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Forms of artificial intelligence (ai) utilization in physical education learning: a systematic literature review

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ABSTRACT

Background. The advancement of Artificial Intelligence (AI) has transformed Physical Education (PE) learning into a more interactive, personalized, data-driven process. However, studies mapping AI utilization and its contributions to PE learning remain limited. **Objectives.** This study aimed to examine, analyze, and synthesize various forms of AI utilization in PE learning through a Systematic Literature Review (SLR). **Method.** The review followed PRISMA guidelines and employed the PICO framework to formulate research questions and select relevant studies. A total of 10 scientific articles were selected through purposive sampling based on predefined inclusion and exclusion criteria. Data were collected through document analysis from Scopus and Google Scholar using the Publish or Perish application and analyzed through thematic synthesis. **Results.** The findings identified five major forms of AI utilization in PE learning: movement analysis, real-time feedback, automated assessment, AI-based learning media, and physical fitness monitoring. These applications enhanced motor skills, learning motivation, student engagement, assessment objectivity, and instructional effectiveness, indicating that AI supports more effective and technology-enhanced learning environments. **Conclusion.** In conclusion, AI has significant potential to improve PE learning quality through interactive, personalized, and evidence-based instructional practices. This study contributes by providing a comprehensive mapping of AI utilization and insights for PE development.

Key words: Artificial intelligence; physical education; systematic literature review.

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INTRODUCTION

Physical Education (PE) is an integral part of education that aims to develop students' physical abilities, motor skills, cognitive competencies, social skills, and affective attributes through planned and meaningful physical activities (Dapp et al., 2021). Beyond improving physical fitness and movement competence, PE contributes to character development, healthy lifestyle promotion, critical thinking, teamwork, and lifelong engagement in physical activity (Martín-Rodríguez & Madrigal-Cerezo, 2025). As education continues to evolve in the digital era, PE is expected to adapt to technological advancements that support more effective, interactive, and student-centered learning experiences. Consequently, the integration of emerging technologies, particularly AI, has become increasingly relevant in enhancing teaching and learning processes in PE (Wang & Wang, 2024).

Despite its important role, PE learning faces several contemporary challenges (Gunawan et al., 2023; Suniga et al., 2025). Declining levels of physical activity among children and adolescents, limited opportunities for individualized instruction, and increasing demands for digital transformation have become major concerns in PE (Wang & Wang, 2024). Furthermore, movement skill assessment often relies on teachers' subjective observations, while large class sizes, limited instructional time, diverse student abilities, and difficulties in monitoring physical activity continuously may reduce learning effectiveness (Bofill et al., 2025; Lee & Lee, 2021). Learning practices also frequently depend on conventional teaching resources, despite the potential of digital technologies to enrich learning experiences and improve student engagement (Ndhanni & Ridwan, 2025). These challenges highlight the need for innovative approaches that provide objective movement analysis, real-time feedback, personalized learning opportunities, and continuous performance monitoring (Cui et al., 2025). In this regard, AI offers significant potential through automated assessment, fitness monitoring, data-driven decision-making, and instant feedback capabilities that can improve the quality and effectiveness of PE learning (Kadhim et al., 2025).

Recent studies have demonstrated the potential of AI in PE through various applications. For example, Ma et al. (2025) reported that AI-based real-time feedback improved students' motor skills, learning interest, and learner autonomy. Similarly, Oshanova et al. (2025) found that an AI-driven real-time exercise monitoring system enabled joint tracking, instant feedback, and injury prevention. In addition, Chen (2025) showed that the integration of deep learning and wearable technology provided a scalable and objective assessment system capable of delivering immediate feedback to learners. These findings suggest that AI can enhance motor skill development, learning motivation, student engagement, and instructional effectiveness in PE learning (Kadhim et al., 2025; Kim et al., 2026). Collectively, these studies indicate that AI can support movement analysis, real-time feedback, objective assessment, and personalized learning, thereby enhancing the effectiveness of PE instruction (Lan & Zhou, 2025; Wan et al., 2025).

However, most existing studies focus primarily on the development, validation, or implementation of specific AI technologies within particular learning contexts, such as movement analysis, fitness monitoring, or automated assessment (Martín-Rodríguez & Madrigal-Cerezo, 2025; Wang & Wang, 2024; Zhang, 2025). While these studies have demonstrated the effectiveness of AI applications in improving various learning outcomes, limited attention has been given to systematically synthesizing and categorizing the diverse forms of AI utilization and their educational contributions across different PE learning settings and educational levels (Tan et al., 2025; Zhong et al., 2025; Zhu et al.,

2026). Furthermore, previous studies have generally examined AI applications separately, resulting in a fragmented understanding of how AI collectively contributes to teaching, learning, assessment, and student engagement in PE (Garzón et al., 2025; Lin et al., 2025). Consequently, there is a need for a comprehensive review that provides a broader understanding of research trends, implementation strategies, and the educational implications of AI in PE (Long et al., 2026; Niu et al., 2026).

This review is important because it offers both theoretical and practical contributions. Theoretically, it enriches the scientific literature by providing a comprehensive synthesis of AI utilization in PE learning and identifying key patterns of implementation across existing studies (Garzón et al., 2025; Lin et al., 2025). Practically, it provides valuable insights for teachers, researchers, and policymakers in developing innovative, effective, and technology-enhanced learning environments (Athaya et al., 2023; Ebrahim & Hussein, 2025; Yusroni, 2024). Unlike previous studies that focused on individual AI applications or specific educational contexts, this review systematically maps the forms, functions, and educational contributions of AI in PE learning (Tohănean et al., 2025; Wang & Wang, 2024). Therefore, the novelty of this study lies in identifying and synthesizing five major forms of AI utilization in PE learning—movement analysis, real-time feedback, automated assessment, AI-based learning media, and physical fitness monitoring—while providing an integrated understanding of their educational contributions across different learning contexts and educational levels. Based on this background, the present study addresses the following research question: "What are the forms of Artificial Intelligence (AI) utilization in PE learning?" Accordingly, this study aims to conduct a Systematic Literature Review (SLR) to examine, analyze, and synthesize various forms of AI utilization in PE learning and to provide a comprehensive overview of AI implementation for improving the quality and effectiveness of PE learning.

METHOD

Search Strategy

This study uses a SLR method to identify, analyze, and synthesize research findings related to the use of AI in PE learning. The SLR method was chosen because it can provide a comprehensive, systematic, and transparent overview of research developments on a specific topic through the process of identifying, selecting, evaluating, and synthesizing relevant literature (Calderon Martinez et al., 2025).

Research Procedures

In the process of compiling research questions, the author used the PICO method. The PICO method is a research framework used to formulate research questions in a structured manner based on the components (P) Population, (I) Intervention, (C) Comparison, and (O) Outcome, thus facilitating the process of searching and selecting literature in a systematic review. PICO is one of the most well-known and efficient ways to formulate research questions (Hosseini, 2024).

Table 1. PICO method

Aspect	Description
P (Population/Problem)	The need for innovation in PE learning through the integration of AI technology in the digital era.
I (Intervention)	The implementation of AI in PE learning processes at elementary and secondary school levels.
C (Comparison)	The implementation of AI in PE learning at the higher education/university level.
O (Outcome)	Identification of the forms, benefits, and implementation of AI in PE learning.

The literature search was conducted using the Publish or Perish (PoP) application through the Google Scholar and Scopus databases to identify articles relevant to the research topic. The search was limited to articles published between 2016 and 2026. The search strategy employed a combination of the following keywords: ("Artificial Intelligence" OR "AI" OR "Machine Learning") AND ("Physical Education" OR "Physical Education Learning" OR "PE") AND ("School" OR "Elementary School" OR "Secondary School"). These keywords were adapted to the characteristics of each database to ensure the retrieval of articles aligned with the objectives of the study. The search results were subsequently screened according to the predetermined inclusion and exclusion criteria.

Assessment Criteria

After determining the PICO framework, the next stage was data extraction. At this stage, the authors applied the inclusion and exclusion criteria to screen the articles, ensuring that the selected data were more specific and relevant to the research objectives. Articles that did not meet the established criteria were excluded from the review process (Carrera-rivera et al., 2022).

Table 2. Inclusion and exclusion criteria

Type	Inclusion Criteria	Exclusion Criteria
Article Type	Research articles published in scientific journals	Theses, dissertations, conference proceedings, opinion papers, and non-scientific articles

Language	Articles published in Indonesian and English	Articles published in languages other than Indonesian and English
Participants/Subjects	Elementary school students, junior high school students, senior high school students, and university students	Participants other than elementary school, junior high school, senior high school, and university students.
Publication Year	Articles published between 2016 and 2026	Articles published before 2016
Research Focus	Studies discussing the use, application, or implementation of AI in PE learning	Studies that do not discuss AI or only discuss multimedia/e-learning without AI technology
Research Variables	The utilization or implementation of AI in PE learning in schools and higher education institutions/universities	The implementation of AI in fields other than PE learning or at educational levels outside schools and higher education institutions/universities
Research Scope	Formal educational settings in schools	Non-formal contexts such as sports clubs, athlete training programs, or fitness centers
Outcomes	Studies that explain the forms, functions, benefits, or implementation of AI in PE learning	Studies that do not explain the implementation or utilization of AI in the context of PE learning

Screening

Furthermore, this study utilized the PRISMA guidelines during the article selection process. PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) is a framework designed to assist researchers in reporting the systematic review process in a transparent and structured manner (Pielken et al., 2021). In practice, PRISMA is commonly presented as a flow diagram illustrating the sequential stages of article selection throughout the review process. These stages include identification, which involves locating relevant articles from various databases; screening, which refers to filtering articles based on predetermined criteria; eligibility, which involves assessing the suitability of articles in relation to the research objectives; and included, which represents the final set of articles selected for inclusion in the review (Page et al., 2021).

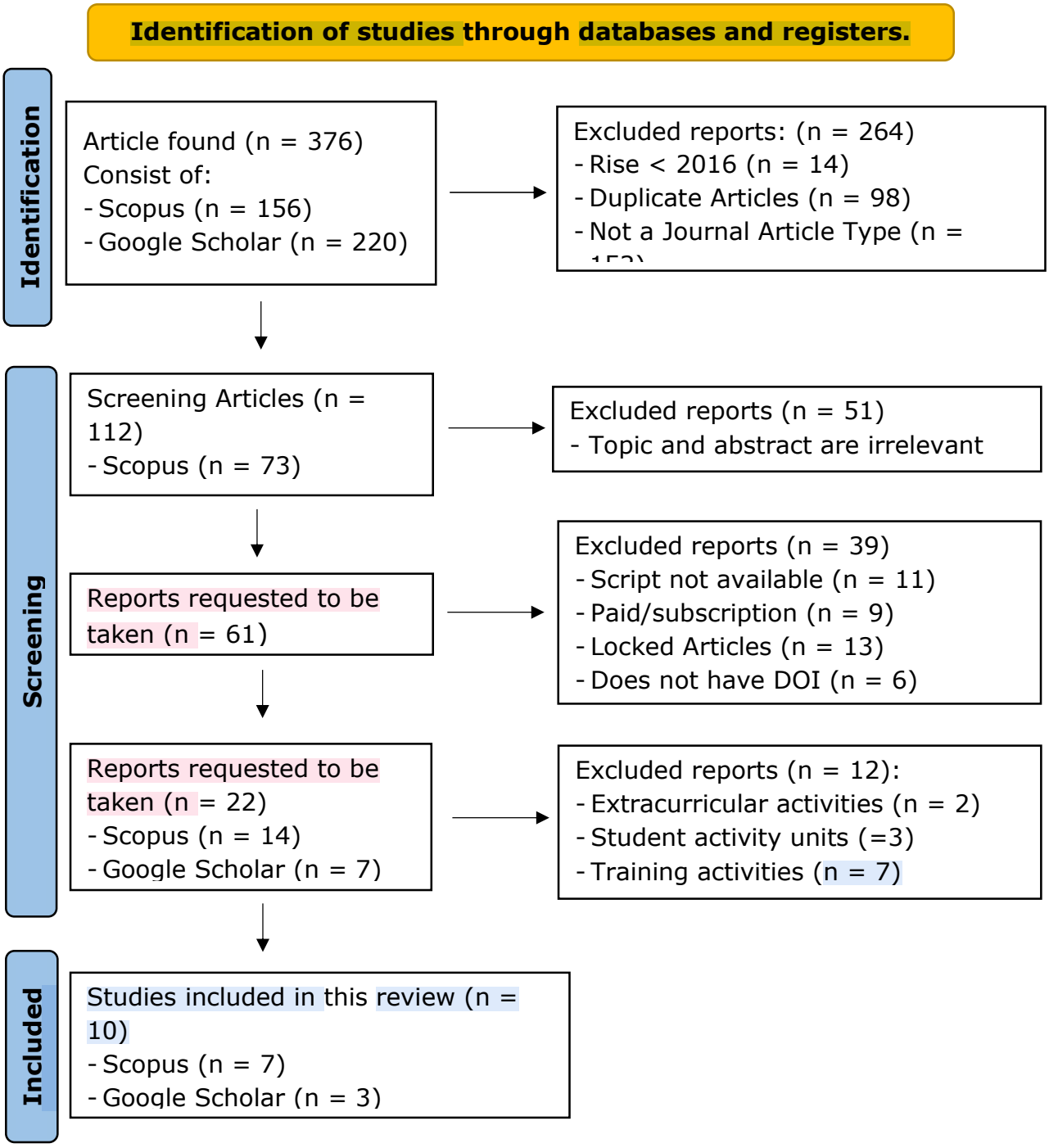

Figure 1. PRISMA flow diagram

FINDINGS AND DISCUSSIONS

Findings

The characteristics of the articles obtained through the PRISMA selection process showed that 10 articles (n = 10) met the inclusion criteria. These articles were published between 2016 and 2026, appearing in reputable national and international journals, consisting of 3 national journals and 7 international

journals. The research designs included experimental studies (n = 5), quasi-experimental design (n = 1), action research (n = 2), qualitative research (n = 1), and mixed-method research (n = 1). The research participants were varied and included elementary school students, coaches, teachers, and pre-service teachers (education students).

Table 3. Summary of selected studies (included articles)

No	Author (Year) & Location	Research Design	Sample	Research Focus	Key Findings
1	(Yau et al., 2026), Taiwan	Action Research	31 University Students	Human Pose Estimation (HPE)	Improved analytical skills.
2	(Kim et al., 2026), South Korea	Participatory Action Research	5 Teachers & 5 Students	AI-based MediaPipe	Enabled precise biomechanical analysis.
3	(Shekerbekova et al., 2025), Kazakhstan	Experimental	120 University Students	AI and Augmented Reality (AR) Technology	Increased motivation, injury prevention, and movement analysis through pose estimation.
4	(Ma et al., 2025), China	Experimental	70 University Students	Real-Time Feedback Pose Recognition	Improved motor skills, learning interest, and learner autonomy.
5	(Oshanova et al., 2025), Kazakhstan	Experimental	80 University Students	Real-Time Exercise Monitoring System (PoseNet)	Enabled joint tracking, instant feedback, and injury prevention.
6	(Chen, 2025), China	Experimental	100 Students	Deep Learning (DL) and Wearable Technology	Provides an objective, scalable assessment system with instant feedback.
7	(Park et al., 2025), South Korea	Experimental	40 Students	AI-FIT	Improved health-related physical fitness, including flexibility, muscular endurance, cardiorespiratory

					endurance, power, and Physical Activity Promotion System (PAPS) scores.
8	(Butsiarah et al., 2025), Indonesia	Descriptive Statistics and Qualitative Analysis	120 University Students	AI Avatar-Based Digital Media (D-ID AI Avatars in Canva)	Created a more dynamic learning environment and increased learner engagement.
9	(Ndhanni et al., 2025), Indonesia	Quantitative and Qualitative Methods (Mixed Methods)	112 Students	Artificial Intelligence-Based Learning Videos	Increased students' motivation and enjoyment in Physical Education learning.
10	(Jamaludin, 2025), Indonesia	Quasi-Experimental Design	60 Students	AI Motion Analyzer 2.0 Based on Pose Estimation Algorithm	Significantly improved students' technical accuracy compared to conventional methods. The AI system provided data-driven movement analysis that helped students identify and correct technical errors more quickly.

Table 4. Thematic Synthesis

Theme of Findings	Number of Studies	Summary of Findings	General Implications
Movement Analysis	4 studies	Human Pose Estimation (HPE), MediaPipe, AI-Augmented Reality (AI-AR), and AI Motion Analyzer	Enhanced biomechanical analysis
Real-Time Feedback	3 studies	Real-time pose recognition feedback, Real-Time Exercise Monitoring System	Improved motor skills, learning interest, learner autonomy, instant

		(PoseNet), and AI Educational Robots	feedback, and injury prevention.
Automated Assessment	1 study	Deep Learning (DL) and Wearable Technology	Provides objective, scalable assessment systems with instant feedback.
Learning Media	1 study	D-ID AI Avatars in Canva and Artificial Intelligence-Based learning videos	Created enjoyable learning environments and increased student motivation.
Data-Driven Monitoring	1 study	AI-FIT	Improved health-related physical fitness monitoring and evaluation.

Table 5. The implementation of AI in pe learning processes at elementary and secondary school levels (intervention)

No	Theme of Findings	Type of AI	Author	Title	Benefits/Findings
1	Movement Analysis	AI-Based MediaPipe	(Kim et al., 2026)	*Development and Implementation of a MediaPipe-Based AI Teaching-Learning Model in School Physical Education for Health Promotion*	Enabled precise biomechanical analysis.
		AI Motion Analyzer	(Jamaludin, 2025)	*The Effectiveness of Artificial Intelligence-Based Sports Learning on the Technical Accuracy and Movement Consistency of High School Students*	Improved movement analysis, technical accuracy, and movement consistency.
2	Automated Assessment	Deep Learning (DL) & Wearable Technology	(Chen, 2025)	*Integrating Deep Learning and Wearable Technology for Real-Time, Scalable, and Objective Physical*	Provides an objective, scalable, and real-time assessment system.

				Education Assessment	
3	Data-Driven Monitoring	AI-FIT	(Park et al., 2025)	*Effectiveness of a Digital Game-Based Physical Activity Program (AI-FIT) on Health-Related Physical Fitness in Elementary School Children*	Improved health-related physical fitness, including flexibility, muscular endurance, cardiorespiratory endurance, power, and Physical Activity Promotion System (PAPS) scores.
4	AI-Based Learning Media	Artificial Intelligence-Based Learning Videos	(Ndhanni et al., 2025)	*The Utilization of Artificial Intelligence-Based Learning Videos to Enhance Students' Motivation and Enjoyment*	Improving Students' Motivation and Enjoyment in Physical Education Learning

Table 6. The implementation of AI in pe learning at the higher education/university level (comparison)

No	Theme of Findings	Type of AI	Author	Title	Benefits/Findings
1	Real-Time Feedback	Real-Time Feedback Pose Recognition	(Ma et al., 2025)	*A Practical Study of Artificial Intelligence-Based Real-Time Feedback in Online Physical Education Teaching*	Improved motor skills, learning interest, and learner autonomy.
		Real-Time Exercise Monitoring System (PoseNet)	(Oshanova et al., 2025)	*Assessing the Efficacy of an Artificial Intelligence-Driven Real-Time Exercise Monitoring System in Computer-Supported Collaborative Learning*	Enabled joint tracking, instant feedback, and injury prevention.

		AI and Augmented Reality (AR) Technology	(Shekerbekova et al., 2025)	*Exploring the Use of Artificial Intelligence and Augmented Reality Tools to Improve Interactivity in Physical Education Teaching and Training Methods*	Increased motivation, injury prevention, and movement analysis through pose estimation.
2	Movement Analysis	Human Pose Estimation (HPE)	(Yau et al., 2026)	*Leveraging Human Pose Estimation for Diagnostic Feedback: Action Research on Instructional Mediation and Sustainable Learning in Coach Education*	Improved analytical skills and diagnostic movement analysis.
3	AI-Based Learning Media	AI Avatar-Based Digital Media (D-ID AI Avatars in Canva)	(Butsiarah et al., 2025)	*Implementation of D-ID AI Avatars in Canva as a Sports Learning Medium*	This media has been shown to foster a more dynamic learning environment and enhance students' engagement in the learning process.

Synthesis of Similarities and Differences in Findings. The synthesis of findings revealed several common patterns across the reviewed studies. Based on the SLR results, most studies indicated that the implementation of AI in PE learning enhances learning effectiveness through movement analysis, automated assessment, and real-time feedback. Technologies such as MediaPipe, PoseNet, Human Pose Estimation (HPE), and AI-based learning videos were found to improve motor skills, learning motivation, and student engagement. Furthermore, nearly all studies reported that AI supports more interactive, objective, and data-driven PE learning, with teachers serving as facilitators in the integration and utilization of educational technology.

Differences in findings were observed in the focus of AI implementation across educational levels. At the elementary and secondary school levels, AI was primarily utilized to enhance learning motivation, physical fitness, and basic movement analysis through relatively simple technologies such as AI-based

learning videos and AI-FIT. In contrast, at the higher education/university level, AI was more frequently employed for real-time feedback, biomechanical analysis, and complex movement monitoring using technologies such as PoseNet and Human Pose Estimation (HPE). These findings suggest that the application of AI tends to become more sophisticated and specialized as the educational level increases.

Table 7. Synthesis of similarities and differences in findings

Aspect	Consistent Studies	Divergent Studies	Explanation of Divergence
Movement Analysis	(Kim et al., 2026), (Jamaludin Jamaludin, 2025), (Yau et al., 2026)	(Ndhanni et al., 2025)	Most studies employed AI-based pose estimation technologies for movement analysis, whereas Ndhanni et al. (2025) utilized AI-based learning videos.
Real-Time Feedback	(Ma et al., 2025), (Oshanova et al., 2025)	(Park et al., 2025)	Real-time feedback studies focus on immediate movement correction, whereas AI-FIT focuses primarily on physical fitness improvement.
AI-Based Learning Media	(Butsiarah et al., 2025), (Ndhanni et al., 2025)	(Shekerbekova et al., 2025)	AI avatars and learning videos were mainly used to enhance learning motivation, whereas AI and AR technologies were primarily used to improve learning interactivity.

Summary of Findings, The SLR findings indicate that AI in PE learning is implemented through various applications, including movement analysis, real-time feedback, automated assessment, AI-based learning media, and physical fitness monitoring. The use of AI has been shown to improve learning motivation, motor skills, student engagement, and the overall effectiveness of PE learning. Overall, AI demonstrates significant potential as an innovative approach to PE instruction by supporting more interactive, objective, and technology-driven learning environments.

Discussion

Findings related to the movement analysis theme reveal that technologies such as Human Pose Estimation (HPE), MediaPipe, and AI Motion Analyzer assist in biomechanical analysis and the assessment of students' movement techniques. These findings are consistent with constructivist learning theory, which emphasizes active learning experiences through direct feedback,

interaction, and learner engagement during the learning process. This perspective is further supported by (Do et al., 2023), who highlighted the importance of feedback and learner participation in technology-enhanced learning environments. Similar findings have also been reported in European contexts. Bofill et al. (2025) highlighted that AI-supported movement analysis and automated assessment systems can improve learning effectiveness and provide more objective evaluation processes in PE. Likewise Martín-Rodríguez and Madrigal-Cerezo (2025) emphasized that AI technologies facilitate personalized instruction and data-driven decision-making, enabling teachers to better monitor students' progress and adapt learning activities to individual needs.

Regarding the real-time feedback theme, the use of PoseNet and AI-based exercise monitoring systems has been shown to improve motor skills, learning interest, and learner autonomy. In addition, AI-based learning media such as AI avatars and AI-generated learning videos have been found to enhance students' motivation and engagement in PE learning. These findings are also supported by (Xue et al., 2026), who reported that students' perceptions of AI usefulness and ease of use positively influenced learning motivation and engagement. Similar trends have also been identified in European countries, where AI-powered feedback systems, wearable technologies, and intelligent monitoring tools are increasingly being integrated into PE to support personalized learning, physical activity monitoring, and student engagement (Bofill et al., 2025; Martín-Rodríguez & Madrigal-Cerezo, 2025).

The findings also revealed the importance of automated assessment and physical fitness monitoring in supporting learning effectiveness. AI-based assessment systems enable more objective, efficient, and data-driven evaluations of students' performance, reducing subjectivity in traditional assessment practices (Chen, 2025). Similarly, AI-supported fitness monitoring technologies allow continuous tracking of students' physical activity and fitness levels, providing valuable information for personalized instruction and health promotion. These findings are aligned with previous studies demonstrating that wearable technologies and AI-driven analytics can improve assessment accuracy, support individualized feedback, and enhance students' participation in physical activity programs (Chen, 2025; Martín-Rodríguez & Madrigal-Cerezo, 2025).

Collectively, these findings indicate that AI can support movement analysis, real-time feedback, automated assessment, AI-based learning media, and physical fitness monitoring, thereby enhancing the effectiveness of PE instruction. Evidence from both Asian and European contexts suggests that AI is becoming an important driver of innovation in PE learning (Bofill et al., 2025; Wang & Wang, 2024; Webber et al., 2026; Zhong et al., 2025), supporting the

transition from traditional teacher-centered approaches toward more data-driven, learner-centered, and technology-enhanced educational environments (Zhu et al., 2026). This convergence of findings across different geographical contexts indicates that AI integration in PE is not merely a regional trend but a global educational transformation aimed at improving learning quality, assessment accuracy, and student engagement (Tan et al., 2025; Zhong et al., 2025; Zhu et al., 2026).

Most studies reported that AI has a positive impact on PE learning, particularly in improving learning effectiveness, student motivation, and movement skills (Huang et al., 2026; Wu, 2025). AI-based technologies also support more interactive and data-driven learning environments (Zhang, 2025). However, differences were observed in the focus of AI implementation. At the elementary and secondary school levels, AI is primarily used to enhance learning motivation, physical fitness, and basic movement analysis through relatively simple technologies such as AI-based learning videos and AI-FIT (Miller et al., 2025). In contrast, at the higher education level, AI is more commonly utilized for real-time feedback, biomechanical analysis, and complex movement monitoring through technologies such as PoseNet and Human Pose Estimation. These differences suggest that AI implementation tends to become more sophisticated as educational levels increase, reflecting variations in learning objectives, technological readiness (Zhang, 2025), and assessment demands across educational contexts (Tohănean et al., 2025; Wang & Wang, 2024).

The review findings indicate that AI has significant potential to support more modern and interactive innovations in PE learning. Therefore, PE teachers need to improve their competence in using AI technologies to make learning more effective and aligned with the demands of digital education. In addition, schools should provide adequate technological infrastructure and learning resources to support the implementation of AI in PE learning (Zhong et al., 2025; Zhu et al., 2026).

Limitations

This study has several limitations that should be acknowledged. First, the review included only articles published in Indonesian and English between 2016 and 2026, which may have excluded relevant studies published in other languages or outside the selected time frame. Second, the literature search was limited to Scopus and Google Scholar databases through the Publish or Perish application, potentially restricting the breadth of available evidence from other academic databases such as Web of Science, ERIC, PubMed, and SPORTDiscus. Third, the reviewed studies varied considerably in terms of educational level, research design, AI technology, and learning context, which may affect the generalizability of the findings. Therefore, the results of this review should be

interpreted with caution, as they represent the available evidence within the defined scope and selection criteria rather than the entirety of AI-related research in PE learning.

Future studies are recommended to examine the long-term effectiveness of AI in PE learning across a wider range of educational levels and educational contexts. Future research may also focus on the development of AI-based learning models, motor skills assessment systems, personalized learning approaches, and the integration of constructivist learning theory with technology-enhanced learning frameworks. Practically, PE teachers are encouraged to adopt AI technologies as innovative learning tools to improve students' motivation, motor skills, and engagement. Schools are expected to provide facilities, technological infrastructure, and training programs to support the effective implementation of AI-based learning. Furthermore, governments and educational institutions should establish policies and guidelines for AI implementation in PE learning, while teacher education programs should integrate digital literacy and AI competencies into their curricula to enhance the preparedness of future PE teachers in the digital era. Future SLR studies are also encouraged to utilize additional academic databases and search engines beyond Scopus and Google Scholar to ensure broader and more comprehensive literature coverage.

CONCLUSION

Based on the findings of this SLR, it can be concluded that the implementation of AI in PE learning takes various forms, including movement analysis, real-time feedback, automated assessment, AI-based learning media, and physical fitness monitoring. The use of AI has been shown to enhance learning effectiveness, motor skills, learning motivation, student engagement, and the objectivity and interactivity of assessment processes. Therefore, AI has significant potential as an innovative approach to PE learning, supporting the transformation of education toward more technology-driven and digitally integrated learning environments. From a practical perspective, the findings suggest that PE teachers can utilize AI technologies to provide more personalized instruction, objective assessment, and meaningful learning experiences, while schools should support AI implementation through adequate technological infrastructure and professional development programs. Theoretically, this study contributes to the existing literature by providing a comprehensive synthesis of five major forms of AI utilization in PE learning and highlighting their educational contributions across different learning contexts and educational levels. Future research is recommended to investigate the long-term effectiveness of AI implementation, develop AI-based learning models and assessment systems,

and explore the integration of AI across diverse educational levels and learning environments to further support innovation in PE.

AUTHOR CONTRIBUTION STATEMENT

The first author, JP, was fully responsible for the manuscript and for managing the research process. AA assisted with the research search and the inclusion and exclusion criteria. JC assisted in the final data analysis and was responsible for interpreting the results.

AI DISCLOSURE STATEMENT

The author states that no AI was used in the completion of this manuscript.

CONFLICTS OF INTEREST

No conflict of interest.