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Empowering Adapted and Inclusive Physical Education Through Artificial Intelligence: A Systematic Review

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Abstract
Artificial intelligence (AI) is rapidly transforming the education sector. It can offer inclusivity for students with special educational needs in Physical Education (PE). This review synthesized current researches and reviews that focused on the application and future directions of AI in Adapted Physical Education (APE) and Inclusive Physical Education (IPE). It is grounded in established theoretical frameworks, including the Technology Acceptance Model (TAM), Unified Theory of Acceptance and Use of Technology (UTAUT), and Universal Design for Learning (UDL). The AI-driven methods help overcome the drawbacks of traditional methods, such as large class sizes and insufficient individualized support. With the help of AI, personalized learning, real-time feedback, and data-driven instructional modifications become feasible. The application of AI to APE/IPE includes motion analysis, adaptive learning platforms, intelligent tutoring systems, and virtual and augmented reality for skills development, injury prevention, and health monitoring. However, concerns and difficulties persist around data privacy issues, ethical considerations, inadequate teacher training, infrastructure limitations, and ensuring equal access to AI technology. The review emphasizes the necessity for professional development of educators, clear policy frameworks for data protection, and inclusive design with stakeholders to ensure that AI tools align with the pedagogical goals and learner needs. Future research should focus on the longitudinal impacts, cultural adaptability, and the balance of AI support with human interaction to sustain the social and motivational aspects of physical education. Ultimately responsible, clear, and well-supported AI integration in APE/IPE holds promise for transforming teaching and learning practices towards a more engaging, personalized, and effective physical education for all students.

Keywords: AI, Personalized Learning, Physical Education

1. Introduction

Artificial intelligence (AI) is rapidly transforming many sectors, including education, with Physical Education (PE) being no exception (Karimi & Khawaja, 2023; Wang et al., 2024; Wang & Wang, 2024; Wu et al., 2025). In response to the diverse needs of students and evolving learning styles, AI offers new possibilities as a tool for developing more flexible, efficient, and accessible learning environments (Singh et al., 2024; Wu et al., 2025). These innovations are especially promising for Adapted Physical Education (APE) and Inclusive Physical

Education (IPE), where the goal is to ensure that all students, including those with special educational needs, are involved. In this ever-changing world, integrating AI into physical education (PE) has become a crucial field of educational innovation (Wu et al., 2025).

Enhancing the inclusion of students with special educational needs in physical education classes is the aim of adapted physical activity (APA) and inclusive physical education (IPE) (Ben Rakaa et al., 2025). According to Rakaa et al. (2025) and Li (2025), the strategy is essential for physical development, engagement, equitable and active involvement of all students. However, common problems with traditional PE approaches, such as large class sizes, a lack of resources, and the inability to provide sufficient individualized support, may make it difficult to effectively incorporate students with diverse abilities (Li, 2025).

The incorporation of AI in adaptive physical education is based on various recognized theoretical frameworks. According to Wu et al. (2025), the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT) provide insight into user acceptability factors that are essential for educators and students to adopt AI successfully. AI technologies apply the Universal Design for Learning (UDL) principles advocated by inclusive education frameworks by offering a variety of interaction, representation, and expression options suited for different learning needs (Rakaa et.al., 2025).

The purpose of this review paper is to explore how AI can support APE and IPE. It will methodically examine the advantages and difficulties of incorporating AI into physical education. This paper aims to give an understanding of AI's role in developing more engaging, adaptive, and supportive learning environments for students with special educational needs.

2. Methods

This review synthesized findings from several systematic and scoping reviews, as well as empirical studies. The methodological approach of this review is described below.

2.1. Search Strategy

Studies were identified by searching keywords from various electronic databases: Google Scholar, PubMed, ProQuest, Research Gate, and Scientific Research. A time search parameter was also established, which covers the years 2021 to 2025. Keywords used included: AI-related terms: “artificial intelligence” and “AI”, for PE-related terms: "physical education," "PE," "adapted physical activity," "APA," "inclusive physical education". Boolean operators like “AND” were also used to narrow search scopes within categories.

2.2. Inclusion

The research had to be published within the years 2021-2025 and should be English-based. It should evaluate the effects of modified teaching methods in physical education or investigate the use of Artificial Intelligence in Adapted or Inclusive Physical Education, or Physical Education. It is focused on students, educators, or professionals in physical education or adapted physical education/ inclusive education. Discusses the results of using AI, like how well students learn, how engaged they are, how they develop their skills, or how difficult it is to incorporate AI into teaching methods.

2.3. Exclusion

Unrelated studies, not directly related to the review, or those with incomplete keywords. Research that is not specifically about physical education, adapted physical education, or inclusive physical education. Even theoretical or conceptual papers that lack empirical support.

3. Results

The PRISMA 2020 flow diagram (Figure 1) illustrates the study procedure. Initially, 334 studies were identified through various sources such as Google Scholar, PubMed, ProQuest, ResearchGate, and Scientific Research. Due to being unrelated to the study, duplicates or having incomplete keywords, 289 studies were excluded from the list during the screening process. Furthermore, during the assessment, 23 were removed for reasons such as being non-English (3), unpublished (6), in books (2), and not available in full text (12). Ultimately, 22 studies met the eligibility criteria and were included in the final review.

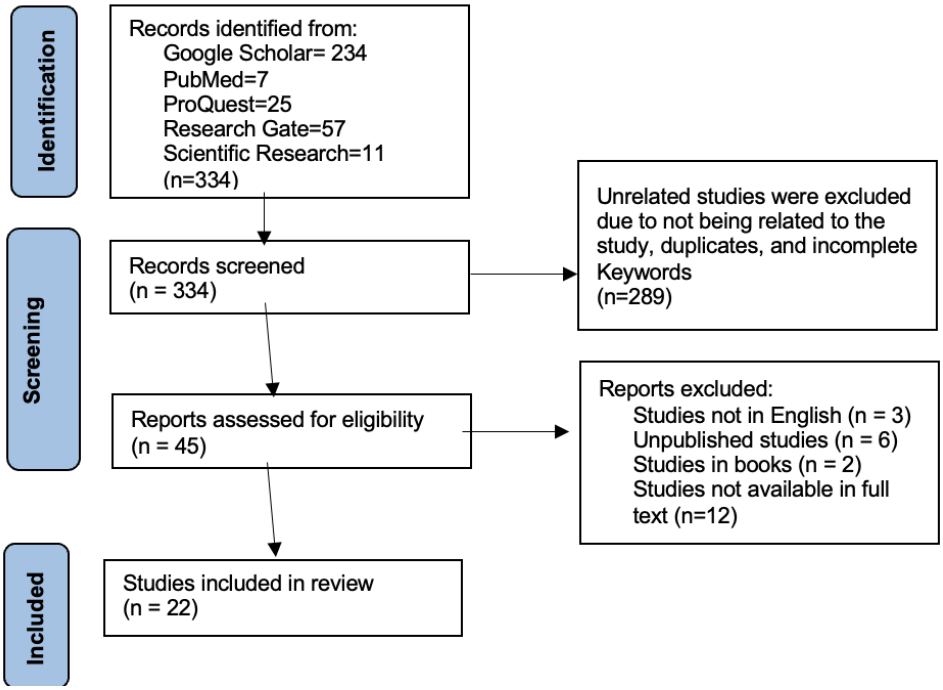

Figure 1 PRISMA 2020 flow diagram

Source: Page MJ, et al. BMJ 2021;372:n71. doi: 10.1136/bmj.n71.

The effective application of AI in improved physical education practices is being documented by more recent studies. Ji et al. (2025) demonstrated how AI-powered motion analysis made it possible to conduct accurate, customized skill evaluations, which sped up students' development in modified curricula. According to Li (2025 and Singh et al. (2024), immersive virtual and augmented reality settings created for students with impairments resulted in increased engagement and improvement of motor skills. According to Cui et al. (2025), wearable AI technologies offer real-time health monitoring to minimize training loads and avoid injury, which greatly enhances student welfare. The significance of user experience design was highlighted by Wu et al. (2025), who further employed extended UTAUT models to identify characteristics promoting positive behavioral intention toward the consumption of AI-generated materials among PE students.

4. Discussion

This review highlights AI's transformative potential for Adapted and Inclusive Physical Education by exploring its advantages, challenges, and how AI can be improved to be utilized in the field.

4.1. Advantages of AI for Adapted Physical Education

AI's core advantage is its capacity to tailor educational activities to meet the individual needs, learning preferences, and physical circumstances of students (Li, 2025; Singh et al., 2024; Sun, 2025). Such personalization is critical in APE and IPE, where diverse abilities require customized methods beyond one-size-fits-all approaches (Kabudi et al., 2021; Sun, 2025). Moreover, AI helps remove barriers faced by learners from different language backgrounds, those with disabilities, or those living in remote areas (Khan, 2024; Li, 2025; Singh et al., 2024).

Traditional training often lacks timely and precise feedback, but AI-powered tools offer quick, accurate, and objective feedback on performance and movement patterns (Ji et al., 2025; Kabudi et al., 2021; Wu et al., 2025; Zhong et al., 2025). Technologies like human skeletal analysis and 3D reconstruction enable teachers to pinpoint specific areas for improvement, facilitate quick adaptations, and enhance the effectiveness and fairness of PE evaluations. (Guo, 2023; Ji et al., 2025; Kabudi et al., 2021; Singh et al., 2024; Wang et al., 2024).

Immersive technologies, including virtual reality and augmented reality, when paired with gamification, create interactive learning environments that greatly increases student engagement and motivation. These are particularly helpful for students with learning difficulties, by improving their motor skills and participation in fitness activities (Li, 2025; Singh et al., 2024; Wu et al., 2025). Real-time health monitoring by smart wearable AI devices further advances injury prevention and supports personalized training by continuously tracking physiological and exercise load data, allowing early risk detection and optimized instructional decisions (Cui et al., 2025; Singh et al., 2024; Sun, 2025; Wang & Li, 2024; Zhong et al., 2025).

AI also assists educators by automating administrative tasks such as lesson planning, equipment management, and attendance tracking, which maximizes teaching efficiency and resource use (Cui et al., 2025; Singh et al., 2024; Sun, 2025). It also helps teachers adjust to new curricular standards and maximizes the use of resources (Kaya, 2025).

4.2. Difficulties and Challenges

AI integration of AI to PE is complex and raises significant concerns. Data privacy, security, and algorithmic bias are major concerns due to the extensive collection and analysis of student data (McNamara et al., 2025; Miao, 2023; UNESCO, 2021; Wang & Li, 2024). According to UNESCO (2021), strong policy frameworks are necessary to ensure ethical use and safeguard learners' rights because generative AI has the potential to provide biased or misleading information.

The literature on the subjective experiences of physical education instructors and their readiness to successfully incorporate AI is noticeably lacking (UNESCO, 2021). The insufficient preparation and inexperience of PE teachers are one of the most prominent barriers to broader acceptance (Rakaa et al., 2025; Kaya, 2025; Martín-Rodríguez & Madrigal-Cerezo, 2025; Singh et al., 2024). To successfully integrate AI tools while retaining their pedagogical understanding, teachers require professional development that covers both technological skills and pedagogical issues. Inadequate infrastructure, technical limitations, and unequal access to AI-supported resources further contribute to educational inequities and must be addressed to ensure fair access (Rakaa et al., 2025; Li, 2025; McNamara et al., 2025). To avoid educational inequalities, it is essential to ensure fair access to AI-supported physical education resources and to use interfaces that are both affordable and easy to use.

Since physical education is dynamic, careless AI implementation can lead to student over-reliance, passive learning, or fragmented knowledge, potentially reducing the effectiveness of dynamic physical education (Zhong et al., 2025). Therefore, the human and social elements of teaching and learning must remain certain in AI integration.

4.3. Data Privacy, Security, and Ethical Use

The integration of AI in adapted and inclusive physical education brings considerable benefits but also raises important questions about data privacy and security. AI systems typically require the collection of a vast amount of sensitive information, including students' academic performance, behavioral patterns, and even biometric data such as facial recognition and/ or physiological measurements. This extensive data collection creates challenges around consent, data ownership, and protection. Without strong safeguards, sensitive data could be vulnerable to breaches, misuse, or unauthorized access, undermining students' privacy rights and trust (McNamara et al., 2025; UNESCO, 2021).

To address these concerns, educational institutions must adopt rigorous data governance frameworks and comply with strict data privacy regulations like the General Data Protection Regulation (GDPR). Modern guidelines, including UNESCO's guidelines on ethical AI use (2021), place a strong emphasis on accountable, transparent AI systems that protect learner privacy and avoid algorithmic bias. Informed consent, data minimization, and secured storage of sensitive biometric and performance data gathered by AI devices are all required by compliance with data protection laws of GDPR counterparts. Furthermore, transparent policies and informed consent processes build confidence among students, educators, and stakeholders in AI use. Ethical AI implementation involves not only technical safeguards but also accountability mechanisms to ensure fairness, transparency, and respect for learner rights (UNESCO, 2021).

4.4. Future Research Directions

Despite the promising advances, substantial gaps remain requiring further investigation.

To determine long-term advantages and potential side effects, longitudinal research monitoring the physical, cognitive, and psychosocial effects of AI-enhanced physical education is required. It is also vital to investigate how cultural contexts influence AI adoption, acceptance, and equity to develop solutions that are sensitive and adaptable across different educational settings.

Continued innovation is also required to create accessible, user-friendly AI gadgets that are specifically suited for a range of disabilities and learning needs. Future research should aim to identify the optimal balance between AI-driven automation and human interaction, preserving the social, motivational, and embodied aspects intrinsic to physical education. Addressing these priorities will help ensure that AI serves as a supportive tool that enhances, rather than replaces educators' role in fostering inclusive and effective physical education.

5. Conclusion

AI is poised to fundamentally reshape adapted and inclusive physical education by offering personalized, engaging, and effective learning experiences. AI provides significant advantages, including customized workout regimens, real-time evaluation and feedback, enhanced student engagement via immersive technologies, and simplified administrative duties for teachers. For students with diverse needs, these AI-driven developments greatly improve overall learning results and improve accessibility and educational outcomes, promoting equity and inclusion in physical education settings.

However, there are several significant obstacles to overcome before utilizing AI in this area. AI introduces crucial challenges such as data privacy, ethical concerns, infrastructure deficits, unequal access to technology, and the need for thorough teacher preparation. To ensure AI enhances rather than replaces the vital role of educators and the embodied aspects of physical learning, it is necessary to integrate AI in PE in a comprehensive way that takes into account both technological capabilities and human consideration. There should be professional development, clear policy formation, and inclusive stakeholder collaboration. Moreover, ongoing researches should examine the long-term cognitive, physical, and social impacts of AI adoption, explore culturally responsive implementations, and elucidate optimal balances between AI use and human interaction in learning.

Moving forward, a collaborative approach among policymakers, educators, researchers, and developers is essential to create clear guidelines, inclusive policies, and transparent, accessible AI solutions. Continuous research must investigate the long-term impacts of AI on physical, cognitive, and social aspects of learning, while preserving the vital human elements of motivation and interaction inherent to quality physical education. Through these efforts, AI can become a powerful tool to empower all learners to reach their highest potential in diverse and inclusive educational environments.

6. Future Recommendations

The following actions are advised to promote ethical, responsible, and inclusive incorporation of AI in Adapted and Inclusive Physical Education:

1. *Policy, Ethics, and Data Protection for Policymakers:* Policymakers should create and implement legal frameworks that protect data privacy, support moral AI design protecting learner privacy and avoiding algorithmic bias, and allocate funds fairly for AI infrastructure in educational institutions.
2. *For Professional Development and Pedagogical Integration among Educators:* To effectively integrate AI tools while maintaining learner-centered, inclusive practices, educators should participate in continual professional development centered on AI technologies and pedagogy. Training must cover AI tool operation, ethical data handling, and curriculum adaptation while maintaining learner-centered, inclusive practices.
3. *For Developers Inclusive Co-design and Stakeholder Engagement:* Collaborate with educators, students, and disability advocates to create AI systems that are transparent, accessible, and in line with inclusive education objectives. Institutions should encourage stakeholders' collaboration, including students, parents, administrators, and tech companies, in co-design procedures. This approach helps match AI applications with local requirements and values, encouraging support and cooperative problem-solving. AI systems should be programmed to be transparent, accessible, and in line with inclusive education objectives.
4. *For Institutional Readiness and Infrastructure Investment:* Conduct readiness assessment, invest in strong infrastructure as well as strong network connectivity, then guarantee the availability of technical support and maintenance. Institutions should conduct readiness assessments and create explicit trial initiatives and feedback loops.
5. *For Future Research of Researchers*: Researchers should encourage empirical investigation of AI applications' impact on long-term educational outcomes. Longitudinal research is suggested to determine the long-term advantages and potential side effects on the physical, cognitive, and psychosocial effects of the AI-enhanced physical education. Research should define the best ratios between AI assistance and direct human interaction to preserve the social and motivational learning components intrinsic to physical education. Researchers should also explore culturally responsive implementation to ensure AI technologies are sensitive and flexible enough to accommodate a range of demographics.

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