics teachers professionally to go beyond the boundaries of the classroom. Teachers are becoming more and more engaged with educational systems that involve technology creators, researchers, policymakers, and other stakeholders. This collaboration makes it possible for teachers to be not only consumers but also producers of AI technologies.

3.7.1 Collaborator with AI Developers

With the advancement of AI in education, teacher knowledge has grown to be increasingly important in the development of educational technologies. Mathematics teachers have valuable information about what happens in the classroom, the needs of students, curricular demands, and effective instruction. Teachers thus increasingly work with developers of AI to design educational technologies which tackle genuine teaching problems [44, 49].

3.7.2 AI Tool Co-Designer

The analyzed papers show how the trend of participatory technology design is developing in relation to which teachers become the active

participants in the creation of AI-based educational tools [50, 51]. Instead of being mere users of such technologies, the teachers become co-designers and are involved in the process of designing learning, assessing, and instructing tools. This is possible due to the participation of mathematics teachers in the creation of AI tools.

3.7.3 Educational AI Research Partner

The use of AI in the field of education has led to increased need for empirical data concerning the effectiveness, implementation, and impact of AI. The math teachers are now involved in educational research projects that examine the effects of AI in teaching and learning [52, 53]. Teachers as research partners can help by offering their experience of working in the classroom and contributing to the testing of new technology.

3.7.4 Contributor to AI Training and Evaluation

Furthermore, the literature under review also suggests that there is an increasing trend in terms of teacher involvement in evaluation and improving AI systems [54, 55]. They evaluate the effectiveness, accuracy, utility, and pedagogical value of outputs produced by AI algorithms and give feedback for further system enhancement. By participating in this process, mathematics teachers make their contribution to developing better AI systems. Table 3 shows the classification of mathematics teachers' role.

4. Proposed AI-Driven Mathematics Teacher Role Transformation Framework

The findings of the reviewed literature indicate that there are many interrelated aspects of the transformation of the role of the math teacher. There is still a need for traditional teaching responsibilities especially where there is an imbalance in accessing AI technology. On the other hand, there are also human-centred responsibilities that continue to differentiate humans from AI, in addition to new AI-augmented roles and emerging roles of math teachers in Table 3.

Table 3. Classification of Mathematics Teachers' Roles in AI-Enhanced Education

Role Category	Teacher Roles	Nature of Role
Traditional Roles Retained	Instructor, Knowledge Provider, Curriculum Implementer, Assessor, Evaluator of Student Performance	Retained
Human-Touch Roles	Human Connector, Interpreter of Classroom Dynamics, Mentor & Guide, Motivator and Role Model	Human-Centred
Existing Roles Enhanced Through	Higher-Order Thinking Facilitator, Differentiated Learning Facilitator, Creative	Enhanced

AI	Learning Designer	
Emerging Roles due to New Possibilities created by AI	AI Expert, Prompt Designer, Teachers' AI Coach, Students' AI Coach, Ethical AI Educator, Self-Regulated Learning Facilitator, Personalized Learning Pathway Designer, Feedback Interpreter	Emerging
Roles Due to AI Shortcomings	Fact Checker, AI Content Curator, Mathematical Reasoning Validator, Ethical Compass, Data Bias Corrector	Corrective
Roles Due to AI Challenges	AI Use Mediator, Critical Thinking Facilitator, Academic Integrity Guardian, Safe AI Use Mentor, Data Privacy Protector, Equitable Access Advocate	Protective
Professional Partnership Roles	Collaborator with AI Developers, AI Tool Co-Designer, Educational AI Research Partner, Contributor to AI Training and Evaluation	Collaborative

Based on the results obtained from this review, an AI-Driven Mathematics Teacher Role Transformation Framework is developed. It is built upon the understanding of the role transformation of mathematics teachers into five intersecting domains: retained traditional roles, human-centred roles, AI-supported roles, new roles emerging because of AI, and professional partnership roles. These roles can also be complemented with the roles of correction and protection related to the limitations of AI use.

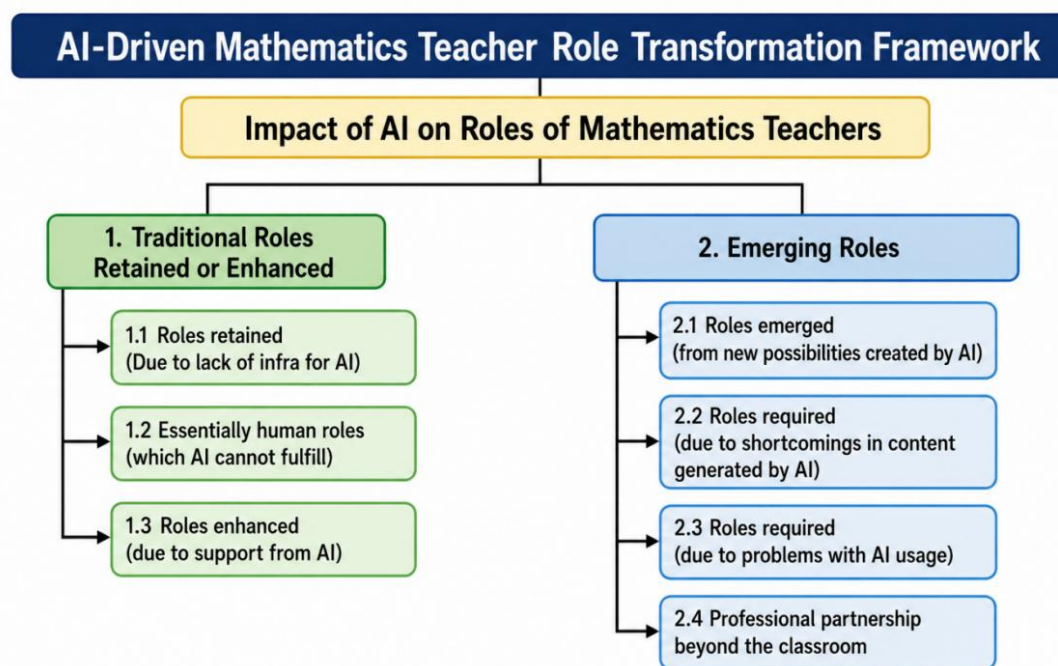


Figure 2. AI-Driven Mathematics Teacher Role Transformation Framework

Figure 2 shows the AI-Driven Mathematics Teacher Role Transformation Framework constructed through the thematic synthesis of the literature. The integration of Artificial Intelligence affects the professional responsibilities of mathematics teachers in two major aspects, including (i) traditional roles

maintained or upgraded and (ii) emergent roles as a result of opportunities and challenges brought by the use of AI. Contrary to the replacement of the role of teachers, the use of Artificial Intelligence results in the transformation and expansion of professional responsibilities of mathematics teachers as it

supports key functions performed by humans, while at the same time generating new roles for teachers.

The thematic synthesis presented across Sections 3.1–3.7 collectively supports the AI-Driven Mathematics Teacher Role Transformation Framework presented in Figure 2. The framework integrates retained, enhanced, emerging, corrective, protective, and collaborative roles into a unified conceptual model that explains how Artificial Intelligence is reshaping the professional identity and responsibilities of mathematics teachers within AI-enhanced educational environments.

5. Discussion

5.1 AI as a Partner Rather than a Replacement

Among the key findings of the review is the necessity to regard AI as a supplementary component rather than a substitute for mathematics teachers. Even though AI-based technologies are capable of creating learning materials, offering adaptability and personalization, they fail to replace the pedagogical judgement, contextual knowledge, and socio-emotional skills possessed by teachers. According to the review, some typical duties of teachers such as instruction, evaluation, mentoring, and curriculum implementation are highly dependent on humans. Thus, AI seems to make teachers more effective in their work through simplifying their activities and facilitating learning processes. These results suggest the perspective of further research that suggests the idea of the future of mathematics education as a collaboration of humans and AI systems [1, 15, 56].

5.2 Transformation of Teacher Professional Identity

Based on the research results, it can be noted that the implementation of AI affects the development of the professional identity of mathematics teachers. For a long time, teachers were viewed as knowledge providers and class instructors. The appearance of AI coach, ethical AI instructor, personalized learning designer, and feedback interpreter as emerging roles proves the transition from knowledge provision towards technology-enabled and learner-oriented professional activities. Nowadays, teachers have to possess not only pedagogic competencies but also be able to work with technologies, make ethically informed decisions, and use data effectively. This implies a further development of the profession of teachers who facilitate and oversee AI-mediated learning [8, 14, 57].

5.3 Human-AI Collaboration in Mathematics Education

This review also reveals an increase in the significance of cooperation between human intelligence and AI in mathematics education [13]. The role of AI in this case includes computational efficiency, personalization, learning analytics, and fast production of content, while human intelligence can be used for contextual interpretation, mathematical reasoning assistance, ethical considerations, and emotional guidance. Such cooperation opens new prospects in terms of improving the learning process and makes it more flexible. In addition, the appearance of the collaborative roles not only in classroom-based teaching but also in co-creation of tools for AI and research on AI implies the involvement of mathematics teachers in the innovation process in education [11, 56, 58].

5.4 Implications for Mathematics Teaching Practice

The results have serious consequences for the practice of teaching mathematics. Firstly, the AI literacy of teachers will need to be an essential part of teachers' competencies, which will allow them to assess and apply AI-based applications in the process of instruction. Secondly, mathematics teaching will become more learner-centered with a focus on reasoning, problem solving, creativity, and self-regulated learning. Finally, teachers will take a leading position in using AI technology ethically while tackling such problems as academic integrity, bias, privacy issues, and technology usage responsibility. These changes indicate that the future mathematics teachers should combine pedagogical knowledge and technological skills along with ethical leadership [3, 10, 16].

5.5 Alignment with Existing Theories

These results correlate well with some theoretical perspectives that describe the changing role of math teachers within AI-assisted education. With regard to the Technology Acceptance Model, the acceptance of AI by teachers is based on usefulness, ease of use, trust and professionalism [59–61]. The appearance of AI-associated duties in this literature review demonstrates that the key elements of its successful integration are technological skills and positive attitudes towards using AI.

Moreover, the results obtained support the theory of Human-AI Collaboration, according to which the best results are achieved when humans' and AI's skills and

capabilities compensate for each other. As seen from the reviewed articles, in the case of the use of AI, teachers retain their pedagogical skills, whereas AI adds efficiency and data-processing capability [1, 56].

Lastly, this review supports the theory of Teacher Professional Identity, which states that the professional identity of teachers changes as a reaction to changing educational environments. The development of AI-based roles is one example that indicates the adaptation of mathematics teachers to new challenges while retaining their fundamental educational duties. Instead of making their professional life irrelevant, AI increases the boundaries of the teachers' profession by opening possibilities for leadership, innovation, collaboration, and empowering learners. The changing role of mathematics teachers may, therefore, be perceived as the process of transforming the profession through merging traditional teaching skills with technological ones [8, 57].

6. Practical Implications

6.1 Implications for Mathematics Teachers

The results of the above-mentioned review suggest that mathematics teachers should extend their professional competence beyond pedagogical competence to efficiently work within AI-enabled learning spaces. With the increasing involvement of AI in the delivery of instruction, production of content, and personalized learning, teachers will have to become literate in relation to AI, be able to analyze data, and critically assess outputs generated by AI systems. Moreover, teachers should be capable of assisting students in using AI technologies in an ethical manner while fostering their higher-order thinking and problem-solving skills.

6.2 Implications for Schools

Institutions of learning have a significant part to play in ensuring that there is an effective implementation of the use of AI in math education. Institutions should provide digital infrastructures, ensure access to quality AI technologies, and develop policies that promote ethical utilization of technology. In addition, the schools should ensure constant training for the teachers so that they gain relevant skills and stay informed about technological advancements. School administrators should also create a culture of collaboration that encourages sharing of ideas and innovations in the use of AI technologies in education.

6.3 Implications for Teacher Education Programmes

The design of teacher education programs needs to be restructured in order to equip future mathematics teachers with the necessary knowledge to deal with AI-based education. The incorporation of AI literacy, prompt design, learning analytics, digital ethics, and human-AI interaction into teacher education programs is imperative. Other than gaining the necessary technical skills, future teachers need to develop an ability to evaluate the AI systems and integrate them responsibly while developing ways of ensuring that their students become autonomous learners.

6.4 Implications for Policymakers

There is a major duty of policymakers to guarantee that the use of AI in education is equitable, ethical, and geared towards educational purposes. There should be established national and institutional policies on the appropriate way to integrate AI, privacy of data, academic integrity and algorithmic transparency. Policy makers should invest in the digital infrastructure and the development of teachers in order to minimize disparities in access to AI in schools and regions. Moreover, policy framework should encourage collaboration between all stakeholders in order to promote the quality and sustainability of the integration of AI into education.

6.5 Implications for AI Developers

According to the findings, the development of educational AI should involve the close collaboration between the developers and the mathematics teachers during the process of development, design and assessment of the educational software and algorithms. Teacher involvement will help to make sure that the development of the educational technology complies with the curriculum and pedagogic principles. The transparency, explainability, fairness and user centeredness will improve the trustworthiness of the technologies. Besides, the AI systems should facilitate teacher decision making.

7. Critical Analysis of Existing Research

7.1 Major Limitation of Existing Research

While many studies have been dedicated to the problem of the influence of AI in math education, the current state of research is far from being complete and lacks a number of key components. To begin with, the overwhelming majority of existing research concentrates on the issues of technological efficiency, students' academic results, and factors that influence the use of AI, while the issue of how AI changes teachers' role is hardly ever discussed. Existing

research tends to consider particular aspects of teachers' work independently of the ecosystem within which role transformation occurs. Secondly, the vast majority of existing literature uses short-term and cross-sectional designs. Thus, little information is provided on how AI influences teacher identity, practices, development, and decision making in the long run.

Thirdly, research on AI often concentrates on particular tools like ChatGPT, ITS, or Learning Analytics. The tool-based approach prevents a holistic view of how different AI tools affect mathematics education together. Fourthly, ethics, societal, and governance-related aspects do not get enough attention. Topics like algorithmic biases, integrity issues, privacy, data transparency, equal access to technology, and responsible use of AI often are noted by scholars but hardly ever studied in detail. Finally, there is a lack of integrative theories that can explain multidimensional changes in the role of a mathematics teacher in terms of instruction, technology, ethics, collaboration, and leadership.

7.2 Research Gaps in AI-Driven Mathematics Teacher Role Transformation

Five main research gaps have been identified through synthesis of the analyzed literature.

- **Lack of Attention to Teacher Professional Role Transformation:** Studies tend to focus on AI technologies per se, instead of studying changes in the professional roles of math teachers.
- **Missing Longitudinal Evidence:** The way teachers' roles, competencies, and professional

identity evolve with growing implementation of AI remains understudied.

- **Inadequate Attention to Ethics and Governance Issues:** It is rare to see research dedicated to teachers' emerging responsibilities regarding ethical, privacy, bias-related, academic honesty issues, and responsible governance of AI technologies.
- **Lack of Models for Human-AI Collaboration:** The existing studies rarely conceptualize human-AI collaboration ecosystems and do not focus on the ways teachers and AI technologies collaborate and support the learning process.
- **Lack of Frameworks:** Frameworks that would combine retained roles, enhanced roles, emerging roles, responsibilities, and functions are scarce.

The suggested framework is an attempt to look at the developing professional duties of mathematics teachers through a futuristic conceptual lens. According to this framework, the future of mathematics teaching will see the convergence of the continuing teaching duties, the human-centric roles, AI-supported pedagogical duties, the new skills related to the use of AI, the duties that entail correction and protection and, lastly, partnerships beyond the classroom environment. This framework also considers the necessary enablers for successful implementation of the human-AI collaboration as well as the desired educational achievements. Figure 3 shows the conceptual framework of future directions.

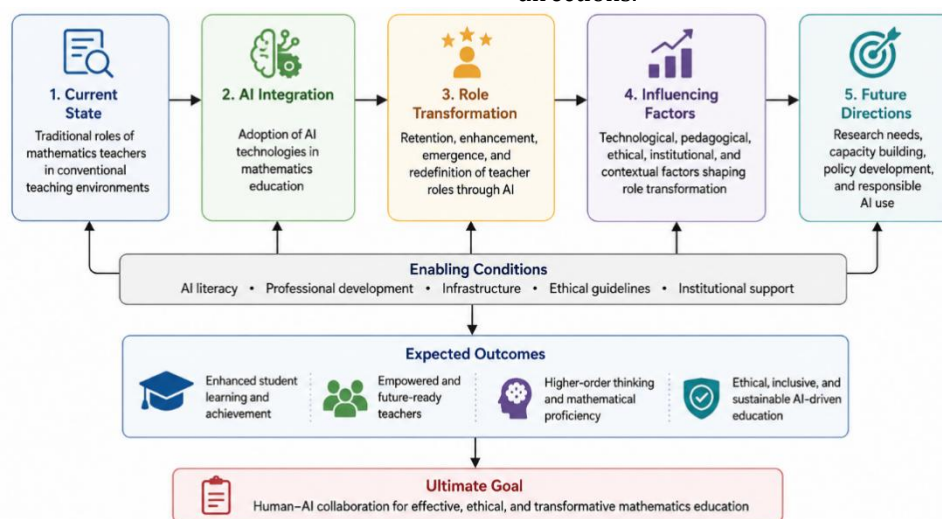


Figure 3. Conceptual Framework for Future Research

8. Future Research Directions

8.1 AI Literacy and Teacher Competencies

It will be useful in the future to find out which AI literacy competencies are necessary for mathematics teachers and what ways can be used to develop them. Comparative studies analyzing the differences in AI readiness between teachers can be very helpful for such professional development programs.

8.2 Ethical AI in Mathematics Education

The field needs further research in order to discover any ethical problems connected with the implementation of AI technologies in mathematics education. These problems may relate to the questions of bias, transparency, accountability, academic integrity, and responsible use of technology.

8.3 AI-Supported Assessment

Even though AI provides many opportunities to improve assessment, it still requires some additional research to evaluate its validity, reliability, and educational significance. It will be interesting in the future to research how both teachers and AI can help in improving assessment.

8.4 Human-AI Co-Teaching Models

The notion of human-AI co-teaching is quite new in mathematics education. It will be interesting in the future to research collaborative models of teaching that incorporate both human skills and AI abilities.

8.5 Longitudinal Studies on Teacher Role Transformation

Existing studies generally take a short-term perspective regarding the use of AI technology. There is a need for longitudinal research in order to understand how the role of the mathematics teacher, the identity of the mathematics teacher, and teaching practices will change over time due to the increasing use of AI technology.

9. Conclusion

This systematic literature review examined the evolving roles of mathematics teachers in Artificial Intelligence (AI)-enabled educational environments through the synthesis of 41 empirical studies published between 2022 and 2026. The findings demonstrate that AI is not replacing mathematics teachers; rather, it is fundamentally transforming and expanding their professional responsibilities. The review identified seven interconnected categories of teacher roles, including traditional roles retained due to inequitable access to AI, human-centred roles that remain uniquely dependent on human interaction, AI-

enhanced pedagogical roles, emerging AI-related responsibilities, corrective roles addressing limitations in AI-generated content, protective roles mitigating risks associated with AI use, and professional partnership roles extending beyond the classroom. These findings collectively indicate a shift from knowledge transmission towards facilitation, ethical guidance, personalization, critical evaluation, and human-AI collaboration. A major contribution of this review is the development of the AI-Driven Mathematics Teacher Role Transformation Framework, which provides a comprehensive conceptual understanding of how mathematics teachers' responsibilities evolve in response to AI integration. By synthesizing fragmented evidence across multiple studies, the framework advances theoretical discussions on teacher professional identity, technology integration, and human-AI collaboration in mathematics education. Despite its contributions, this review is subject to certain limitations. The analysis was restricted to English-language peer-reviewed journal articles published between 2022 and 2026, which may have excluded relevant studies from other publication sources and languages. Additionally, the rapidly evolving nature of AI technologies suggests that future developments may introduce new teacher roles not captured within the current review. Future research should focus on longitudinal investigations of teacher role transformation, AI literacy development, ethical AI implementation, AI-supported assessment, and human-AI co-teaching models. Such efforts will further strengthen the evidence base required for effective and responsible integration of AI in mathematics education.

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