Journal of Advanced Sport Technology
DOI: 10.22098/jast.2026.19334.1457
Received: 04 February 2026 | Accepted: 20 April 2026

ORIGINAL ARTICLE *Open Access*

New Generations of Artificial Intelligence in Physical Education: Opportunities, Threats, and Strategies

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How to cite: Labbaf, A. H., Vahdani, M., Cronin, L. New Generations of Artificial Intelligence in Physical Education: Opportunities, Threats, and Strategies. *Journal of Advanced Sport Technology*, 2026; 10(2): 58-77. doi: 10.22098/jast.2026.19334.1457

A B S T R A C T

Background: This study examined the impact of artificial intelligence on physical education by answering three fundamental questions: what roles might artificial intelligence play in physical education, what are the risks associated with the utilization of artificial intelligence, and what strategies should be implemented to ensure the optimal and effective use of artificial intelligence in physical education?

Methods: Three groups of participants took part in the research: group 1 included 1-10 specialists who served as presenters on 4 expert panels on artificial intelligence and education, group 2 included 2-7 experts in physical education, and group 3 included 3-4 experts in artificial intelligence. The data was gathered by recording the statements of experts in the specialized panels and interviewing the other experts involved. Thematic analysis was utilized to examine the data. The initial coding process occurred after the four expert panels and then after each interview. Two methods were employed to ensure reliability: 1) the conceptual network extracted from the interview text was given to the interviewees for their review and approval, and 2) the method of using critical friends was utilized.

Results: The first theme identified explored the functions of artificial intelligence, including standardization of space and sports equipment, empowerment and professional development of PE teachers, classroom management, educational planning, improving assessment processes, and the production of PE content. The second theme included threats such as depriving students of thinking and creativity, emotional and social damages, scientific credibility of the presented content, and ethical concerns. Finally, the third theme indicated six basic strategies for the optimal use of artificial intelligence: 1) preventative and deterrent policies to limit any negatives of AI, 2) understanding problems and challenges that AI can address, 3) developing AI literacy among teachers, 4) promoting AI among teachers to maximise its benefits, 5) provision of the necessary infrastructure for the use of AI, and 6) ensuring the safety and security of users.

Conclusions: In practice, the findings highlighted the future uses of AI within physical education, along with the potential negatives of AI that need to be carefully managed. As a growing area of technology, PE teachers should be encouraged to increase their AI knowledge and skills, so that they can implement AI within their practices. Researchers and policymakers should continue to explore the possibilities of how AI can be used effectively within PE.

K E Y W O R D S : Physical education classes, Physical education teaching, Technology

Introduction

Advancements in technology and computer science are propelling us towards a tech-driven society where machines are progressively being crafted to fulfil human needs [1,53]. Several studies have explored the impact of technology on physical education (PE), including its role in assessment of learning [2, 3], student participation [4, 5], curriculum support [6], game-based approaches [7], and the training of PE teachers [8]. Sargent and Calderón [9] demonstrated that technological progress is often framed as enhancing student learning and motivation in health-related domains. In terms of the implementation of new technology, Bodsworth and Goodyear [10] suggested that action research and collaborative reflection/inquiry acted as crucial facilitators for the teacher-researcher to utilize digital technology to enhance learning.

One of the emerging technologies of recent years is the new generations of artificial intelligence (AI). In essence, AI allows machines to simulate human intelligence [11] and is a branch of computer science and information technology that explores how computers can think, learn, and evolve [12]. With AI, the computer controller filters raw data to make sense of it and then processes it into data that meets user needs [13]. AI includes human abilities such as learning, reasoning, and perception, as well as the ability to understand natural language in a computer algorithm. In the past decade, AI has garnered increasing global attention because of its potential to revolutionize society [14]. AI has advanced rapidly in recent years [15] and is expected to remain one of the most valuable technologies for years to come [16].

The advancement of AI have made great strides in diverse areas and played a remarkable role in human life [13]. Foremost is the fact that intelligent information processing systems in AI make complex tasks easier to accomplish [14]. McCabe and Trevathan [17] highlighted that AI performs repetitive tasks by predicting the outcomes of human-classified data and making decisions similar to humans by solving problems using algorithms developed by humans. Similarly, Roll and Wylie [18] argue that AI can carry out automated tasks, do tasks more quickly and efficiently, facilitate better decision-making, and ultimately, automate decision-making processes without human intervention. Other researchers suggest that understanding the techniques and applications of AI can reduce managers' decision-making time [19], streamline research processes [20], aid organizational employees [21], and simplify daily human affairs.

Likewise, AI plays a significant role in the field of education and has garnered the attention of experts [22]. AI presents both opportunities and challenges for education [23]. In terms of opportunities, Chiu, Xia [24] highlighted that AI has three roles in teaching: 1) providing adaptive teaching strategies, 2) enhancing teachers' ability to teach, and 3) supporting teachers' professional development. It is important to note that a wide range of new technology-based learning methods are emerging within education, such as digital textbook-based learning management systems, customized learning through big data analytics, interactive speech recognition and synthesis technology, and chatbots that assist through natural language processing [13]. AI can also help make informed decisions to access and distribute information for educational and research purposes [25]. Despite all of these opportunities, one of the main challenges of AI for educators is academic integrity; namely, students doing homework or assessments using AI [26].

Given the opportunities related to AI, it is important to think about how students and educators might implement AI. Ouyang and Jiao [23] proposed three main paradigms related to AI in education which include: 1) AI-directed, learner-as-recipient; 2) AI-supported, learner-as-collaborator; and 3) AI-empowered, learner-as-leader. Within higher education, Zawacki-Richter, Marín [27] suggested that there are four areas of applications for AI: profiling and prediction, assessment and evaluation, adaptive systems and personalization, and intelligent tutoring systems. Similarly, through their systematic review, Chiu, Xia [24] demonstrated that AI can be applied in the four areas: student learning, teacher instruction, assessment, and management.

In terms of PE, a small number of studies have looked at AI within this context [13, 28-31]. One particularly interesting study by Lee and Lee [13] examined the principles and implementation of AI in (PE). Their findings revealed that personalized PE classes, knowledge delivery, learning, comprehensive assessment, and counselling methods are among the key functions of AI in PE. According to their results, there are three primary reasons for integrating AI into PE. Firstly, AI means that PE is no longer confined to the playground/classroom due to advancements in technologies like AR (augmented reality) and VR (virtual reality). As such, students now have the freedom to take as many PE classes as they desire without constraints. Secondly, personalized learning and tailored instruction can enhance students' achievement of learning outcomes. In this regard, AI can accurately assess each student's athletic capabilities, gather data, and offer immediate feedback to achieve the best possible results. Thirdly, AI offers diverse learning tools to captivate students and sustain their motivation to learn.

Nevertheless, as it is in its infancy, the impact of AI on PE remains unclear and further research is needed to determine the usefulness of these emerging technologies in PE. Given the potential impact of AI on education, it is crucial to acknowledge its potential in the field of PE, address the associated challenges, and uncover the best strategies for its implementation. Therefore, the primary objective of this study is threefold: (1) to identify the potential roles of artificial intelligence in physical education, (2) to examine the associated risks and threats of AI implementation in PE contexts, and (3) to propose evidence-based strategies for the optimal and effective utilization of AI in PE.

Accordingly, the study sought to answer the following research questions: (a) what roles might AI play in PE? (b) What risks does AI pose? And (c) what strategies should be employed for optimal AI use in PE?

Material and Methods

Researchers personal and professional profiles

The first author, a 36-year-old male with a doctorate in management and planning in PE, possessed 8 years of experience as a PE teacher, 6 years as a member of the planning council for the PE curriculum at the Ministry of Education, and 3 years as a university professor. Additionally, he has published numerous qualitative research studies over the past 10 years. The second author is a 26-year-old PhD student in sport management who has conducted several research studies using qualitative and mixed-methods approaches. The third author, a 40-year-old male lecturer in psychology, possessed a doctorate in sport psychology and has conducted several qualitative and

quantitative research studies in the fields of PE and youth sport.

Participants

This study included 21 participants who were divided into three groups (see Table 1 for further details). Group 1 included 10 AI and/or education specialists who served as presenters on 4 expert panels on AI and education. The panels were titled as follows: panel 1 - 'Necessity of using AI in the educational system', panel 2 - 'Analysis of the different dimensions and effects of AI on school education', panel 3 - 'AI and Education', and panel 4 - 'AI and curriculum developments. All 4 panels were held in 2023 at the Iranian Institute of Education Studies. Group 2 participants included 7 PE experts who participated in interviews. This group included 3 academic experts and 4 experienced PE teachers who had utilized various forms of AI. Group 3 included 4 AI experts who participated in interviews.

Table 1. Participant characteristics

Data Source	Participant Number	Contributor Code in the Findings Section	Expertise	Education Level
Panel 1	1.	SP1	Lecturer and researcher in AI	Ph.D
	2.	SP2	Professor of education	Ph.D
Panel 2	3.	SP3	Professor of philosophy of education	Ph.D
	4.	SP4	Professor of electronics and computers	Ph.D
Panel 3	5.	SP5	Robotics specialist	Ph.D
	6.	SP6	Professor of curriculum	Ph.D
	7.	SP7	Professor of education	Ph.D
Panel 4	8.	SP8	Associate professor of educational policy studies	Ph.D
	9.	SP9	Associate professor of curriculum	Ph.D
	10.	SP10	Associate professor of physics	Ph.D

Data Source	Participant Number	Contributor Code in the Findings Section	Expertise	Education Level
Interview with PE specialists	11.	PE1	Assistant professor of PE	Ph.D
	12.	PE2	PE expert in the education ministry	Ph.D
	13.	PE3	PE expert in the education ministry	Ph.D
	14.	PE4	PE teacher	Masters
	15.	PE5	PE teacher	Masters
	16.	PE6	PE teacher	Ph.D
	17.	PE7	PE teacher	Ph.D
Interview with artificial intelligence experts	18.	AI1	Computer engineer - AI	Masters
	19.	AI2	Assistant professor of computer engineering - AI	Ph.D
	20.	AI3	Associate professor of computer engineering - AI	Ph.D
	21.	AI4	Computer engineer - AI	Masters

Note. SP = Specialized panel, PE = physical education, AI =Artificial intelligence.

Inclusion and exclusion criteria. Participants were included if they met at least one of the following criteria: (a) having a minimum of 5 years of professional experience in AI, education, or physical education; (b) possessing a master's degree or higher in the relevant field; (c) having published at least two peer-reviewed articles or books in AI, PE, or educational technology; or (d) for PE teachers, having at least 3 years of practical teaching experience with demonstrated use of digital or AI-based tools in their classes. Exclusion criteria were: (a) lack of direct professional engagement with AI or PE; (b) less than 3 years of relevant work experience for non-academic participants; and (c) unwillingness to provide informed consent or to be audio-recorded.

Recruitment procedures. Panel participants (Group 1) were recruited through direct invitation by the Iranian Institute of Education Studies, which organized the four expert panels. The research team contacted all panel presenters via official email, and all 10 agreed to have their panel statements included in the study. For interview participants (Groups 2 and 3), purposive and snowball sampling were used. Initially, the research team identified 5 key informants (2 PE academics, 2 PE teachers, and 1 AI expert) through professional networks. These informants then recommended other eligible participants. Invitations were sent via email and phone calls.

Sample adequacy and saturation. The sample size (N = 21) was determined based on the principle of data saturation in thematic analysis. Saturation was assessed using the method of "informational redundancy," whereby no new codes or themes emerged after analyzing the 4th expert panel and the 9th interview. Specifically, by the end of panel 4, no novel functions, threats, or strategies were identified beyond those already coded from panels 1–3. Similarly, after the 9th interview (total of 11 interviews), three consecutive interviews yielded no new themes. Thus, the research team concluded that the sample was adequate to address the research questions.

Procedures

At first, with the coordination of the Institute of Education Studies in Iran, audio files of the 4 panels were made available to the researchers. The information in the panels was publicly available and did not require the informed consent of the participants. The audio files were carefully converted into text that was analyzed. Furthermore, the panel experts were invited to participate in a semi-structured interview. All the interviews were conducted with the informed consent of the participants. According to the expertise of the participant, both general and specific questions which related to their area of expertise were asked. For example, AI experts were questioned more about the general functions of AI and the challenges ahead, whereas PE academics and teachers were questioned about the functions of AI in PE. The format of the expert panels meant that each of the panel members gave a speech at the beginning, which was then followed by a discussion amongst the panel members, and concluded with audience members asking questions. The average time of the 4 expert panels was 117 minutes and the average time of the 11 interviews was 43 minutes.

Data analysis

The audio from the expert panels and interviews were transcribed verbatim. Maxqda20 software was utilized for storing, managing, and analyzing all the text. Thematic analysis was utilized to examine the data. The initial coding process occurred after the four expert panels and then after each interview. Thematic analysis, in line with the guidance of Braun, Clarke and Weate [32], was employed to identify patterns of meaning across the dataset. Initially, the second author listened to the audio recordings, read the text, and labelled the initial codes. Subsequently, candidate themes were developed based on the substantive meaning around which the core codes were

clustered. After developing themes, the interview transcripts were reviewed for text fragments related to those themes that may have been overlooked during the initial data analysis. Next, the entire coding process was reviewed and revised by the first author. In cases of disagreement, the codes were selected by consensus of the researchers. Two methods were employed to ensure reliability: 1) the conceptual network extracted from the interview text was given to the interviewees for their review and approval, and 2) the method of using critical friends was utilized. For the latter, researchers shared their interpretations and codes with expert friends to receive their feedback [33]. The role of a critical friend was not to 'agree' or reach consensus, but to encourage rethinking by challenging each other's knowledge and interpretations. In this study, we used an assistant professor of sport management and a doctoral student in the same field as critical friends, as they were both experienced in qualitative research and well-versed in PE.

To ensure the trustworthiness of the findings, the present study explicitly addressed four quality criteria: credibility through member checking and critical friends, transferability through rich description of participants and context, dependability through systematic audit trail and consensus-based coding, and confirmability through reflexive practices and direct quotation of participants.

Results and Discussion

The researchers identified three main themes within the data. The first theme explores the functions of AI, including the standardization of space and sports equipment, empowerment and professional development of teachers, classroom management, educational planning, improving assessment processes, and the production of PE content. The second theme includes the threats of AI such as depriving students of thinking and creativity, emotional and social damages, scientific credibility of the presented content, and ethical concerns. The third theme included 6 basic strategies for the optimal use of AI.

1- Functions of AI

1-1 Standardization of space and sports equipment

AI can be utilized in the construction, setting out, and standardizing of space and equipment in PE. For example, one participant (PE 1) noted: "Currently, numerous sports equipment, like smart balls [that can be visually tracked in real-time], are developed using AI". Another participant (PE 2) mentioned: "Many sports facilities are planned using specialized software that employs AI to meet required standards" and participant 19 (AI2) suggested that "AI can identify errors in ground lines by analyzing sensor data and alert stadium managers for necessary repairs and improvements".

Such findings were in line with recent research showing that AI-powered sports equipment can be impactful in areas such as athlete performance monitoring, competition regulations, and training quality [34]. AI can be viewed as a supportive technology that offers tailored assistance in conducting PE lessons by utilizing tools like data analysis and simulated training scenarios [35]. While AI-based technology in equipment is not yet widespread in PE, students currently utilize smart watches and mobile applications in their classes. With the advancements of AI, it is expected that AI-powered equipment will continue to advance in PE classes over the coming years.

1-2 Empowerment and professional development of PE teachers

AI serves as a valuable tool for the professional development of PE teachers. In this regard, participants noted that AI now functions as an assistant, providing comprehensive responses to their queries. For example, one participant (PE 5) mentioned: "I often seek answers to my scientific and professional queries from ChatGPT". Additionally, another participant (PE 7) stated: "I utilize various platforms for my research. Some assist me in locating articles, while others aid in crafting them". Participant 16 (PE 6) remarked: "I address many classroom challenges through AI. For instance, in student engagement and teaching specific skills". Thus, it appears that AI can help enhance teachers' professional and specialized competencies.

Tied to the professional development of PE teachers, empowering teachers is another function of AI. For example, teachers can use AI to solve their problems, access scientific resources, interact with teachers from other countries, and participate in international training courses. This shows that AI and technology in general has been able to break boundaries and empower teachers. In practice, teachers can easily produce PE educational content (such as posters, clips, films, applications, etc.) with AI-based tools. Teachers can also register their interests on various platforms (e.g., social networking platforms such as Instagram and Twitter), and the database will suggest content based on their needs and preferences.

It is important to note that PE teachers should enhance their technology literacy to maximize its utilization. In this regard, AI can be overwhelming for teachers and they may be unfamiliar with the types of prompts needed to obtain the desired output from an AI application like ChatGPT. So, enhancing and guiding technology use among PE teachers can facilitate the use of such technologies and contribute to their professional development [37].

1-3 PE Classroom Management

AI plays a crucial role in managing PE classes. For instance, one participant (SP 7) highlighted the availability of software for analyzing human behavior, emphasizing the ease with which activities can be filmed and observed using fixed cameras. Specifically, he said: "Now there are various software for analyzing human behavior. It is enough to film the class activities with one or more fixed cameras, it is easy to observe and analyze the level of interaction and the type of behavior of people". Participant 2 (SP 2) mentioned tools that can be categorized based on learners' previous performance, while participant 9 (SP 9) discussed the development of software to record class activities and students' performance. Furthermore, several teachers pointed out the diverse functions of AI in online PE classes. For example, participant 16 (PE 6) shared how AI provided information about students' activity levels during the COVID-19 pandemic, facilitating class monitoring and control. Likewise, participant 14 (PE 4) noted the existence of software enabling detailed information retrieval with a single click, including health status, body measurements, psychological traits, and more. In this regard, the use of AI significantly saves time and energy for PE teachers by swiftly and accurately handling various classroom processes such as analysis, ranking, grading, and evaluation.

Based on our results, it seems that managing PE classes is a key role of AI. Similar findings have been reported in the field of education, where AI can help ensure the fair treatment of students,

enhance their overall enjoyment [13], assist teachers by recommending personalized activities based on students' performance, help students with homework [1], and alert teachers to questions or assignments that a large number of students have answered incorrectly [38]. In virtual classes, online platforms can offer features to assess the students conduct and performance. For instance, several platforms like 'Skyroom' and 'Class' offer teachers a way to track student engagement, such as monitoring speaking time, participation in chat discussions, and indicating readiness for participation in group discussions. Additionally, creating mobile apps to track student performance is now feasible and teachers can efficiently group students based on the reports from such apps. For instance, 'Apple Health' and 'Samsung Health' offer the option to track the number of steps taken by users across different time intervals. According to Kamel Boulos and Yang [39], after the completion of the exercise, it is possible to analyze and examine the GPS data in relation to heart rate, number of steps taken, changes in elevation, and speed. These features can be found in numerous mobile apps such as Sports Tracker, RunKeeper, and Strava. In summary, AI can greatly contribute to the management of PE classes, including tasks such as grouping based on past performance, virtual class management, and providing feedback.

1-4 Enhancing PE planning and sharing global experiences

Based on our results, it seems that AI opens up new possibilities for advancing pedagogical knowledge globally. Participant 1 (SP 1) noted that "Numerous scientific databases and websites leverage AI. You can now easily set up specific keywords in your account to receive the latest articles and content via email on a weekly or monthly basis. AI can function as an intelligent personal assistant". Another finding was that AI enables personalized training programs based on individual characteristics, needs, and interests. Participant 11 (PE 1) mentioned that "Many applications now offer tailored training programs based on your physical and mental traits". AI also aids PE instructors and students in educational planning. For example, Participant 16 (PE 6) stated: "I frequently utilize AI in game design and training; it generates great ideas suitable for my requirements. At times, it assists me in creating assignments and exercises".

Our findings indicated that AI plays a key role in educational planning. The personalization of education and learning has been a major focus of AI [40]. AI has a significant impact on teaching and individualized learning, catering to the specific needs of all students [41]. Essentially, AI programs allow learners to update their knowledge and solve problems at their level, thus promoting self-regulated learning [13]. AI also adds value to educational platforms and facilitates the creation of personalized teaching and learning environments [1]. In practice, there are numerous applications and software available that PE teachers can use for this purpose. Platforms like Rytr, Writesonic, and Dall E can be utilized for generating audio and video content for students. Additionally, educators can access necessary content or generate it by consulting diverse scientific databases. For instance, when you come across an article in repositories like Science Direct, AI will help recommend related articles to you so that you are accessing the latest scientific content when teaching students. Given the potential obstacles, like having open access to these databases and the quality issues regarding content, verification by a reputable scientific entity (such as a scientific institute, university or academic) is essential.

1-5 Improving assessment processes in PE

Regarding the role of AI in assessment processes, participant 6 (SP 6) said: “This technology can monitor students’ academic progress and provide feedback to the teacher or student”. Additionally, Participant 17 (PE 7) noted that “through analyses from various software, I can gather feedback from my class. This serves as a form of self-assessment for evaluating class performance”.

Based on our results, another role of AI is for assessment purposes. Utilizing predictive analytics technology, AI can offer specialized assistance to students through assessing them, forecasting their learning levels, and predicting their academic performance or dropout [13]. This support aids students in their learning journey and presents numerous opportunities for personalized educational advancement tailored to each student. Additionally, AI holds the potential to furnish feedback to both teachers and students regarding a course’s effectiveness by tracking and monitoring student progress and alerting teachers to any issues in student performance [1]. Furthermore, in conjunction with advancements in measurement technology, there is ongoing development of technology that integrates sensors directly into the equipment. The data collected via these sensors can be leveraged to execute intricate routines using machine learning technology and automatic analysis of physical activity [42]. The utilization of AI and other technologies to recognize learning conditions can empower teachers to intervene in real-time to enhance students’ learning outcomes [43].

1-6 Production of PE content

One of the points made by several participants was the availability and creation of PE content through AI. For instance, one teacher (PE 5) stated that “during the Covid-19 epidemic, I used many applications to create PE content”. Also, participant 14 (PE 4) mentioned: “Artificial Intelligence has greatly simplified the creation of content for physical education. For instance, it is now possible to generate an avatar through the Ossa.ai tool and utilize platforms like AltoZee, Cohesive, and Videezy for content creation”.

As such, it seems AI has facilitated access to content for students and educators. Some researchers suggest that its integration into modern education enriches educational content, alters education perceptions, and impacts traditional educational models [13]. Okunlaya, Syed Abdullah and Alias [25] demonstrated that AI can intelligently retrieve and share information for learning and research. Previously, PE teachers were the primary knowledge source due to limited information availability. However, the application of AI in education now offers tailored knowledge through extensive data provided by deep learning [44]. Utilizing ChatGPT can introduce educators and students to newly generated knowledge, potentially offering contemporary perspectives on existing knowledge. It can also save educators time, create efficiencies, and facilitate organized professional learning to update their content [45]. Nonetheless, concerns exist regarding content validity and data reliability [45]. In practical terms, AI can play a role in the development of PE content, but in each case, its validity must be ensured. For example, through study sessions with PE teachers or through PE experts, we can critique the content produced by AI to ensure its effectiveness. On this point, future research could focus on effective strategies for using AI in PE.

2- Threats of AI

2-1 Impact on thinking and creativity in learners

AI, like other technologies (e.g., social media), may either support the development of thinking and creativity or hinder it. Participant 9 (SP 9) stated: "Students' overreliance on AI can lead to cognitive consequences. For instance, they absorb information instead of thinking critically or exercising their creativity". Conversely, within the panel discussion, participant 6 (SP 6) also commented that "on the other hand, AI can act as a source of inspiration, like a teammate. The exchange of ideas can foster creativity and the generation of new ideas".

Within the literature, similar concerns exist about students' reliance on AI, as it may detract from their full engagement in the learning process and can limit their creativity and critical thinking [45]. While some researchers argue that AI has limited penetration in human domains like art and literature due to deficiencies in mental abilities such as creativity, innovation, and critical thinking, others suggest that it can foster thinking and creativity [1]. In practice, AI seems to offer opportunities for designing assignments that encourage student thinking, but conversely has the potential to hinder students' independent thinking. Therefore, cultivating a culture of intelligent use of AI by PE teachers is crucial.

2-2 Emotional and social damage and stress and anxiety

Experts from various fields highlighted the adverse psychological impacts of AI. For instance, participant 3 (SP 3) pointed out that AI does not take emotions into account when engaging with individuals. While there is some indication that researchers are developing intelligences that incorporate emotional aspects in interactions, it is believed that, in the short term, AI cannot replace humans in this regard. Essentially, children derive pleasure from social interaction and group activities, and engaging with a non-human entity like AI cannot fulfil their psychological needs in a meaningful manner. On this point, participant 2 (SP2) expressed that "I believe current AIs lack emotions and struggle to form proper connections with learners. Their feedback can lead to discomfort, anxiety, and stress". Other experts cautioned about the potential social harm resulting from interacting with AI. Participant 5 (SP 5) highlighted that 'Now any child or teenager can ask AI any question. If AI doesn't consider the social and psychological impact on students, it could seriously affect their well-being. They may receive sensitive information on topics like sex and drugs. However, free access to information presents these challenges".

Our findings suggest that AI faces the challenge of potential psychological harm to users due to its inability to replicate human emotions and feelings [43]. Similar to social networking sites, AI may also lead to addictive behaviors and excessive use can be detrimental [46]. Interestingly, Lee and Lee [13] argue that the surpassing of humans by AI has led to a new phenomenon known as AI anxiety, with other researchers suggesting that the widespread use of AI gives rise to various anxieties [47]. Therefore, it is crucial to educate and regulate this new technology. In terms of PE, further research is needed to explore other potential threats of AI.

2-3 scientific validity of the content

Another point that was repeatedly stressed pertained to the scientific validity of the content

generated by AI. For example, participant 19 (AI 2) highlighted that "the sources and databases of some AIs lack necessary credibility". Participant number 10 (SP 10) also noted that "At times, AI fails to grasp the user's request or question, leading to inaccurate responses". Hence, effective interaction and communication between the user and AI will be crucial for obtaining accurate answers. Another concern raised was the lack of accountability of AI for the information it provides to the user, with no oversight of AI performance. For instance, participant 4 (SP4) mentioned that "no organization or institution is accountable for the precision of ChatGPT responses. These responses might occasionally be inaccurate or insufficient. They may also not always reflect the most recent information. Despite AI's capacity to self-update and improve through interactions, it does not oversee the accuracy of its responses".

Based on our findings, an issue regarding AI is its scientific validity when utilizing vast amounts of people's data to generate responses [48]. Killian, Marttinen [45] also argued that the accuracy and validity of the sources employed by AI for data generation is not always reliable. For example, AI may use outdated research that is not peer reviewed when generating content. This clearly raises concerns about the validity of the content that PE teachers might obtain using AI.

2-4 Ethical concerns related to AI

Ethical concerns regarding AI were highlighted by experts, including worries about the authenticity of student work. Participant 3 (SP 3) expressed uncertainty about whether tasks are completed by students themselves and participant 8 (SP 8) raised concerns about immoral content in cyberspace, the internet, and AI, noting that such content can be easily accessed by teenagers. Furthermore, participants flagged the potential violation of people's privacy. Participant 20 (AI 3) specifically mentioned the presence of malicious links in some AI systems, which could compromise the security of user devices with a single click.

Our findings clearly indicated that our participants were aware of the ethical issues regarding AI. A clear ethical concern is the unauthorized access to data by AI tools, which poses a risk of researchers not receiving credit for their work [45]. Another concern is the invasion of people's privacy, as certain AI systems may contain malware that can steal users details. Furthermore, the participants raised concerns about access to inappropriate content that does not align with the students' age and culture. While researchers have begun to engage in ethical discourse around AI, there are still no formal guidelines and frameworks for its management [49]. For now, it seems that strategies involving setting limitations for young individuals and educating them on the proper use of AI should be implemented.

3- Value-creating strategies

3-1- Policymaking for mitigating the impact of AI

As previously mentioned, concerns regarding social, psychological, and ethical implications pose a threat to students' well-being. Therefore, at a macro level, policymakers must implement effective strategies to manage the use of AI. In this regard, participant 8 (SP 8) emphasized the pivotal role of key organizations, such as the Ministry of Education (ME), Ministry of Science, Research and Technology (MSRT), Ministry of Communication and Information Technology

(MCIT), Iranian Cyber Police (ICP), The Supreme Council of Cyberspace (SCC), and the Strategic Secretariat in Addressing Social Harms (SSASH). Interestingly, participant 7 (SP 7) suggested integrating technology education in schools to help students strike a balance between embracing new technologies and leading a life not solely reliant on technology. The participants in our research also expressed concerns about the potential for inactivity resulting from the advancement of new technologies. For instance, participant 13 (PE 3) emphasized the importance of ensuring that students maintain a healthy and active lifestyle. Additionally, other participants highlighted the need for genuine interaction between teachers and students. Likewise, Participant 11 (PE 1) stressed the significance of agency theory in effective communication, emphasizing that face-to-face interaction is irreplaceable and cautioned against the potential for students to lose touch with their real identity in cyberspace.

At a practical level, we must ethically consider humans in the AI development process. Implementing preventive measures and mechanisms before serious problems arise in the application of AI is crucial [34]. Some organizations have outlined the repercussions of immoral behavior linked to AI through policies. For example, the Institute of Electrical and Electronics Engineers (IEEE) has developed a series of guidelines and standards for the ethical design and deployment of AI technologies (The IEEE Global Initiative on Ethics of Autonomous and Intelligent Systems - IEEE Standards Association, 2023). Awareness of these guidelines and standards contributes to the mitigation of ethical issues associated with AI [45].

3-2 The importance of needs assessment in AI

While the range, extent, and speed of AI services are significant, it is crucial not to overlook the necessity of a needs assessment regarding AI. Specifically, our experts emphasized the need for a comprehensive needs assessment within the education system to identify the situations and conditions in which AI can be used successfully. Participant 3 (SP 3) suggested that "certainly, the curriculum should be revised. AI should be integrated as a new technology in both the content and educational materials for students". Participant 1 (SP 1) emphasized that "AI itself is a tool for advancing learning. It is important to explore how we can utilize it to address educational challenges and anticipate future student needs".

It seems that now that we have AI technology, we should use it to solve the problems and challenges of PE. For this, we need a precise needs assessment in the following areas: what areas of PE can AI be used within, which fields of PE need AI to be designed appropriately, and how much can AI actually serve student learning? Future research in PE should look to explore these questions in further detail.

3-3 Empowering individuals through education on AI

A key finding was the need to empower teachers, students, employees, and parents through AI education. In this regard, panel members stressed the need to implement training in AI. For example, Participant 8 (SP 8) highlighted the urgent need for training by saying that "Some of our teachers lack advanced technological skills. We cannot afford to fall behind other nations. This is an opportunity to bridge the gap. Technological advancements are rapid, leaving our teachers struggling to keep up". Participant 11 (PE 1) suggested "we should segment AI education into

specific components. Educating PE teachers about AI in various ways can enhance their professional capabilities and elevate classroom quality". In terms of the content of training, participant 16 emphasized that "AI training should be comprehensive, covering both the advantages and disadvantages of AI".

Based on our findings, it seems that some changes in the role of PE teachers are necessary. They should shift from being 'knowledge transmitters' following a standardized curriculum to becoming learning coaches, trainers, and counsellors who assist students in achieving their learning goals [13]. As a result, PE teachers must actively develop and adapt their skills and competencies to leverage new technologies [45]. To achieve this, it is important to identify the types of AI relevant to PE and provide guidance on their usage. Additionally, students should be given valid reasons for utilizing AI and schools should be advised to address this matter in information sessions with parents and guardians. Also, Luckin, Cukurova [50] offered suggestions to enhance the comprehension of AI by educators and trainers. These researchers proposed that when utilizing AI in educational settings, three key scenarios should be taken into account: 1) AI making decisions for educational tasks (e.g., selecting the next activity for a student in an online learning platform), 2) AI providing guidance or data for human decision-making (e.g., offering various assessment tools for students), and 3) AI identifying patterns in data (e.g., recognizing behavioral patterns that may signal a student being at risk.

3-4 Spreading and promoting AI is an undeniable necessity

Like previous technological advancements, older generations may be less inclined to embrace it. However, to utilize this technology optimally, it must be widely promoted and integrated across various communities. As participant 14 (PE 4) noted, "PE teacher must have comprehensive understanding of this technology. Some educators may only be familiar with basic AI functions, such as question-and-answer capabilities, while synthetic intelligence offers much more".

Lee and Lee [13] argue that to integrate AI into PE, there must be an understanding of PE, technology and AI. Essentially, AI represents a contemporary technology that can serve as a learning tool and therefore strategies for disseminating and encouraging the utilization of this tool among PE instructors need to be established. It is important to note that this effort should be carried out in a logical and systematic manner to yield a positive impact.

3-5 Focusing on Infrastructures

It is clear that as AI offers more valuable services to society, it also necessitates technological infrastructures. Participant 21 (AI 4) remarked: "While many countries have advanced AI, our access to websites and AI is restricted due to international sanctions". Participant 18 (AI 1) added: "We often overlook the inequality in education. Not all students have access to prestigious schools".

Overall, it seems that implementing AI in the educational system is a major challenge [51]. Similar to other educational resources, AI necessitates a substantial initial investment for software acquisition and cloud support, as they are highly developed and advanced [1]. Unfortunately, many underprivileged areas lack these essential infrastructures. In Iran and other countries, numerous

students still lack access to fundamental technological tools such as laptops, tablets, or computers. Consequently, the educational system must prioritize the establishment of infrastructure in schools to ensure that there is equality for all students regarding AI use.

3-6 Security and safety

Another aspect highlighted by participants is the importance of prioritizing security and safety in the implementation of AI. Participant 10 (SP 10) emphasized that "we must not overlook security. Infrastructure, education, and advocacy should go hand in hand with security and safety. Failure to ensure safety and security could turn AI into a threat". Participant 2 (SP 2) added: "Students are vulnerable to numerous hazards. It is essential to furnish them with the required infrastructure to enhance safety and security".

Our findings suggest that the implementation of AI technology necessitates a secure infrastructure. Ensuring the security of data exchange is paramount, as users must have confidence in the safety of utilizing AI. Therefore, the security level of each AI should be assessed before granting access to users. In this context, Lameras and Arnab [52] underscore the importance of educators acquiring digital skills. These competencies pertain to teachers' proficiency with digital tools and educators should be knowledgeable about potentially unsafe tools and exercising caution when using them.

Limitations

The first limitation of the present study was the geographical scope of the study, as all participants were from Tehran and Isfahan, the two most developed cities in Iran. This may have limited their understanding of the challenges in less developed areas of the country. As such, future studies should encompass a broader range of locations when investigating AI in PE. Secondly, the research only involved adult experts, overlooking the perspectives of PE students who may be familiar with AI. Subsequent research should include the viewpoints of such students. Lastly, the rapid pace of technological change is noteworthy. This study reflects the opinions of experts during 2023, but as time progresses, researchers will accumulate new experiences in the field of AI. Therefore, future research can yield additional findings in relation to AI use in PE.

Conclusion

The findings from the present study highlight the opportunities, challenges, and strategies for using AI in PE. Some of the key opportunities include the use of AI to enhance the professional skills of PE teachers, optimizing space and equipment in PE, for classroom management and curriculum development, and improving educational processes such as assessment, feedback, and personalization. Conversely, some of the challenges of AI highlighted within the current study include depriving students of thinking and creativity skills, potential emotional and social damages, and scientific credibility of the content, and ethical concerns. Lastly, the findings provided six strategies for the optimal use and implementation of artificial intelligence in PE: 1) develop preventive and deterrent policies to limit any negatives of AI, 2) understand the problems and challenges that AI can address, 3) develop AI literacy among teachers, 4) promote AI among teachers to maximise its benefits, 5) develop and provide the necessary infrastructure for the use of AI in schools, and 6) ensure the safety and security of end users. As a growing area of technology, PE teachers should be encouraged to increase their AI knowledge and skills so that

they can implement AI within their practices. Likewise, researchers should continue to explore the possibilities of how AI can be used effectively within PE.

Ethical Considerations:

Compliance with ethical guidelines

Ethical guidelines have been followed and informed consent was obtained from all subjects involved in this study.

Funding

This research received no external funding.

Conflict of Interest

The authors declare no conflict of interest.

Acknowledgment

All the specialists, managers, and teachers who collaborated with us in this research are greatly appreciated and thanked.

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نشریه فناوری ورزشی پیشرفته
DOI: 10.22098/jast.2026.19334.1457
تاریخ دریافت: ۱۴۰۴,۱۱,۱۵ تاریخ پذیرش: ۱۴۰۵,۰۱,۳۰
Journal of Advanced Sport Technology
«مقاله پژوهشی»

نسل‌های نوین هوش مصنوعی در تربیت بدنی: فرصت‌ها، تهدیدها و راهبردها

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چکیده

هدف: این مطالعه با پاسخ به سه پرسش اساسی، تأثیر هوش مصنوعی بر تربیت بدنی را بررسی کرده است: هوش مصنوعی چه نقش‌هایی می‌تواند در تربیت بدنی ایفا کند؟ مخاطرات به‌کارگیری هوش مصنوعی چیست؟ و چه راهبردهایی باید اجرا شود تا استفاده از هوش مصنوعی در تربیت بدنی بهینه و اثربخش باشد؟

روش‌شناسی: سه گروه از مشارکت‌کنندگان در پژوهش حاضر حضور داشتند: گروه اول شامل ۱ تا ۱۰ متخصص ارائه‌دهنده در چهار پنل تخصصی هوش مصنوعی و آموزش، گروه دوم شامل ۲ تا ۷ متخصص تربیت بدنی، و گروه سوم شامل ۳ تا ۴ متخصص هوش مصنوعی. داده‌ها از طریق ضبط بیانات متخصصان در پنل‌های تخصصی و مصاحبه با سایر متخصصان جمع‌آوری شد. برای تحلیل داده‌ها از روش تحلیل مضمون استفاده شد. فرآیند کدگذاری اولیه پس از چهار پنل تخصصی و سپس پس از هر مصاحبه انجام گرفت. برای اطمینان از پایایی از دو روش استفاده شد: ۱) شبکه مفهومی استخراج‌شده از متن مصاحبه جهت بازبینی و تأیید در اختیار مصاحبه‌شوندگان قرار گرفت، و ۲) از روش «دوستان منتقد» بهره گرفته شد.

نتایج: نخستین مضمون شناسایی‌شده به کارکردهای هوش مصنوعی از جمله استانداردسازی فضا و تجهیزات ورزشی، توانمندسازی و توسعه حرفه‌ای معلمان تربیت بدنی، مدیریت کلاس، برنامه‌ریزی آموزشی، بهبود فرآیندهای ارزشیابی و تولید محتوای تربیت بدنی پرداخت. مضمون دوم تهدیدهایی مانند محروم کردن دانش‌آموزان از تفکر و خلاقیت، آسیب‌های عاطفی و اجتماعی، اعتبار علمی محتوای ارائه‌شده و نگرانی‌های اخلاقی را دربرمی‌گرفت. در نهایت، مضمون سوم شش راهبرد اساسی برای استفاده بهینه از هوش مصنوعی را نشان داد: ۱) سیاست‌های پیشگیرانه و بازدارنده برای محدودسازی پیامدهای منفی هوش مصنوعی، ۲) درک مسائل و چالش‌هایی که هوش مصنوعی می‌تواند آن‌ها را حل کند، ۳) توسعه سواد هوش مصنوعی در معلمان، ۴) ترویج هوش مصنوعی در بین معلمان برای بهره‌گیری حداکثری از مزایای آن، ۵) تأمین زیرساخت‌های لازم برای استفاده از هوش مصنوعی، و ۶) تضمین ایمنی و امنیت کاربران.

نتیجه‌گیری: در عمل، یافته‌ها بر کاربردهای آتی هوش مصنوعی در تربیت بدنی و نیز پیامدهای منفی بالقوه‌ای که باید به دقت مدیریت شوند، تأکید داشت. هوش مصنوعی به عنوان حوزه‌ای رو به رشد از فناوری، معلمان تربیت بدنی را برمی‌انگیزد تا دانش و مهارت‌های خود را در این زمینه افزایش دهند تا بتوانند آن را در فعالیت‌های حرفه‌ای خود به کار گیرند. محققان و سیاست‌گذاران باید به کاوش در امکان‌های استفاده اثربخش از هوش مصنوعی در تربیت بدنی ادامه دهند.

واژه‌های کلیدی: آموزش تربیت بدنی، فناوری، کلاس‌های تربیت بدنی