

ARTIFICIAL INTELLIGENCE-BASED TECHNOLOGIES IN PHYSICAL EDUCATION: IMPACT ON TEACHING, TRAINING AND ASSESSMENT

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Abstract

The present study examined the role and impact of Artificial Intelligence (AI)-based technologies in Physical Education, with particular emphasis on teaching, sports training and assessment. The study was undertaken in response to the rapid development of digital-intelligent technologies and their increasing application in educational and sports settings. A descriptive and analytical research approach based on systematic examination of recent empirical and review literature was adopted. Published studies concerning AI, digital technologies, physical education, teaching, training, movement analysis, assessment, personalised learning and technology adoption were critically examined. The evidence indicated that AI-based technologies had contributed to lesson planning, personalised learning, movement analysis, real-time feedback, physical fitness monitoring, performance analysis and more objective assessment. A systematic review of 85 empirical studies published between 2014 and 2024 reported that digital-intelligent technologies had been integrated across different stages of physical education, including instructional design, real-time process visualisation, data-driven evaluation and feedback. Another systematic review of 65 peer-reviewed studies published between 2020 and 2025 reported positive outcomes of AI-supported physical education, particularly in learning efficiency and motivation. However, limitations related to teacher competence, infrastructure, data privacy, algorithmic accuracy, digital inequality and ethical use were also identified. The study concluded that AI-based technologies had significant potential to strengthen physical education by making teaching more personalised, training more data-informed and assessment more systematic. Nevertheless, AI was found to be more appropriate as a support system for teachers and coaches rather than as a substitute for professional judgement. Effective implementation required adequate infrastructure, continuous professional development, institutional support, ethical safeguards and responsible data management.

Keywords: Artificial Intelligence, Physical Education, Digital Technology, Teaching, Sports Training, Assessment, Personalised Learning, Technology Adoption etc.

1. Introduction

Physical Education has traditionally focused on movement, physical fitness, motor-skill development, sports participation, health promotion and holistic development. The increasing integration of digital technologies has gradually transformed these conventional processes. Artificial Intelligence has further expanded this transformation by enabling systems to analyse information, identify patterns, provide feedback and support decision-making.

The present study was developed within the conceptual framework of the doctoral research synopsis concerning the use, impact, opportunities and challenges of Artificial Intelligence and modern technology in Physical Education. The original research framework identified teaching, training, assessment, sports performance, technology acceptance and implementation challenges as important dimensions. It also recognised teachers, coaches and students as the principal stakeholders in the technological transformation of Physical Education. Recent research has demonstrated that AI is no longer

limited to experimental applications in Physical Education. It has increasingly been associated with intelligent instructional design, movement analysis, real-time feedback, adaptive learning, physical fitness monitoring and data-driven assessment. A systematic review of 85 empirical studies published between January 2014 and November 2024 found that digital-intelligent technologies had been adopted across different stages of Physical Education. The present study examined AI-based technologies not as isolated technological tools but as components of a broader transformation of Physical Education teaching, sports training and assessment.

2. Need and Significance of the Study

The integration of AI into Physical Education had become increasingly important because conventional teaching and training approaches were often dependent on direct observation and periodic assessment. AI-supported systems could provide continuous information concerning movement, performance and learning. This created possibilities for more individualised instruction, timely feedback and evidence-based decision-making. The

significance of the study was further strengthened by the research gap identified in the doctoral synopsis. Although research on digital education, ICT, e-learning and sports analytics had expanded, comprehensive research examining the combined effects of AI on physical performance, sports performance, teaching quality, training systems and assessment remained limited. The synopsis also identified a shortage of integrated studies examining teachers, coaches and students together, particularly in the Maharashtra and Marathwada context.

The study was therefore significant from educational, technological, professional and policy perspectives. It provided an organised understanding of how AI could support Physical Education while simultaneously identifying the conditions necessary for responsible and effective implementation.

3. Objectives of the Study

- To examine the major applications of Artificial Intelligence-based technologies in Physical Education teaching.
- To analyse the contribution of AI-based technologies to sports training, performance monitoring and skill development.
- To examine the role of AI in assessment, feedback and evaluation of Physical Education and sports performance.
- To identify the major technological, pedagogical, infrastructural, economic and ethical challenges associated with the implementation of AI in Physical Education.
- To examine the opportunities offered by AI for improving the quality, efficiency and personalisation of Physical Education.
- To formulate educational and practical recommendations for the responsible integration of AI-based technologies into Physical Education.

4. Research Questions-

- How were AI-based technologies being applied in Physical Education teaching?
- In what ways did AI contribute to sports training and performance analysis?
- How did AI-based technologies influence assessment and feedback?
- What major challenges restricted the effective implementation of AI in Physical Education?
- What institutional and professional conditions were required for sustainable AI integration?

5. Research Methodology:

5.1 Research Approach and Design- A descriptive and analytical research approach was adopted. The study was completed through

systematic examination, comparison and interpretation of published research concerning Artificial Intelligence and technology in Physical Education. This approach was consistent with the broader research framework of the doctoral synopsis, which had identified descriptive and survey-based research as the principal methodological orientation and had proposed the use of quantitative and qualitative evidence.

5.2 Sources of Information- Information was obtained from peer-reviewed research articles, systematic reviews and scholarly publications concerning AI and digital technologies in Physical Education. Particular attention was given to recent literature published between 2020 and 2026, while earlier foundational studies were considered where necessary.

The reviewed evidence included systematic reviews, empirical studies of Physical Education teachers and students, and research concerning AI adoption, digital competence, movement analysis, personalised learning and assessment.

5.3 Analytical Procedure-

The selected literature was organised under five analytical dimensions:

- AI applications in teaching
- AI applications in sports training
- AI-supported assessment
- Educational and professional benefits
- Implementation barriers and ethical challenges

The findings were then compared and synthesised to identify common patterns, areas of agreement and areas requiring further investigation.

6. Review of Related Literature

Recent literature showed a clear movement from general digital technology towards AI-supported Physical Education. Bofill, Pla-Campas and Sebastiani (2025) conducted a systematic review of research published between 2019 and 2024 and examined the contribution of AI to learning in Physical Education. Their review indicated that AI was becoming an emerging educational resource within the discipline.

Zhong et al. (2025) reviewed 85 empirical studies published between 2014 and 2024. The review showed that digital-intelligent technologies had been applied throughout the Physical Education process, including intelligent instructional design, real-time process visualisation and data-driven evaluation and feedback. The review also identified algorithmic accuracy, data privacy and unequal access to digital resources as major challenges.

Tohanean et al. (2025) examined the integration of AI and ICT in Physical Education and reported benefits related to personalised learning, real-time

feedback, motivation, inclusion and objective assessment of motor performance. At the same time, the study identified inadequate infrastructure, insufficient teacher training and personal-data protection as significant implementation concerns.

A recent systematic review by Wan and Zhang examined 35 studies concerning AI for teaching and learning in Physical Education. The review identified lesson planning, movement analysis, assessment, feedback, personalised learning and teacher professional development as important AI applications. It further indicated that AI was generally positioned as a support mechanism for teachers rather than as a replacement for teachers' instructional decisions.

Suniga's systematic literature review of 10 scientific studies identified five major forms of AI utilisation in Physical Education: movement analysis, real-time feedback, automated assessment, AI-based learning media and physical fitness monitoring. These applications were associated with improvements in motor skills, motivation, engagement, assessment objectivity and instructional effectiveness.

7. Analysis of AI-Based Technologies in Physical Education

Table 1: Major Applications of AI-Based Technologies in Physical Education

No.	Application area	Major educational or sporting function
1	Intelligent teaching	Lesson planning and instructional support
2	Personalised learning	Individualised learning pathways
3	Movement analysis	Analysis of body movement and technique
4	Real-time feedback	Immediate information regarding performance
5	Sports training	Training planning and performance monitoring
6	Physical fitness monitoring	Continuous monitoring of fitness-related indicators
7	Assessment	Data-supported and relatively objective assessment
8	Sports analytics	Performance analysis and decision support

The literature indicated that AI applications had extended across almost the entire Physical Education process. Rather than being restricted to a single classroom function, AI had increasingly been used for planning, instruction, monitoring, feedback and assessment. This supported the view that AI was becoming part of an integrated Physical Education ecosystem.

8. Impact on Teaching

AI-based technologies had contributed to changes in Physical Education teaching by enabling personalised learning, instructional assistance, digital learning resources and timely feedback. Teachers could use technology-supported information to identify differences in students' performance and modify instruction accordingly. A survey of 265 Physical Education teachers found widespread interest in using digital technology. Teachers identified learning and assessment, physical activity, teaching support, communication and teamwork as important reasons for technology integration.

Table 2: Evidence Concerning the Impact of AI and Digital Technologies on Teaching

Evidence	Sample / studies	Major finding
Zhong et al. (2025)	85 empirical studies	Intelligent instructional design and data-driven feedback were major applications
Wan & Zhang	35 studies	Lesson planning, feedback, personalised learning and professional development were identified
Saiz-González et al.	265 PE teachers	Teachers demonstrated considerable interest in digital technology integration
Suniga	10 studies	AI supported personalised and technology-enhanced learning

The evidence suggested that AI had the potential to shift Physical Education teaching from a predominantly teacher-centred model towards a more personalised and data-informed model. Nevertheless, professional judgement remained essential because technological outputs required pedagogical interpretation.

9. Impact on Sports Training

Sports training had emerged as another important area of AI application. Movement-analysis systems, wearable devices, video analysis and intelligent monitoring could provide information concerning technique, movement patterns, training performance and physical condition. The reviewed literature indicated that AI could support coaches by identifying patterns that might not be easily detected through unaided observation. It could also facilitate continuous monitoring and assist in modifying training according to individual performance.

Table 3: Major Contributions of AI to Sports Training

Dimension	Contribution
Performance monitoring	Continuous recording and analysis of performance
Movement analysis	Identification of movement patterns and technical errors
Training planning	Data-supported individual training decisions
Skill development	Feedback concerning technical execution
Fitness monitoring	Monitoring of physical-condition indicators
Performance evaluation	Comparison of performance over time

Recent reviews have particularly emphasised movement analysis, physical fitness monitoring and real-time feedback as important AI applications in Physical Education and sports. AI-based training systems had the potential to make sports training more individualised, systematic and evidence-based. However, technological analysis could not fully replace the contextual knowledge and professional judgement of coaches.

10. Impact on Assessment

Assessment represented one of the strongest potential applications of AI in Physical Education. Conventional assessment often depended on teacher observation, periodic testing and manually recorded performance. AI-supported assessment could provide additional information through movement analysis, video interpretation, automated scoring and continuous monitoring. The systematic review by Zhong et al. demonstrated that data-driven evaluation and feedback formed an important part of the emerging digital-intelligent Physical Education framework.

Table 4: AI-Supported Assessment in Physical Education

Assessment component	AI-supported function
Motor performance	Analysis of movement quality
Skill execution	Identification of technical performance
Physical fitness	Continuous performance monitoring
Learning progress	Comparison of performance over time
Feedback	Immediate performance-related information
Evaluation	Support for relatively objective assessment

The reviewed evidence therefore indicated that AI could strengthen assessment by increasing the availability of performance information. However, automated assessment should be interpreted carefully because algorithmic accuracy, contextual

differences and data quality could influence the results.

11. Quantitative Evidence from Recent Literature

A 2025 systematic review of 65 peer-reviewed studies published between 2020 and 2025 reported that AI applications were particularly associated with learning efficiency and motivation. The review reported positive outcomes in 90% of the included studies, while learning efficiency accounted for 38.5% and motivation for 32.3% of the reported outcomes.

Table 5: Selected Quantitative Evidence from Recent Research

Indicator	Reported evidence
Studies reviewed by Zhong et al.	85
Studies using machine-learning approaches	49
Studies specifying particular algorithms	41
Studies reviewed by the 2025 AI teaching review	65
Studies reporting positive outcomes	90%
Studies reporting learning-efficiency outcomes	38.5%
Studies reporting motivation-related outcomes	32.3%

In the 85-study review, 49 studies used machine-learning approaches, indicating that approximately 57.6% of the reviewed studies incorporated machine-learning techniques. Forty-one studies specified particular algorithms, representing approximately 48.2% of the total. These findings demonstrated that computational methods had become a substantial component of the emerging AI research landscape in Physical Education.

12. Factors Affecting AI Adoption

AI adoption was not determined solely by the availability of technology. Teacher competence, perceived usefulness, institutional support, infrastructure, professional development, ethical awareness and data-security concerns influenced implementation. Research involving Physical Education teachers demonstrated substantial interest in digital technology, but barriers remained. These included limitations in infrastructure, professional preparation and practical implementation. Research specifically examining AI implementation in Physical Education identified three broad categories of factors: personal factors, Physical-Education-specific factors and systemic factors. Technological proficiency, willingness to adapt, curriculum adaptation, professional development and institutional support were identified as important considerations.

Table 6: Major Factors Influencing AI Adoption

Factor	Expected influence on adoption
Digital competence	Enables effective use of AI tools
Perceived usefulness	Encourages willingness to adopt
Ease of use	Reduces resistance to technology
Professional development	Builds confidence and competence
Institutional support	Facilitates sustained implementation
Infrastructure	Provides technical conditions for use
Data security	Influences trust in AI systems
Ethical awareness	Supports responsible use
Financial resources	Determines accessibility
Curriculum compatibility	Supports pedagogical integration

13. Challenges in AI Implementation

Despite its potential benefits, AI integration in Physical Education presented several challenges. The first was technological inequality. Institutions with limited infrastructure could not provide the same opportunities as technologically advanced institutions. The second challenge concerned teacher competence. Without appropriate professional development, teachers could find it difficult to select, interpret and use AI-generated information. Data privacy represented another important concern because AI-based systems could process personal and performance-related information. Algorithmic accuracy was also significant because inaccurate outputs could affect assessment and training decisions. The systematic review by Zhong et al. specifically identified algorithmic accuracy, data privacy and unequal digital access as important implementation barriers.

Table 7: Major Challenges in AI-Based Physical Education

No.	Challenge	Nature of challenge
1	Inadequate infrastructure	Technical
2	Lack of teacher training	Professional
3	Digital inequality	Social and institutional
4	Data privacy	Ethical and legal
5	Algorithmic accuracy	Technical
6	Financial constraints	Economic
7	Resistance to change	Organisational
8	Excessive dependence on technology	Pedagogical
9	Limited institutional policy	Administrative
10	Ethical use of AI	Professional and social

14. Discussion

The findings demonstrated that AI-based technologies had moved beyond experimental use and had increasingly become relevant to different components of Physical Education. Teaching benefited primarily through personalised learning, instructional support and real-time feedback. Sports training benefited through movement analysis, performance monitoring and data-supported training decisions. Assessment benefited through automated or semi-automated analysis and the availability of continuous performance information. These findings were consistent with recent systematic reviews. Zhong et al. identified intelligent instructional design, real-time visualisation and data-driven evaluation as major components of digital-intelligent Physical Education. Similarly, Tohanean et al. reported benefits in personalised learning, real-time feedback, motivation, inclusion and assessment. The findings also supported the position that AI should be treated as an assistive technology rather than as a replacement for teachers and coaches. The review by Wan and Zhang specifically indicated that AI was intended to support teachers while instructional decisions remained a human responsibility. The discussion further indicated that technological innovation without professional preparation could not ensure effective implementation. Teacher competence, infrastructure, institutional support and ethical safeguards were therefore not secondary considerations but essential conditions for successful AI integration.

15. Major Findings of the Study-

- AI-based technologies had been increasingly integrated into Physical Education teaching, training and assessment.
- Personalised learning, movement analysis, real-time feedback, physical fitness monitoring and data-supported assessment emerged as major application areas.
- AI had the potential to improve the efficiency and personalisation of Physical Education teaching.
- AI-supported systems had strengthened the possibility of systematic sports-performance monitoring and movement analysis.
- AI had created opportunities for more continuous and information-based assessment.
- Recent literature reported generally positive educational outcomes, particularly in learning efficiency and motivation.
- Teacher competence and professional development emerged as critical factors in successful AI implementation.

- h. Infrastructure limitations and unequal access to digital technologies remained significant barriers.
- i. Data privacy, algorithmic accuracy and ethical use represented major concerns.

16. Educational and Practical Implications

The findings had several implications for Physical Education. First, teacher education and professional development programmes needed to include AI literacy, digital competence, data interpretation and ethical use of technology. Second, universities and colleges needed to strengthen digital infrastructure so that AI-supported teaching and training could be implemented equitably. Third, assessment systems could incorporate AI-supported tools where appropriate, while maintaining human supervision. Fourth, sports departments could explore AI-assisted movement analysis, performance monitoring and personalised training. Finally, institutions needed clear policies concerning data protection, responsible AI use and academic integrity.

17. Limitations of the Study

The study was based primarily on published research and therefore did not claim to represent the responses of a particular group of teachers, coaches or students. The findings were dependent on the quality, scope and geographical distribution of the available literature. The study also did not generate original statistical data from the proposed SRTMUN sample of 100–150 respondents. The doctoral synopsis had proposed such a primary survey across 10 selected colleges; therefore, the present paper should be understood as a literature-based research paper rather than as a substitute for the eventual primary-data component of the doctoral study.

18. Recommendations-

- a. AI literacy should be incorporated into Physical Education teacher-education and professional-development programmes.
- b. Universities should provide adequate digital infrastructure and technical support.
- c. Teachers and coaches should receive continuous training in AI-supported teaching, training and assessment.
- d. AI-based assessment should always remain subject to professional verification.
- e. Institutions should develop clear policies for data privacy, security and ethical AI use.
- f. AI tools should be selected according to pedagogical relevance rather than technological novelty.
- g. Digital-access inequalities between institutions should be addressed through systematic infrastructure development.

- h. Further empirical research should examine AI adoption among Physical Education teachers, coaches and students in Indian universities.
- i. Future research should compare rural and urban institutions and institutions with different levels of technological infrastructure.

19. Conclusion

The study concluded that Artificial Intelligence-based technologies had considerable potential to transform Physical Education teaching, sports training and assessment. Their major contribution was found in personalised instruction, movement analysis, real-time feedback, performance monitoring and data-supported assessment. Recent research consistently indicated that AI could make Physical Education more personalised, interactive and evidence-informed.

Technological integration could not be considered successful merely because AI tools were available. Teacher competence, infrastructure, institutional support, data protection, algorithmic accuracy and ethical responsibility were essential for meaningful implementation. Consequently, the future of AI in Physical Education depended not on replacing teachers and coaches but on strengthening their professional capacity through responsible and evidence-based technological support. The study therefore concluded that AI-based technologies represented an important opportunity for the modernisation of Physical Education, provided that technological innovation was accompanied by professional development, institutional preparedness, equitable access and a clear ethical framework.

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