



Artificial Intelligence for Teacher Professional Development in Islamic Education: A Systematic Literature Review and Future Competency Framework

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DOI: <https://doi.org/10.21580/rjtpd.v3i02.33595>

ABSTRACT

The development of Artificial Intelligence (AI) has transformed educational practices, including the professional development of teachers who increasingly demand pedagogic, digital, reflective, and ethical competencies. Although research on AI in education is progressing rapidly, a synthesis that specifically examines the professional development of teachers in the context of Islamic education is still limited and has not yet resulted in a comprehensive conceptual framework. This research aims to analyze research trends, identify key themes, opportunities, challenges, and formulate the Future AI-Driven Teacher Professional Development Framework as a conceptual model for teacher professional development in the digital era. The study used the Systematic Literature Review (SLR) approach based on the PRISMA 2020 guidelines by searching the literature from the Scopus, Web of Science, ERIC, ScienceDirect, and SpringerLink databases. Of the 2,384 publications identified, 112 articles met the inclusion criteria and were analyzed through thematic synthesis. The results show that AI contributes to the improvement of digital competence, pedagogic innovation, continuous professional learning, reflective practices, and learning efficiency. However, its implementation still faces challenges in the form of teacher readiness, digital infrastructure gaps, ethical governance, and data protection. This research offers a Future AI-Driven Teacher Professional Development Framework that integrates six main dimensions, namely digital competence, pedagogic innovation, professional learning, AI ethical governance, reflective practices, and integration of Islamic values. The framework makes a theoretical contribution to the professional development of teachers as well as a reference for policy formulation, training programs, and the sustainable implementation of AI in Islamic education.

Keywords:

Artificial Intelligence; Teacher Professional Development; Islamic Education; Systematic Literature Review; PRISMA 2020.

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1. Introduction

The development of Artificial Intelligence (AI) has significantly changed the global education landscape, especially in the way teachers design learning, conduct assessments, manage classrooms, and develop professional competencies on an ongoing basis. The emergence of Generative AI, learning analytics,

intelligent tutoring systems, and various applications based on large language models is no longer seen as just a technological innovation, but has become part of the transformation of the educational ecosystem that supports adaptive learning, data-driven decision-making, and increased effectiveness of pedagogic practices (Giannakos et al., 2024; López et al., 2025; Yan et al., 2024). In this context, teachers are not only required to have pedagogic and professional competence, but also digital literacy, the ability to use AI critically, and ethical awareness in integrating technology into the learning process (Adiyono et al., 2025; Chee et al., 2024; Rudolph et al., 2024). Cutting-edge research shows that AI has the potential to improve teaching quality, accelerate feedback, support personalization of learning, and expand teachers' opportunities for sustainable professional reflection (Garzón et al., 2025). However, the use of AI must still place teachers as the main actors in pedagogic decision-making so that technology functions as a support, not a substitute for the role of humans in education (Adiyono et al., 2026; Bauer et al., 2025; Topali et al., 2025).

In the past decade, research on AI in education has grown rapidly, but most of it is still oriented towards improving student learning outcomes, implementing learning technologies, or developing intelligent learning systems. Recent systematic studies show that the proportion of research that specifically addresses AI as a means of teacher professional development is still much smaller than research that focuses on the use of AI in the classroom (Adiyono et al., 2024; Yue et al., 2024). In addition, most studies are conducted in the context of general education in developed countries, while research on the professional development of teachers in madrasas, Islamic schools, Islamic boarding schools, and Islamic universities is still relatively limited. Several studies have begun to examine the application of AI in Islamic education and the improvement of the competence of Islamic religious education teachers, but the discussion still focuses on the benefits of technology, implementation challenges, or ethical aspects partially without producing a comprehensive conceptual framework regarding the professional development of AI-based teachers in the context of Islamic education (Bond et al., 2024; Islam et al., 2024; Papakostas, C., 2025; Posangi et al., 2025). This condition shows that the available literature is still fragmented and has not provided a complete synthesis of the relationship between AI, professional development of teachers, and the integration of Islamic values.

Based on these conditions, there is a research gap that needs attention. First, there has not been much research that synthesizes empirical evidence on how AI supports the sustainable professional development of teachers in an Islamic educational environment (Ahmad, Z. A., 2025). Second, the results of previous studies still show inconsistencies regarding the effectiveness of AI in improving teacher competence because some studies report on improving digital competence and pedagogic innovation (Rosmini et al., 2024), while other studies highlight challenges in the form of teacher readiness, infrastructure limitations, ethical governance, data privacy, and low institutional support (Asal et al., 2025; Ren et al., 2025). Third, there is no conceptual model that integrates pedagogic, professional, digital, reflective, AI ethics, and Islamic values as the foundation for teacher professional development in the AI era (Sperling et al., 2024; Zhai, X., 2024; Zou et al., 2025). These gaps indicate the need for a systematic synthesis that not only summarizes previous research findings, but also produces a conceptual framework that can serve as a basis for policy development, teacher training, and follow-up research (Aljemely, Y., 2024).

Based on this background, this study aims to systematically analyze the development of research on the use of Artificial Intelligence in teacher professional development in Islamic education, identify key themes, opportunities, challenges, and formulate a *Future AI-Driven Teacher Professional Development Framework* as a conceptual model for teacher competency development in the digital era. The research uses a Systematic Literature Review (SLR) approach based on the PRISMA 2020 guidelines, with an analysis unit in the form of reputable scientific articles that discuss AI, teacher professional development, and Islamic education. The PRISMA 2020 guidelines were chosen because they provide systematic, transparent, and replicable reporting standards in the process of identification, selection, feasibility assessment, and synthesis of scientific evidence, thereby increasing the validity and credibility of the results of systematic reviews (Page et al., 2021). This article is organized into five main parts, namely an introduction that explains the background and gaps of the research, a research method that explains the PRISMA procedure and synthesis strategy, a research result that

presents the characteristics of the literature and thematic findings, a discussion that interprets the results based on theory and previous research, and a conclusion that contains conclusions, theoretical contributions, practical implications, and recommendations for further research. Thus, this article is expected to make a scientific contribution in the form of a synthesis of the latest evidence while offering a new conceptual framework that strengthens the professional development of teachers in Islamic education in the era of artificial intelligence (Tan et al., 2025).

2. Methods

This study uses the Systematic Literature Review (SLR) approach which follows the guidelines of Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) to identify, evaluate, and synthesize scientific evidence regarding the use of *Artificial Intelligence* in teacher professional development in the context of Islamic education. This approach was chosen because it provides a transparent, systematic, and replicable procedure in summarizing research developments while identifying knowledge gaps and future research directions.

The literature search process was carried out on five reputable international databases, namely Scopus, Web of Science, ERIC, ScienceDirect, and SpringerLink. The search uses a combination of Boolean operator-based keywords, such as (*"artificial intelligence" OR "generative AI" OR "AI in education"*) AND (*"teacher professional development" OR "teacher competence" OR "professional learning"*) AND (*"Islamic education" OR madrasah OR pesantren OR Islamic school*). The literature published between 2018 and 2026 is prioritized to represent the latest developments in the implementation of AI in education.

Article selection is carried out through four stages of PRISMA, namely identification, screening, eligibility, and inclusion (Page et al., 2021). The inclusion criteria include empirical research articles, conceptual studies, and *systematic reviews* published in reputable journals and explicitly discuss the relationship between AI, teacher professional development, digital competence, pedagogic innovation, or learning transformation in Islamic education and relevant educational contexts. Non-scientific articles, proceedings that do not go through *the peer review process*, double publications, and studies that are not directly related to the focus of the research are excluded from the analysis process.

All articles that met the criteria were extracted using a data extraction sheet that contained information about the author, year of publication, country of research, research design, level of education, type of AI technology used, teacher competencies developed, key findings, implementation challenges, and research recommendations. Furthermore, the data was analyzed through thematic synthesis to identify patterns of relationships between studies, dominant themes, research gaps, and opportunities for AI-based teacher professional development.

To increase the credibility of the synthesis results, the methodological quality of each article is evaluated using the Mixed Methods Appraisal Tool (MMAT) 2018, so that only articles that meet methodological quality standards are included in the final synthesis. The results of the analysis are then used to build the Future AI-Driven Teacher Professional Development Framework, which is a conceptual framework that explains the dimensions of pedagogic, professional, digital, ethical, and reflective competencies needed by teachers in integrating Artificial Intelligence effectively in the Islamic education environment. This framework is the main contribution of the research as well as offering a direction for teacher professional development that is relevant to the transformation of education in the digital era.

Furthermore, the proposed framework not only synthesizes existing empirical evidence but also identifies key research gaps that should guide future investigations on AI integration in Islamic education. It emphasizes the importance of contextualizing AI adoption within the values, pedagogical traditions, and ethical principles of Islamic educational institutions rather than relying solely on technological innovation. By integrating evidence-based professional development strategies with value-oriented educational practices, the framework provides practical guidance for policymakers, teacher educators, school leaders, and curriculum

developers in designing sustainable professional learning programs that enhance teachers' readiness, resilience, and responsible use of Artificial Intelligence in rapidly evolving educational contexts.

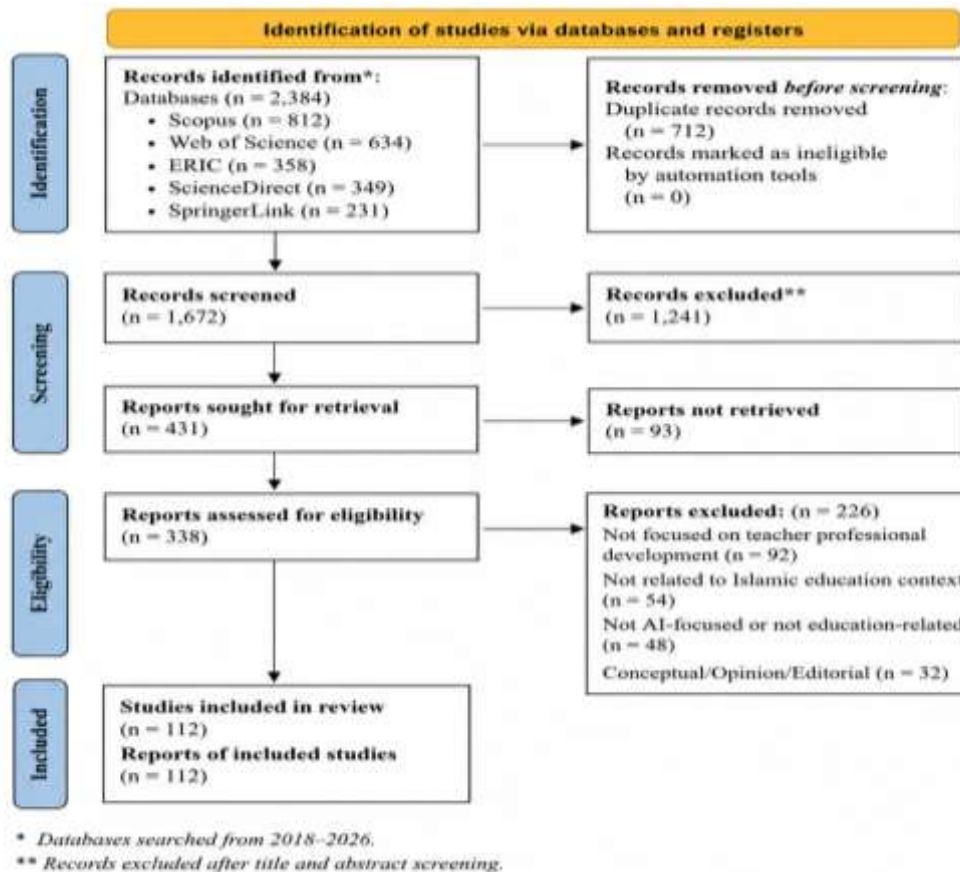


Figure 1. PRISMA Flow Diagram

Figure 1 presents the literature selection flow using the PRISMA 2020 (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines which describe the process of identification, screening, feasibility assessment, and determination of articles analyzed in the research in a systematic and transparent manner. The process began by identifying 2,384 articles from five international databases, namely Scopus, Web of Science, ERIC, ScienceDirect, and SpringerLink. After the removal of 712 duplicate articles, 1,672 articles were obtained that entered *the screening stage* based on titles and abstracts. At this stage, 1,241 articles were removed because they were not relevant to the focus of the research, leaving 431 articles for *the full-text retrieval process*. A total of 93 articles were not successfully obtained in full text, so 338 articles entered *the eligibility stage* to be thoroughly evaluated based on the inclusion and exclusion criteria that had been set.

Furthermore, 226 articles were issued because they did not focus on teacher professional development, were not related to the context of Islamic education, did not discuss the use of *Artificial Intelligence* in education, or were only conceptual and editorial articles without empirical evidence. Finally, 112 articles met all the criteria and were included in the systematic synthesis as the basis for the preparation of the Future Competency Framework for the professional development of teachers in artificial intelligence-based Islamic education. The selection flow shows that every decision in the review process is carried out objectively, documented, and can be replicated, thereby increasing transparency, methodological validity, and credibility of research findings in accordance with the PRISMA 2020 reporting standards recommended for *systematic literature review*.

3. Results and Discussion

Results

3.1 Results of Literature Selection Based on PRISMA 2020

Based on the literature identification process using the PRISMA 2020 guidelines, this study successfully identified 2,384 documents from five international databases, namely Scopus, Web of Science, ERIC, ScienceDirect, and SpringerLink. After removing 712 duplicate articles, a total of 1,672 articles entered the screening stage by title and abstract. Furthermore, 1,241 articles were eliminated because they were not in accordance with the research focus on the professional development of Artificial Intelligence-based teachers in Islamic education. The complete manuscript search stage resulted in 338 articles that were evaluated using inclusion and exclusion criteria, while 226 articles were excluded because they did not meet the scope of the study, did not present empirical evidence, or were only conceptual articles. In the end, 112 articles met all methodological requirements and were used as the basis for a thematic synthesis in this study. The selection process shows that the synthesis of evidence is carried out transparently, systematically, and can be replicated according to the guidelines of PRISMA 2020.

Table 1. Summary of Literature Selection Based on PRISMA 2020

Stages	Quantity
Records identified	2.384
Duplicate removed	712
Records screened	1.672
Records excluded	1.241
Full-text assessed	338
Full-text excluded	226
Studies included	112

Table 1 shows that only approximately 4.7% of all identified articles met all research criteria. This percentage indicates that research on AI-based teacher professional development in Islamic education remains relatively limited compared to general educational AI publications.

3.2 Characteristics of Included Studies

After the literature selection process based on the PRISMA 2020 guidelines, as many as 112 articles met all inclusion criteria and became the basis for the synthesis in this study. The analysis of the characteristics of the study was carried out to identify the development of publications, the tendency of research focus, and the dynamics of the development of studies on Artificial Intelligence (AI) in the professional development of teachers in the context of education, especially Islamic education. One of the characteristics analyzed is the distribution of articles by year of publication, since this indicator is able to describe the evolution of academic attention to research topics over time. The analysis of publication trends provides information about the development phase of the field of study, the period of increasing research intensity, and the momentum of the emergence of AI technology innovations that affect the direction of research. Various systematic studies show that publications on AI for teacher professional development have increased significantly after 2020, in line with the rapid digital transformation of education, the development of *Generative Artificial Intelligence*, and the increasing need for teachers for digital competence and AI literacy. Therefore, the distribution of articles by year of publication is an important indicator to understand the development of knowledge, identify emerging research directions, and explain the position of this research in enriching the literature on the professional development of AI-based teachers in the Islamic education environment.

Table 2. Distribution of Articles by Year of Publication

Year	Quantity
2018	4
2019	7
2020	11
2021	16
2022	20
2023	22

2024	18
2025–2026	14

Publications have experienced a consistent increase since 2020 with a peak in the 2022–2024 period. The increase indicates increasing academic attention to the use of Artificial Intelligence as a means of teacher professional development, especially after the development of Generative AI technology that accelerates digital learning innovation.

3.3 Distribution of Research by Region

An analysis of 112 articles that met the inclusion criteria showed that research on Artificial Intelligence (AI) for teacher professional development is spread across different regions of the world, although the distribution is not evenly distributed. The dominance of publications in the Asian region indicates high research investment, acceleration of digital transformation of education, and increasing attention to the development of AI-based teacher competencies, while contributions from Africa and Australia are still relatively limited, reflecting a geographical gap in knowledge production. This distribution pattern is in line with recent *systematic reviews* that report that most AI research in education originates from Asia, followed by Europe and North America, while studies focusing on Islamic education, particularly madrassas and Islamic boarding schools, still need to be strengthened through empirical research and cross-border collaboration.

Table 3. Regional Distribution

Region	n	%
Asia	45	40.2
Europe	24	21.4
North America	18	16.1
Middle East	13	11.6
Africa	7	6.3
Australia	5	4.4

Most of the research comes from Asia, showing that this region is at the center of the development of AI implementation in education. However, studies that specifically discuss madrasas, Islamic boarding schools, and Islamic education are still relatively few, so it opens up opportunities for further research.

3.4 Distribution by Educational Level

Analysis of the characteristics of the study by level of education shows that the implementation of Artificial Intelligence (AI) in the professional development of teachers has been applied at various levels of education, from elementary school to college, although with different levels of intensity. The dominance of research at the secondary school and tertiary levels indicates that these two levels are the most active environment in adopting AI to improve teacher competence, pedagogical innovation, and digital learning transformation, while research on madrasas and especially Islamic boarding schools is still relatively limited. These findings are in line with various *recent systematic reviews* that state that AI research in education is still dominated by the context of formal education, while the study of teacher professional development in Islamic educational institutions requires reinforcement through broader and contextual empirical research.

Table 4. Distribution of Education Levels

Levels	n
Elementary School	17
High School	34
Madrasah	23
Pesantren	9
College	29

The majority of research was conducted at the secondary school and college levels. On the other hand, research on pesantren is still very limited, so it is one of the important research gaps. These findings indicate the need for an expansion of research on madrasas and pesantren in order to obtain more comprehensive empirical evidence regarding the implementation of AI in teacher professional development that is in line with the characteristics, Islamic values, and contextual needs of Islamic educational institutions.

3.5 Types of Artificial Intelligence Used

The results of the synthesis of 112 articles show that the use of Artificial Intelligence (AI) technology in teacher professional development is very diverse, with an increasingly strong tendency to use Generative AI as the main technology in supporting learning planning, teaching material preparation, assessment, and pedagogic reflection. While *Intelligent Tutoring Systems*, *Machine Learning*, *Learning Analytics*, *Adaptive Learning*, and *AI Assessment* are also widely used, the rapid development of *large language models* such as ChatGPT, Gemini, and Claude has shifted the research orientation from specific AI systems to generative AI technologies that are more flexible, collaborative, and easily integrated into the professional practice of teachers. These findings are consistent with various *recent systematic reviews* that report that Generative AI is the most dominant AI technology in education research today because it is able to support teacher competency development, learning innovation, personalization of the learning process, and professional work efficiency, although its implementation still requires attention to ethical aspects, information accuracy, and governance of responsible use of AI.

Table 5. Types of Artificial Intelligence Used

Technology AI	Frequency
Generative AI (ChatGPT, Gemini, Claude)	38
Intelligent Tutoring System	24
Machine Learning	17
Learning Analytics	14
Adaptive Learning	10
AI Assessment	9

Generative AI is the most widely used technology in teacher professional development because it is able to support the preparation of learning tools, the development of teaching materials, the provision of feedback, and the reflection of learning quickly. This technological dominance shows a paradigm shift in teacher professional development towards more adaptive, personalized, and human-AI collaboration-based learning, thereby strengthening teachers' capacity to improve the quality of learning while maintaining the role of teachers as the main pedagogic decision-makers.

3.6 Developed Teacher Competencies

The results of the synthesis of 112 articles show that the development of teacher competencies through Artificial Intelligence (AI) not only focuses on improving technical abilities using technology, but also includes strengthening pedagogic, professional, reflective, research, and ethical competencies in the use of AI. The dominance of digital competence and pedagogical competence shows that the latest literature places digital literacy and the ability to integrate AI into learning strategies as the main foundation of teacher professional development, while ethical AI literacy, reflective practice, research competence, and intercultural competence are increasingly receiving attention as competencies that support the implementation of AI in a responsible and sustainable manner. These findings are in line with various systematic studies that affirm that the development of teachers' AI competencies must be multidimensional, integrating aspects of technology, pedagogy, professional learning, cultural values, and ethics so that teachers are able to utilize AI effectively without neglecting the professional role and human values in education.

Table 6. Developed Teacher Competencies

Competence	Frequency
Digital Competence	87
Pedagogical Competence	75
Professional Competence	63
Ethical AI Literacy	48
Reflective Practice	44
Research Competence	36
Intercultural Competence	28

Digital competence is the most dominant dimension, followed by pedagogic and professional competence. In contrast, AI ethical competencies and reflective practices still receive lesser attention, despite both being important aspects of responsible AI implementation.

3.7 Main Themes of the Synthesis

A thematic analysis of 112 articles that met the inclusion criteria identified seven main themes that consistently illustrate the direction of research development on Artificial Intelligence (AI) in teacher professional development. These themes show that AI is not only used to improve teachers' digital competence, but also plays a role in encouraging pedagogical innovation, personalized learning, administrative efficiency, strengthening sustainable professional development, inclusive learning, and the importance of ethical governance in AI implementation. These findings are in line with various *recent systematic reviews* that affirm that the direction of AI research in education has shifted from mere technology adoption to the development of teacher competencies that are holistic, centered on teacher agency, and supported by ethical frameworks and sustainable professional learning.

Table 7. Themes Synthesis

Theme	Number of Studies
AI improves teachers' digital competence	71
AI supports pedagogic innovation	66
AI strengthens personalized learning	58
AI improves administrative efficiency	52
AI requires ethical governance	49
AI strengthens sustainable professional development	46
AI supports inclusive learning	34

Thematic analysis shows that AI is no longer positioned as a technological tool, but is evolving into an ecosystem that supports the continuous improvement of teacher competence. However, various studies confirm that the effectiveness of AI implementation is still influenced by teachers' digital readiness, institutional support, education policies, and ethical governance.

3.8 Future AI-Driven Teacher Professional Development Framework

Based on a thematic synthesis of 112 articles that met the inclusion criteria, this study formulated the Future AI-Driven Teacher Professional Development Framework as a major conceptual contribution that integrates various empirical findings regarding teacher professional development in the era of artificial intelligence. This framework shows that effective teacher professional development no longer only relies on improving pedagogic and digital competencies, but must also integrate continuous professional learning, ethical AI governance, reflective practices, and the internalization of Islamic values so that the use of AI remains oriented towards character building, moral responsibility, and learning quality. These findings expand on existing teacher professional development models by offering a multidimensional framework that places AI as a support for pedagogic decision-making and teacher capacity building, in line with various *systematic review* studies that emphasize the importance of developing a holistic, *human-centered*, and ethically responsible AI competency framework in educational contexts.

Table 8. AI-Driven Teacher Professional Development Framework

Dimensions	Synthesis Results
Pedagogical Innovation	AI supports adaptive learning design
Digital Competence	Mastery of AI is a core competency of teachers
Professional Learning	Professional development takes place continuously
Ethical Governance	AI privacy, transparency, and accountability
Reflective Practice	AI supports learning evaluation and reflection
Islamic Values Integration	Integration of AI with Islamic values

The synthesis of 112 articles resulted in the Future AI-Driven Teacher Professional Development Framework, which is a conceptual framework that places teachers' professional development on six main dimensions: pedagogic innovation, digital competence, continuous professional learning, AI ethical

governance, reflective practices, and the integration of Islamic values. This framework is the main conceptual contribution of the research as well as providing direction for policy development, teacher training, and the implementation of AI in Islamic education in a sustainable manner.

Discussion

The results of the synthesis of 112 articles show that the use of Artificial Intelligence (AI) has shifted the paradigm of teacher professional development from a periodic training model to a continuous, adaptive, and data-based professional learning (Katsarou, 2026). These findings explicitly answer the research formulation that AI is no longer positioned just as a learning support tool, but as an ecosystem that facilitates the continuous improvement of teachers' pedagogic, professional, digital, reflective, and ethical competencies (Khurma et al., 2026; Meylani, R., 2024; Zou et al., 2025). This process can be seen from the dominance of research that discusses the use of Generative AI, learning analytics, intelligent tutoring systems, and adaptive learning as instruments to design learning, compile assessments, provide feedback, and evaluate teaching practices more effectively (Bouguettaya et al., 2025; Weng et al., 2024). These findings are in line with the results of a recent systematic review that has so far focused more on the implementation of AI in the classroom than on teacher professional development, so there is still a great need to build a professional development model that is integrated with AI (Mah et al., 2026; Mouta et al., 2024).

The research findings were obtained through systematic synthesis using the PRISMA 2020 guidelines which allowed the process of identification, screening, feasibility evaluation, and synthesis of articles to be carried out transparently and can be replicated. Of the 2,384 publications identified in five international databases, only 112 articles met all the inclusion criteria and thus became the basis for the preparation of the thematic synthesis. A rigorous selection process resulted in a body of evidence that has high relevance to the research focus, namely AI-based teacher professional development in the context of education, including Islamic education (Doğan et al., 2025). This approach improves the validity of the synthesis because each article is evaluated based on topic suitability, methodological quality, and empirical contribution before being included in the analysis. This principle is in line with the recommendations of PRISMA 2020 which emphasizes the transparency of the selection process and the interpretation of results based on the overall available evidence (Page et al., 2021).

The results of the study show that AI strengthens the concept of continuous professional development, which is the development of teacher competencies as a process that lasts throughout the professional career (Trevisan et al., 2024; Li et al., 2025). Unlike conventional training, which generally takes place separately and periodically, AI allows teachers to obtain real-time learning support through individual needs analysis (Nasution, 2026), learning resource recommendations, automated feedback, and data-driven reflection (Barrera Castro et al., 2024; Luo et al., 2025; Seo et al., 2024). These findings reinforce the theory of *Professional Learning* developed by Darling-Hammond and various OECD studies on the importance of professional learning centered on teaching practices, collaboration, and continuous reflection. In this context, AI serves as a facilitator that accelerates the learning process of teachers without replacing their professional role as pedagogical decision-makers. Thus, AI plays the role of *professional augmentation* rather than *professional replacement*, so that human competence remains at the core of the education process (Ali, M., 2025; Gordon et al., 2024; Haroud et al., 2025).

The results of this study reinforce previous studies that reported that AI makes a real contribution to improving digital competence, administrative efficiency, personalization of learning, and the quality of pedagogic decision-making (Suryanarayana et al., 2024). However, this synthesis also shows that there is a considerable gap in the literature. Most research still focuses on the use of AI to improve student learning, while research on AI as a teacher professional development instrument is still relatively limited. This is consistent with the findings of a recent systematic review that shows that the proportion of research on AI for teacher professional development is much smaller than research on AI for the learning process (Li et al., 2025; Tammets et al., 2023). In addition, there is still very little research that specifically discusses the context of

madrassas, pesantren, and Islamic education, which opens up space for more contextual empirical research in the future (Abdullah, 2017).

A synthesis of literature shows that the implementation of AI in Islamic education has different characteristics compared to general education. Teachers' professional development is not only directed at improving pedagogic and digital competencies, but also at the ability to integrate technology with Islamic values, ethics, and student character formation (Musri et al., 2023; Saraya et al., 2023). Therefore, the success of AI implementation in madrassas and pesantren is not enough to be measured through improving learning efficiency, but also through the ability of teachers to maintain a balance between technological innovation (Zahra et al., 2023), moral formation, and Islamic educational goals (Jumaidah et al., 2026; Yugo, 2025). These findings expand on the perspective of previous research by positioning AI as an instrument that must operate within a framework of values, moral responsibility, and benefits, not just as a technological innovation.

The main contribution of this research is the development of the Future AI-Driven Teacher Professional Development Framework, which is a conceptual framework that modifies the conventional teacher professional development model by integrating six main dimensions, namely digital competence, pedagogical innovation, professional learning, ethical AI governance, reflective practice, and Islamic values integration. In contrast to the previous model which focused more on pedagogic and professional competencies, this framework places AI literacy, ethical governance, and the integration of Islamic values as core components of teacher professional development in the digital era (Ayanwale et al., 2024; Biagini, G., 2025; Daher, R., 2025). Thus, this study not only synthesizes the available empirical evidence, but also offers the development of theories in the form of conceptual models that can be used as a basis for policy design, teacher training curriculum (Cholil, M. C. A., 2025), as well as subsequent empirical research on AI-based teacher professional development in the context of Islamic education. These findings are also in line with the direction of cutting-edge research that encourages the development of *AI-based teacher professional development* programs that maintain teacher agency, personalized learning, and ethical governance as the foundation of educational technology implementation (Kelley, 2025).

4. Conclusion

This study concludes that Artificial Intelligence (AI) has developed into one of the main drivers of the transformation of teacher professional development in Islamic education. Based on a systematic synthesis of 112 articles selected using the PRISMA 2020 guidelines, this study answers the formulation of the problem by showing that AI contributes significantly to the improvement of digital competence, pedagogic innovation, continuous professional learning, reflective practice, and teacher learning efficiency. However, the effectiveness of AI implementation is still influenced by various challenges, such as low AI literacy, limited digital infrastructure, ethical issues, data protection, and suboptimal policy and institutional support. These findings reinforce the results of previous research that stated that AI has great potential in supporting teacher learning and professional development, but research on AI that is specifically oriented towards teacher professional development, especially in the context of Islamic education, is still relatively limited and requires greater attention.

This research also makes a theoretical contribution through the development of the Future AI-Driven Teacher Professional Development Framework, which integrates six main dimensions, namely digital competence, pedagogic innovation, professional learning, AI ethical governance, reflective practices, and the integration of Islamic values as the foundation of teacher professional development in the era of artificial intelligence. The framework expands on the existing model of teacher professional development by positioning AI as a means that strengthens teachers' capacity and agency, rather than replacing their role in the educational process. From a practical perspective, the results of this research can be a reference for the government, educational institutions, and teacher training providers in designing AI-based professional development programs that are sustainable, contextual, and ethical. Further research is suggested to test this conceptual framework through empirical studies on madrasah in the context of Islamic education.

5. References

- Abdullah, M. A. (2017). Islamic studies in higher education in Indonesia: Challenges, impact and prospects for the world community. *Al-Jami'ah: Journal of Islamic Studies*, 55(2), 391-426. <https://doi.org/10.14421/ajis.2017.552.391-426>
- Adiyono, A., Al Matari, A. S., Patimah, L., & AS, A. A. N. (2025). Can AI-Optimized YouTube Videos Enhance Islamic Religious Education? A Quantitative Study on Student Learning Outcomes. *Jurnal Pendidikan Agama Islam*, 22(1), 175-194. <https://doi.org/10.14421/jpai.v22i1.11100>
- Adiyono, A., Hendawi, M., Sholeh, M., Sain, Z. H., AlBadawi, H., & Fuadiy, M. R. (2026). Human-AI Collaboration in Combatting Digital Fraud in Education: Strengthening Academic Integrity, Ethical Values, and Cybersecurity in Higher Education. In *Safeguarding Educational Integrity Through Deepfake Face Detection* (pp. 385-410). IGI Global Scientific Publishing. <https://doi.org/10.4018/979-8-3373-3770-8.ch017>
- Adiyono, A., Jasiah, J., Ritonga, M., & Al-Matari, A. S. (2024). ChatGPT and active learning: A new paradigm for student participation in the classroom. In *Empowering Digital Education with ChatGPT* (pp. 189-209). Chapman and Hall/CRC. <https://doi.org/10.70376/r2ajk953>
- Ahmad, Z. A. (2025). The Role of Artificial Intelligence in Enhancing Pedagogical Methods in Modern Islamic Education. *Journal of Hunan University Natural Sciences*. <https://doi.org/10.55463/issn.1674-2974.52.6.9>
- Ali, M. (2025). The Role of AI in Reshaping Medical Education: Opportunities and Challenges. *The Clinical Teacher*, 22. <https://doi.org/10.1111/tct.70040>
- Aljemely, Y. (2024, October). Challenges and best practices in training teachers to utilize artificial intelligence: a systematic review. In *Frontiers in Education* (Vol. 9, p. 1470853). Frontiers Media SA. <https://doi.org/10.3389/feduc.2024.1470853>
- Asal, M. G. R., Alsenany, S., Elzohairy, N., & El-Sayed, A. (2025). The impact of digital competence on pedagogical innovation among nurse educators: The moderating role of artificial intelligence readiness.. *Nurse education in practice*, 85, 104367. <https://doi.org/10.1016/j.nepr.2025.104367>
- Ayanwale, M. A., Adelana, O. P., Molefi, R. R., Adeeko, O., & Ishola, A. (2024). Examining artificial intelligence literacy among pre-service teachers for future classrooms. *Computers and Education Open*. <https://doi.org/10.1016/j.caeo.2024.100179>
- Barrera Castro, G. P., Chiappe, A., Becerra Rodríguez, D. F., & Sepúlveda, F. (2024). Harnessing AI for Education 4.0: Drivers of Personalized Learning. *Electronic Journal of e-Learning*. <https://doi.org/10.34190/ejel.22.5.3467>
- Bauer, E., Greiff, S., Graesser, A., Scheiter, K., & Sailer, M. (2025). Looking Beyond the Hype: Understanding the Effects of AI on Learning. *Educational Psychology Review*, 37. <https://doi.org/10.1007/s10648-025-10020-8>
- Biagini, G. (2025). Towards an AI-Literate Future: A Systematic Literature Review Exploring Education, Ethics, and Applications. *International Journal of Artificial Intelligence in Education*, 35, 2616 - 2666. <https://doi.org/10.1007/s40593-025-00466-w>
- Bond, M., Khosravi, H., De Laat, M., Bergdahl, N., Negrea, V., Oxley, E., Pham, P., Chong, S. W., & Siemens, G. (2024). A meta systematic review of artificial intelligence in higher education: a call for increased ethics, collaboration, and rigour. *International Journal of Educational Technology in Higher Education*, 21, 1-41. <https://doi.org/10.1186/s41239-023-00436-z>
- Bouguettaya, S., Pupo, F., Chen, M., & Fortino, G. (2025). A Meta-Survey of Generative AI in Education: Trends, Challenges, and Research Directions. *Big Data Cogn. Comput.*, 9, 237. <https://doi.org/10.3390/bdcc9090237>
- Chee, H., Ahn, S., & Lee, J. (2024). A Competency Framework for AI Literacy: Variations by Different Learner Groups and an Implied Learning Pathway. *Br. J. Educ. Technol.*, 56, 2146-2182. <https://doi.org/10.1111/bjet.13556>

- Cholil, M. C. A. (2025). Improving Learning Outcomes through the Problem Based Learning Model in Islamic Education Subjects in Elementary Schools. *Research Journal on Teacher Professional Development*, 3(01), 59-67. <https://doi.org/10.21580/rjtpd.v3i01.24854>
- Daher, R. (2025). Integrating AI literacy into teacher education: a critical perspective paper. *Discover Artificial Intelligence*, 5. <https://doi.org/10.1007/s44163-025-00475-7>
- Doğan, S., Nalbantoglu, U. Y., Çelik, I., & Dogan, N. A. (2025). Artificial intelligence professional development: a systematic review of TPACK, designs, and effects for teacher learning. *Professional Development in Education*, 51, 519 - 546. <https://doi.org/10.1080/19415257.2025.2454457>
- Garzón, J., Patiño, E., & Marulanda, C. (2025). Systematic Review of Artificial Intelligence in Education: Trends, Benefits, and Challenges. *Multimodal Technol. Interact.*, 9, 84. <https://doi.org/10.3390/mti9080084>
- Giannakos, M. N., Azevedo, R., Brusilovsky, P., Cukurova, M., Dimitriadis, Y., Leo, D. H., Järvelä, S., Mavrikis, M., & Rienties, B. (2024). The promise and challenges of generative AI in education. *Behaviour & Information Technology*, 44, 2518 - 2544. <https://doi.org/10.1080/0144929x.2024.2394886>
- Gordon, M., Daniel, M., Ajiboye, A., Uraiby, H., Xu, N. Y., Bartlett, R., Hanson, J., Haas, M., Spadafore, M. T., Grafton-Clarke, C., Gasiea, R. Y., Michie, C., Corral, J., Kwan, B., Dolmans, D., & Thammasitboon, S. (2024). A scoping review of artificial intelligence in medical education: BEME Guide No. 84. *Medical Teacher*, 46, 446 - 470. <https://doi.org/10.1080/0142159x.2024.2314198>
- Haroud, S., & Saqri, N. (2025). Generative AI in Higher Education: Teachers' and Students' Perspectives on Support, Replacement, and Digital Literacy. *Education Sciences*. <https://doi.org/10.3390/educsci15040396>
- Islam, A., Reksiana., Nata, A., Rosyada, D., Dinia, M., Rahiem, H., & Ugli, A. R. R. (2024). Digital Extension of Digital Literacy Competence for Islamic Religious Education Teachers in the Era of Digital Learning. *Jurnal Pendidikan Agama Islam*. <https://doi.org/10.14421/jpai.v21i2.9719>
- Jumaidah, M., Adiyono, A., & Zahra, N. (2026). Toward a Value-Based Digital Religious Literacy Framework: Contextualizing Akidah-Akhlak in the Digital Era. *Nuris Journal of Education and Islamic Studies*, 6(1), 201-211.
- Katsarou, D. V., & Angelidou, A. A. (2026). The Impact of ADHD on Children's Language Development. *Children*, 13. <https://doi.org/10.3390/children13020206>
- Kelley, M. J., & Wenzel, T. (2025). Advancing Artificial Intelligence Literacy in Teacher Education Through Professional Partnership Inquiry. *Education Sciences*. <https://doi.org/10.3390/educsci15060659>
- Khurma, O. A., Ali, N., Almarashdi, H., Fidalgo, P., Alarabi, K., & Alkhalaileh, H. (2026). Sustainable AI Integration in Teacher Education: From Personalised Learning to Signature Pedagogies. *Education Sciences*. <https://doi.org/10.3390/educsci16050786>
- Li, K., Wang, P., & Chen, G. (2025). How can AI be integrated into teacher professional development programs? A systematic review based on an adapted technology-based learning model. *Teaching and Teacher Education*, 168, 105219. <https://doi.org/10.1016/j.tate.2025.105219>
- López-Meneses, E., López-Catalán, L., Pelicano-Piris, N., & Mellado-Moreno, P. C. (2025). Artificial Intelligence in Educational Data Mining and Human-in-the-Loop Machine Learning and Machine Teaching: Analysis of Scientific Knowledge. *Applied Sciences*. <https://doi.org/10.3390/app15020772>
- Luo, J., Zheng, C., Yin, J., & Teo, H. (2025). Design and assessment of AI-based learning tools in higher education: a systematic review. *International Journal of Educational Technology in Higher Education*, 22. <https://doi.org/10.1186/s41239-025-00540-2>

- Mah, D.-K., Groß, N., Egloffstein, M., & Prilop, C. N. (2026). Artificial intelligence in K-12 instruction: the role of teacher professional development. *Smart Learning Environments*, 13. <https://doi.org/10.1186/s40561-026-00442-4>
- Meylani, R. (2024). Artificial Intelligence in the Education of Teachers: A Qualitative Synthesis of the Cutting-Edge Research Literature. *Journal of Computer and Education Research*. <https://doi.org/10.18009/jcer.1477709>
- Mouta, A., Torrecilla-Sánchez, E. M., & Pinto-Llorente, A. M. (2024). Comprehensive professional learning for teacher agency in addressing ethical challenges of AIED: Insights from educational design research. *Education and Information Technologies*, 30, 3343 - 3387. <https://doi.org/10.1007/s10639-024-12946-y>
- Musri, N. A., & Adiyono, A. (2023). Kompetensi Guru Mata Pelajaran Fiqih dalam Meningkatkan Keunikan Belajar. *Jurnal Ilmu Manajemen dan Pendidikan*, 3(1), 33-42. <https://doi.org/10.30872/jimpian.v3i1.2203>
- Nasution, I., & Adiyono, A. (2026). Educational Management Before, During, and After Covid-19: A Prisma-Based Statistical Systematic Literature Review. *Manajeria: Jurnal Ilmu Manajemen Pendidikan*, 5(01), 81-97. <https://doi.org/10.52431/manajeria.v5i01.4552>
- Papakostas, C. (2025). Artificial Intelligence in Religious Education: Ethical, Pedagogical, and Theological Perspectives. *Religions*. <https://doi.org/10.3390/rel16050563>
- Posangi, S. S., Lundeto, A., Labaso, S., Anwar, H., & Damopolii, M. (2025). Enhancing Islamic Education Quality through Educational Supervision and ICT. *Jurnal Ilmiah Peuradeun*. <https://doi.org/10.26811/peuradeun.v13i2.1955>
- Ren, X., & Wu, M. (2025). Examining Teaching Competencies and Challenges While Integrating Artificial Intelligence in Higher Education. *TechTrends*, 69, 519 - 538. <https://doi.org/10.1007/s11528-025-01055-3>
- Rosmini, H., Ningsih, N., Murni, M., & Adiyono, A. (2024). Transformasi Kepemimpinan Kepala Sekolah pada Era Digital: Strategi Administrasi Pendidikan Berbasis Teknologi di Sekolah Menengah Pertama. *Konstruktivisme: Jurnal Pendidikan dan Pembelajaran*, 16(1), 165-180. <https://doi.org/10.35457/konstruk.v16i1.3451>
- Rudolph, J., Ismail, F. M. M., & Popenici, S. A. D. (2024). Higher Education's Generative Artificial Intelligence Paradox: The Meaning of Chatbot Mania. *Journal of University Teaching and Learning Practice*. <https://doi.org/10.53761/54fs5e77>
- Saraya, A., Mardhatillah, A., Fitriani, E. N., & Adiyono, A. (2023). The role of islamic religious education teachers: problems in evaluating student learning outcomes in junior high schools. *Dharmas Education Journal (DE Journal)*, 4(2), 565-572. <https://doi.org/10.56667/dejournal.v4i2.1060>
- Seo, K., Yoo, M., Dodson, S., & Jin, S.-H. (2024). Augmented teachers: K-12 teachers' needs for artificial intelligence's complementary role in personalized learning. *Journal of Research on Technology in Education*, 57, 876 - 893. <https://doi.org/10.1080/15391523.2024.2330525>
- Sperling, K., Stenberg, C.-J., McGrath, C., Åkerfeldt, A., Heintz, F., & Stenliden, L. (2024). In search of artificial intelligence (AI) literacy in Teacher Education: A scoping review. *Computers and Education Open*. <https://doi.org/10.1016/j.caeo.2024.100169>
- Suryanarayana, K. S., Kandi, V. P., Pavani, G., Rao, A. S., Rout, S., & Krishna, T. S. R. (2024). Artificial intelligence enhanced digital learning for the sustainability of education management system. *The Journal of High Technology Management Research*, 35(2), 100495. <https://doi.org/10.1016/j.hitech.2024.100495>
- Tammets, K., & Ley, T. (2023). Integrating AI tools in teacher professional learning: a conceptual model and illustrative case. *Frontiers in artificial intelligence*, 6, 1255089. <https://doi.org/10.3389/frai.2023.1255089>
- Tan, X., Cheng, G., & Ling, M. H. (2025). Artificial intelligence in teaching and teacher professional development: A systematic review. *Computers and Education: Artificial Intelligence*, 8, 100355. <https://doi.org/10.1016/j.caeai.2024.100355>

- Topali, P., Haelermans, C., Molenaar, I., & Segers, E. (2025). Pedagogical considerations in the automation era: A systematic literature review of AIEd in K-12 authentic settings. *British Educational Research Journal*. <https://doi.org/10.1002/berj.4200>
- Trevisan, O., Christensen, R., Drossel, K., Friesen, S., Forkosh-Baruch, A., & Phillips, M. (2024). Drivers of Digital Realities for Ongoing Teacher Professional Learning. *Technology, Knowledge and Learning*, 29, 1851 - 1868. <https://doi.org/10.1007/s10758-024-09771-0>
- Weng, X., Xia, Q., Gu, M., Rajaram, K., & Chiu, T. (2024). Assessment and learning outcomes for generative AI in higher education: A scoping review on current research status and trends. *Australasian Journal of Educational Technology*. <https://doi.org/10.14742/ajet.9540>
- Yan, L., Greiff, S., Teuber, Z., & Gašević, D. (2024). Promises and challenges of generative artificial intelligence for human learning. *Nature Human Behaviour*, 8, 1839 - 1850. <https://doi.org/10.1038/s41562-024-02004-5>
- Yue, M., Jong, M., & Ng, D. (2024). Understanding K–12 teachers' technological pedagogical content knowledge readiness and attitudes toward artificial intelligence education. *Education and Information Technologies*, 29, 19505 - 19536. <https://doi.org/10.1007/s10639-024-12621-2>
- Yugo, T. (2025). Improving the quality of islamic education through pesantren-based management in indonesia. *Journal of Educational Research and Practice*, 3(2), 238-254. <https://doi.org/10.70376/jerp.v3i2.357>
- Zahra, I. A. F., Suja, M. A. R., Dinata, V. C., Naufal, I. M., & Anbiya, B. F. (2023). Analysis of differentiated learning using learning technology based on discovery learning model in elementary school. *Research Journal on Teacher Professional Development*, 1(2), 160-168. <https://journal.walisongo.ac.id/index.php/rjtpd/article/view/18399>
- Zhai, X. (2024). Transforming Teachers' Roles and Agencies in the Era of Generative AI: Perceptions, Acceptance, Knowledge, and Practices. *Journal of Science Education and Technology*, 34, 1323 - 1333. <https://doi.org/10.1007/s10956-024-10174-0>
- Zou, D., Xie, H., & Kohnke, L. (2025). Navigating the Future: Establishing a Framework for Educators' Pedagogic Artificial Intelligence Competence. *European Journal of Education*. <https://doi.org/10.1111/ejed.70117>