ISSN 2522-6398 Vol. 8, Issue 11: 128-134, DOI: 10.25236/FER.2025.081119

# The Practical Challenges and Breakthrough Pathways of AI Empowering University Physical Education

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***Abstract:*** *The continuous innovation of artificial intelligence technology is driving the advancement of university physical education toward intelligent development. This study explores the current practices and core challenges of artificial intelligence in university physical education through literature review and logical analysis, while proposing corresponding optimization strategies. The research indicates that artificial intelligence has been applied in areas such as teaching auxiliary tool development, personalized training plan design, virtual reality technology application, and intelligent resource management. However, it still faces issues like uneven distribution of educational resources, significant data security risks, weak digital skills among teachers, and insufficient student initiative in learning. To address these challenges, the study recommends measures such as balancing the allocation of educational resources, improving data security protection systems, enhancing technical training for faculty, fostering students' autonomous learning awareness, and promoting interdisciplinary collaborative innovation. These efforts aim to deepen the organic integration of artificial intelligence and physical education, providing robust support for the modernization of physical education in the new era.*

***Keywords:*** *Artificial Intelligence; University Sports Education; Practical Challenges; Breakthrough Pathways; Educational Intelligence*

## 1. Introduction

Artificial intelligence, as the core driving force of a new round of technological revolution, is profoundly affecting the modernization process of the education sector. Policy documents such as the "14th Five Year Plan for Sports Development" and "China's Education Modernization 2035" clearly propose to promote the deep integration of artificial intelligence and education, providing policy guarantees for the intelligent development of university sports teaching. As an important component of higher education, university sports shoulder the important tasks of enhancing students' physical fitness, imparting sports skills, and cultivating a sound personality. With powerful data processing, intelligent analysis, and virtual simulation capabilities, artificial intelligence can achieve precise teaching processes, customized teaching plans, and immersive upgrading of teaching scenarios, providing effective solutions to solve problems such as homogenized teaching and single evaluation standards in traditional sports teaching models. Nevertheless, At present, the practical application of artificial intelligence in the field of physical education teaching in universities is still in its infancy, constrained by factors such as uneven regional development, high technology investment costs, and insufficient digital literacy of teachers. A mature large-scale application system has not yet been established, and existing research is often limited to exploring a single technology or analyzing local problems, lacking systematic research on the application status, implementation obstacles, and promotion strategies. Therefore, this article comprehensively reviews relevant literature, systematically summarizes the specific application scenarios of artificial intelligence in physical education teaching in universities, deeply analyzes the main challenges currently faced, and proposes practical and feasible development suggestions, in order to provide theoretical support and practical guidance for the digital transformation of physical education teaching in universities.

## 2. The current application status of artificial intelligence in physical education teaching in universities

Currently, the application of artificial intelligence in physical education teaching in universities has covered the entire process of "teaching learning practice evaluation". Through intelligent devices,

ISSN 2522-6398 Vol. 8, Issue 11: 128-134, DOI: 10.25236/FER.2025.081119

algorithm models, and scenario simulation technology, the teaching mode has shifted from "experience driven" to "data-driven", which can be summarized into four major scenarios:

### *2.1 Intelligent teaching assistance tools achieve deep application*

Intelligent wearable devices and smart sports equipment have become key support for teaching assistance, capable of real-time tracking and quantitative evaluation of students' exercise status. On the one hand, sports wristbands, smartwatches, and flexible wearable sensors such as electromyography sensors and blood lactate monitoring devices can collect physiological parameters such as students' heart rate, steps, energy consumption, and electromyographic signals. With the help of AI algorithms, they can analyze exercise intensity and physical load, providing a basis for teachers to dynamically adjust training plans. This type of device can rely on big data to predict training risks and reduce the incidence of sports injuries.[1] Relevant technologies have been piloted in courses such as track and field and basketball in universities. On the other hand, devices such as intelligent treadmills and AI table tennis training robots are gradually being introduced into classroom teaching. Intelligent treadmills can automatically adjust speed and slope based on students' physical fitness data, analyze hitting trajectory and strength through computer vision technology, and provide real-time feedback on action standardization, effectively improving the efficiency of elective course teaching. The application of such tools breaks through the limitations of traditional teaching "visual observation" and promotes the transformation of teaching evaluation from "qualitative description" to "quantitative analysis". In gymnastics teaching, teachers can use wearable devices to collect data on students' movement amplitude, balance, etc., compare them with standard movement models, accurately identify problems such as "insufficient limb coordination" and "landing center of gravity deviation", and achieve personalized guidance.[2]

### *2.2 Construction of Personalized Teaching System*

With the help of IoT sensing devices and big data technology, artificial intelligence can create intelligent information acquisition, flexible processing, and customized teaching processes. Specifically, the intelligent teaching platform can instantly collect students' physical function indicators such as lung capacity, long jump scores, as well as sports performance characteristics, reaction time endurance levels, and learning record information, such as historical performance and sports tendencies, to establish a refined student sports feature file. [3]Then, cluster analysis and regression modeling are used to deeply mine the above data, clarify the strengths and weaknesses of each student, such as proposing high-intensity interval training and core strength enhancement exclusive training plans for students with outstanding endurance but insufficient explosive power. Finally, teachers refer to the system prompts and combine them with course requirements to improve teaching strategies, We will also optimize strategies in real time based on the actual training performance of students, focusing on basic skills training for students with weak skill foundations, and increasing team tactical practical exercises for students with strong abilities. This personalized teaching model effectively changes the traditional teaching mode of uniform pace and content, causing difficulties for excellent students who cannot keep up due to insufficient food and poor students who cannot keep up.

### *2.3 VR/AR Immersive Teaching Application of Technology*

Virtual reality (VR) and augmented reality (AR) technologies promote the expansion of teaching scenarios from "physical space" to "virtual real combined space" by constructing simulation environments, enhancing teaching interest and interactivity. [4]In VR teaching, students can enter virtual venues to participate in practical training of high-risk or high investment projects with the help of VR devices. For example, in gymnastics classes, students can repeatedly practice projects such as balance beams and vault in virtual training centers, and the system uses motion capture technology to analyze motion trajectories and provide real-time feedback on details such as "center of gravity imbalance" and "arm angle deviation", effectively avoiding the risk of injury during real training. For special courses such as skiing and diving, VR technology can simulate complex environments such as slope and underwater pressure, significantly reducing the cost of venue and equipment investment, AR technology enriches teaching forms through the combination of "real environment+virtual information overlay". In basketball tactical teaching, students can wear AR glasses to view virtual markers such as player running trajectory and passing timing, and intuitively grasp tactical points such as "pick and roll coordination" and "quick counterattack". In martial arts training, AR technology converts standard movements into virtual animations to cover students' real-time movements and assist them in correcting

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posture errors. This application makes students' movements more standardized than traditional teaching.

### *2.4 Intelligent management of teaching resources*

Artificial intelligence technology helps to achieve efficient integration and precise allocation of sports teaching resources, solving the problems of fragmentation and retrieval difficulties in traditional resource management. On the one hand, relying on AI learning platforms can provide structured classification and intelligent push of teaching materials, such as teaching videos, training plans, action demonstrations, etc. When students search for "basketball shooting skills", the system will provide advanced content based on the learning stage, including "basic posture - power application skills - practical improvement". Teachers can also use the platform to call on excellent lesson plans from other colleges to promote the circulation and sharing of teaching resources. On the other hand, the platform constructs personal growth profiles by continuously collecting and analyzing students' sports data, dynamically tracking their physical development and skill progress, and providing objective basis for the comprehensive evaluation of the semester.

## 3. The realistic dilemma of empowering college physical education teaching with artificial intelligence

Artificial intelligence has brought new vitality to physical education teaching in universities, but its practical application is still limited by various factors, mainly reflected in the four levels of resources, technology, faculty, and students. Moreover, these issues interact and constrain the full potential of technology:

### *3.1 Unequal distribution of teaching resources*

The uneven allocation of teaching resources is the primary obstacle to the application of artificial intelligence, which is manifested in two aspects: regional differences and differences in universities, leading to polarization in technology application. From the perspective of regional distribution, there is a significant gap in resource allocation between universities in the eastern coastal areas and universities in the central and western regions. Universities in cities such as Hangzhou and Shanghai have achieved comprehensive coverage of artificial intelligence body testing and are equipped with advanced devices such as smart wearables and VR teaching systems. In contrast, some universities in the central and western regions are unable to afford the purchase and maintenance costs of VR equipment due to funding shortages, with a single VR teaching system priced at about 50000 to 100000 yuan. According to Li Hong's research, universities in economically underdeveloped areas invest less than 100000 yuan annually in sports intelligent equipment, which is only 1/5 to 1/3 of universities in developed areas. In terms of universities, there is also an imbalance in resource allocation between key universities and ordinary universities. "Double First Class" universities can rely on research funding and policy support to build intelligent sports laboratories to promote the deep integration of artificial intelligence and physical education teaching. However, most ordinary universities are in a passive adaptation stage and only try to use simple intelligent devices such as sports wristbands in some courses, making it difficult to achieve systematic applications. This difference leads to the scattered application of artificial intelligence in college physical education teaching, making it difficult to form economies of scale.

### *3.2 Prominent data security risks*

The obvious data security risks highlight the lack of privacy protection and management mechanisms. The application of artificial intelligence technology in physical education teaching in universities requires a large amount of student data support, which includes sensitive information such as physiological indicators such as heart rate and blood pressure, exercise trajectory, and identity authentication. However, the current data management in this field generally has obvious shortcomings such as arbitrary collection, fragile storage, and disorderly use, which leads to a sharp increase in the risk of student privacy leakage. [5]The specific manifestation is that the data collection process does not strictly follow the principle of minimization, and some intelligent terminals excessively collect personal information unrelated to teaching, such as home address and medical history. The protection measures for data storage and transmission are relatively weak. Most universities lack dedicated encryption systems and use regular servers to store data, which is vulnerable to malicious attacks. At

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the same time, there is a lack of effective constraint mechanisms in the data usage process. Some institutions use student sports data for scientific research or school enterprise cooperation projects without fulfilling their disclosure obligations. In some cases, some enterprises use student data for commercial activities such as promoting sports equipment under the banner of "smart teaching", which deviates from the original intention of educational data serving teaching. The Global Education Monitoring Report (2023) points out that data privacy issues have become a key bottleneck hindering the development of educational technology, and this problem is particularly severe in the context of physical education teaching in universities.

### *3.3 Insufficient technical literacy of teachers*

The lack of technical literacy among teachers is reflected in their limited abilities and unclear role positioning. Physical education teachers are responsible for the implementation of artificial intelligence applications, but their technical reserves and role adaptation abilities are difficult to meet the requirements of intelligent teaching development. This is mainly manifested in two aspects. Firstly, their technical operation and data analysis abilities are insufficient. Most university physical education teachers graduated from sports training or physical education majors, and their knowledge reserves of computer technology and data science are limited, making it difficult to proficiently use intelligent devices and analysis systems. For example, Zhang Jing's survey shows that 68% of university physical education teachers cannot effectively use data analysis tools to extract the value of sports data, and can only process basic indicators such as heart rate and steps. They cannot deeply analyze training problems behind the data through algorithm models. Secondly, their role positioning is vague, which leads to a crisis of professional identity, In the traditional physical education teaching model, teachers are knowledge transmitters and skill guides, and artificial intelligence intervenes to replace some core functions such as data collection and action evaluation, which leads teachers to doubt their own value. Stan's research points out that some young teachers feel lost and even doubt their professional value because students are more inclined to obtain answers through AI rather than seeking advice from teachers. [6]In addition, there is a lag in the teacher training system of universities, and teacher training content mainly focuses on sports skills or teaching methods, lacking systematic training for artificial intelligence plus physical education teaching. The recruitment process does not include intelligent teaching ability in the assessment criteria, resulting in less than 5% of teachers with a composite background of sports and AI, which is difficult to meet the development needs of intelligent teaching.

### *3.4 Weakening of Students' Autonomous Learning Ability*

The decline in students' autonomous ability is reflected in their dependence on technology and thinking inertia. Although the convenience of artificial intelligence improves learning efficiency, it makes students overly dependent on technology, thereby weakening their ability to explore and solve problems independently. On the one hand, instant feedback replaces autonomous perception, and smart devices can immediately point out movement errors such as insufficient arm angle and unstable landing center of gravity. Students do not need to repeatedly practice and self adjust to feel movement deviations, gradually losing their sense of movement. For example, in tennis class, students who rely on AR technology to correct their movements after leaving the device have a 40% decrease in movement standardization, which is significantly higher than that of traditional teaching mode students. On the other hand, personalized recommendations lead to rigid learning paths, The AI system recommends learning content and paths based on students' historical data, and students do not need to independently choose resources or develop plans, which can easily lead to passive learning habits. The "2022 Blue Book of Artificial Intelligence Education" points out that artificial intelligence causes students to lose their basic ability to independently screen, explore, and distinguish, making them blindly believe that system recommendations are the best choice.[7] In addition, thinking inertia is also reflected in learning motivation. Some students rely on AI to generate training plans and answers, and are unwilling to think deeply about action principles or tactical logic. For example, in basketball tactical learning, they only memorize AI recommended tactical steps but do not understand the underlying offensive and defensive logic, which makes it difficult to adapt flexibly in actual combat. This technological dependence not only hinders the continuous improvement of sports skills, but also violates the goal of cultivating autonomous exercise ability in college sports.

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## 4. Breakthrough Paths for Empowering College Physical Education Teaching with Artificial Intelligence

To address the aforementioned challenges, it is essential to coordinate efforts across four key areas: resources, technology, faculty, and students. By leveraging policy guidance, technological innovation, capacity building, and instructional adjustments, a comprehensive system integrating artificial intelligence into university physical education can be developed.

### *4.1 Optimize regional resource allocation to reduce disparities between schools and regions*

In terms of coordinating regional resource allocation to reduce inter school and regional differences, a "policy tilt+technology interoperability" approach is adopted to alleviate the uneven distribution of resources and promote the popularization of artificial intelligence applications. Firstly, a "Special Fund for Intelligent Sports in Colleges and Universities" should be established, with the education regulatory department playing a leading role, in conjunction with local governments and corporate institutions, to provide financial assistance to universities in resource scarce areas of the central and western regions. These funds should be prioritized for the purchase and maintenance of intelligent equipment. For example, special funds can be used to create a "regional intelligent sports teaching resource library", which should collect high-quality VR courses, excellent teacher lesson plans and other materials for free use by universities in underdeveloped areas. Secondly, it is necessary to establish a "targeted assistance" system, guiding developed universities in the eastern region to establish cooperative relationships with universities in the central and western regions, and assisting the development of universities with insufficient resources through "equipment support+teacher exchange". Finally, we need to promote "simple" smart devices and recommend affordable and easy-to-use devices for universities with limited budgets, such as hundred yuan sports wristbands and mobile motion analysis software, to achieve "economic intelligence" and prevent falling into the trap of "device centric" thinking.

### *4.2 Establish a full process data security mechanism to safeguard student privacy*

We need to improve the full cycle data security protection system to safeguard students' privacy rights, and use a combination of technical protection and institutional constraints to build a strong defense line for data security, ensuring that data applications are legal and compliant. Firstly, it is necessary to standardize data collection behavior, strictly adhere to the "minimum necessary" standard in accordance with the Personal Information Protection Law, collect only physiological indicators and exercise data necessary for teaching, and exclude irrelevant information such as home addresses. Through anonymization technology, identity information is encrypted to cut off direct association between data and individuals. Secondly, it is necessary to strengthen data storage and transmission protection. Universities should equip dedicated data servers using SSL/TLS encryption protocols to ensure transmission security. Professional security agencies should regularly conduct security audits and vulnerability checks to prevent external attacks, and establish data backup systems to prevent data loss caused by system anomalies. Finally, the scope of data usage should be defined, and the "Guidelines for the Application of University Physical Education Teaching Data" should be formulated to clarify that data is only for teaching and research purposes and commercial use is prohibited. Before implementing the data authorization system, written permission must be obtained to publicly publish scientific research results, and personal identification information must be removed.

### *4.3 Improving the Teacher Training System*

To build a new system for teacher development and redefine teacher functions, the strategy of "introduction optimization+system training+role transformation" should be adopted to comprehensively enhance the level of teacher intelligence, highlighting the leading value of teachers in smart teaching. Firstly, we need to reform the standards for talent introduction, increase the evaluation of intelligent teaching abilities in the selection of physical education teachers, prioritize the recruitment of talents with interdisciplinary backgrounds in sports, computer science, sports training, and data science, and promote the establishment of cooperative relationships between universities and institutions in the field of sports artificial intelligence, such as the School of Sports Engineering at Beijing Sport University, to provide targeted education talents with AI application capabilities. Secondly, a tiered training program should be implemented to provide new teachers with intelligent device operation and basic data analysis skills training, enabling them to proficiently use tools such as

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sports wristbands and teaching platforms. Experienced teachers should receive in-depth training on AI teaching plan design and algorithm model application, such as building student ability maps based on data and developing personalized teaching plans. At the same time, a mentorship system should be implemented, with technical experts leading new teachers to create a collaborative teaching team atmosphere for progress. Finally, it is necessary to transform the positioning of teachers' functions and establish the role of artificial intelligence as a "teaching aid" to promote the transformation of teachers from knowledge transmitters to learning guides, data analysts, and emotional companions. In terms of data application, teachers need to analyze the analysis reports generated by AI to accurately identify students' technical shortcomings. In terms of humanistic care, teachers should cultivate students' core competencies such as teamwork spirit and stress resistance through teacher-student interaction, which cannot be replicated by AI. In terms of teaching innovation, teachers should actively explore the integration of AI and curriculum, such as integrating AR technology into martial arts teaching to develop virtual practical training scenarios.

### *4.4 Strengthen guidance for students' self-directed learning and avoid dependence on technology*

We should highlight the guidance for students' self-directed learning and weaken their dependence on technology, relying on the combination strategy of "teaching design+ability cultivation+scenario innovation" to activate students' intrinsic learning motivation, and achieve the organic unity of technical support and independent exploration. One approach is to implement task oriented teaching, assigning open-ended practical tasks such as "designing personalized 800 meter endurance improvement plans" in the curriculum, encouraging students to actively collect professional information based on AI generated physical fitness monitoring data and dynamically optimize training strategies. Teachers only use open-ended questions instead of standard answers. The "AI Assistant" platform developed by Tianjin University relies on the visualization function of "thought chain" to break down the reasoning logic of action principles, guiding students to deeply understand the basis of action design rather than mechanical imitation. This model is worth promoting and learning from at the university level. The second step is to strengthen metacognitive training, using platforms such as "learning notes" and "stage reflection reports" to systematically organize students' experiences and confusions in AI assisted learning, such as the problem of excessive reliance on AR action correction leading to weakened proprioceptive ability. This will encourage students to actively adjust their learning methods, incorporate self-directed learning evaluation indicators such as information retrieval efficiency and training plan development ability into the assessment system, and form an intrinsic driving force to reduce technological dependence. The third step is to build an immersive learning environment and use VR technology to create "autonomous decision-making" training modules. For example, in virtual off-road scenarios, students need to independently plan their paths and assess terrain risks, while AI only provides limited prompts when necessary. This not only leverages the advantages of technical assistance but also hones students' comprehensive ability to independently solve problems.

### *4.5 Promote interdisciplinary cooperation and achievement sharing, and build a collaborative ecosystem*

To promote interdisciplinary collaboration and the circulation of achievements to create a linkage system, the "interdisciplinary+industry education integration+experience promotion" model should be adopted to break through the bottleneck of technological transformation and cultivate a long-term smart teaching environment. One approach is to deepen interdisciplinary collaboration. Universities can establish "Sports Intelligent Chemistry Interdisciplinary Laboratories" and collaborate with forces from sports science, computer science, data science, and other fields to develop intelligent tools suitable for sports education, such as motion recognition technology for swimming training and physical fitness assessment systems for track and field teaching. Interdisciplinary modules should be integrated into professional courses, such as adding courses such as "Introduction to Sports Data Analysis" and "Practice of Smart Teaching Platforms" to sports majors, in order to enhance students' comprehensive literacy. The second is to promote the linkage of school enterprise and inter school resources. Universities can work together with technology enterprises to develop cost-effective and compatible sports intelligent terminals. Regular "Intelligent Sports Teaching Practice Forum" should be held to organize effective universities to share experiences, such as Tsinghua University's AI swimming training and Beijing Normal University's virtual classroom. A "Handbook for Intelligent Application of College Sports" should be compiled for reference by various schools. A national "Sports Teaching Intelligent Resource Library" should be established to collect high-quality courses, teaching case examples, and technical solutions, and promote efficient resource circulation.

ISSN 2522-6398 Vol. 8, Issue 11: 128-134, DOI: 10.25236/FER.2025.081119

## 5. Conclusions

Artificial intelligence brings precise, personalized, and immersive innovation opportunities to physical education teaching in universities. Its application has covered teaching assistance scheme design scenarios, simulation resource management, and other scenarios, providing a new path to solve the difficulties of traditional teaching. However, in the practical process, due to factors such as imbalanced resource allocation, data security risks, insufficient teacher quality, and weakened student autonomy, the value of artificial intelligence has not been fully unleashed. To achieve a deep integration of artificial intelligence and university physical education teaching, it is necessary to build a collaborative system of "policy technology faculty student", narrow the resource gap through special funds and targeted support, ensure data security through technical protection and institutional norms, enhance faculty capabilities through recruitment optimization and training, strengthen students' autonomy through task driven and metacognitive training, and build an ecological environment through interdisciplinary cooperation and achievement sharing. In the future, with the reduction of technology costs and increased policy support for application experience accumulation, artificial intelligence will play a greater role in physical education teaching in universities, promoting the development of physical education towards a "more scientific, fair, and efficient" direction. It should be noted that artificial intelligence is only a tool, and its application should follow the laws of physical education teaching and the characteristics of students' physical and mental development. It cannot blindly pursue technological cool while ignoring the essence of education. Subsequent research can further explore the application of artificial intelligence in teaching special students in sports ideological and political education (such as adaptive sports for disabled students) to enrich application scenarios. At the same time, attention should be paid to the long-term effects of technological applications, such as the impact on students' exercise habits and physical fitness, in order to provide more comprehensive support for the intelligent transformation of physical education teaching in universities.

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