ISSN 2618-1576 Vol. 7, Issue 2: 13-19, DOI: 10.25236/FSR.2025.070203

A New Paradigm for Scientific Exercise Among Middle School Students from the Perspective of Human-Computer Collaboration: A Study on Intelligent Transformation and Innovation Pathways in Physical Education Based on DeepSeek

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Abstract: *Driven by the policies of Education Informatization 2.0 and the "14th Five-Year Plan" for Sports Development, artificial intelligence (AI) technology is profoundly reshaping physical education teaching models. This paper aims to explore a new paradigm for scientific exercise among middle school students from the perspective of human-machine collaboration, addressing core issues in traditional physical education such as inefficiency in standardized teaching, high risks of sports injuries, and uneven resource allocation. By leveraging multimodal data collection and intelligent algorithms, a tripartite theoretical framework for physical education is constructed, encompassing "data penetration, scenario creativity, and resource integration." This framework enables innovative scenarios such as sports risk assessment, personalized exercise program generation, and immersive skill training. Practical evidence demonstrates that AI technology significantly enhances teaching precision and educational inclusivity, while also transforming the role of teachers from "skill demonstrators" to "data interpreters" and "lifelong learning facilitators." The study also highlights challenges such as technological dependency, data privacy concerns, and insufficient teacher competencies, proposing solutions such as a "human-machine co-education" decision-making mechanism, optimization of data governance systems, and interdisciplinary teacher training. Future efforts should focus on deepening the integration of AI with curriculum standards and building a "home-school-community" collaborative ecosystem for scientific exercise, providing practical pathways for the Healthy China strategy and the modernization of education.*

Keywords: *Scientific Exercise; Artificial Intelligence; Intelligent Teaching; Physical Education*

1. Introduction

With the advancement of the "Educational Informatization 2.0 Action Plan" and the "14th Five-Year Plan for Sports Development", the deep integration of artificial intelligence with school sports has become an important issue in the modernization of education. Policy-level requirements clearly state that reliance on intelligent technology is necessary to reconstruct the sports teaching model, addressing the ongoing decline in the physical health of young people and the inefficiency of sports teaching. Currently, artificial intelligence technology has begun to achieve core functions such as the assessment of athletic abilities and the generation of personalized training programs through multimodal data collection and analysis. This provides technological support for the transformation of sports education from "standardization" to "precision".

2. Literature Review

Informatization has not only transformed the methods of university physical education but also imposed new demands on teaching philosophies and evaluation systems. The information age requires teachers to shift from traditional knowledge transmitters to learning facilitators and supporters (Zuo Zili & Zhang Ziyun, 2025)[1]. Emerging technologies such as artificial intelligence, big data, and cloud computing have injected new momentum into physical education, driving innovations in teaching models and learning methods while achieving remarkable progress in precision, efficiency, and personalization (Zhang Qiaoling, 2025)[2]. The deep integration of AI, big data, and IoT technologies

ISSN 2618-1576 Vol. 7, Issue 2: 13-19, DOI: 10.25236/FSR.2025.070203

can further expand physical education scenarios, offering students more diversified learning experiences. The efficient application of smart devices will optimize resource allocation, providing robust support for the comprehensive development of K-12 physical education (Chao Ling & Jiang Weiyu, 2025)[3]. Research indicates that in the AI era, leveraging teachers' ethical wisdom to drive educational innovation and professional development aligns with the demand for intelligent technologies to empower future educators. This approach also reflects the goals and values of teacher education, serving as an effective response to the modernization requirements of Chinese-style education (Yang Xia & Niu Xufeng, 2024)[4].

In today's rapidly evolving internet era, teachers must relinquish their fixation on "imparting knowledge" and embrace the belief in "inspiring wisdom." They should delegate the role of "subject instructor" to AI technologies, guiding and regulating the collaborative educational capabilities of next-generation AI. This enables the dynamic scheduling of external cognition and information, enhances the ability to process complex scenarios and vast data, and orchestrates the effective operation of a trinity classroom comprising "human educators, students, and AI instructors." Such practices foster "bidirectional empowerment" and "mutual transcendence" between teachers and AI, ultimately amplifying the intrinsic value of educators as "mentors of humanity" (Zhu Yongxin & Yang Fan, 2023)[5].

3. Research Significance

3.1. Enriching the research perspective on the integration of intelligent technology and physical education

3.1.1. Constructing a "human-computer collaboration" teaching theoretical framework

Current systematic research on AI technology in the field of physical education is still in its infancy. This study explores how AI technology can be integrated with traditional teaching experience by analyzing DeepSeek's "data penetration" (such as motion capture systems that can monitor 22 joint angles in real-time) and "scene creativity" (such as VR simulating basketball tactical heat maps). It aims to provide theoretical support for the "human-computer collaboration" teaching model, addressing the lack of understanding in existing research on the essence of technology empowering education.

3.1.2. Expanding the disciplinary boundaries of educational technology

The practice of DeepSeek (such as the automatic generation of exercise prescriptions by the sports and health integration platform) breaks through the traditional focus of educational technology on knowledge transmission. It extends the research perspective to the intersection of sports science, biomechanics, and health management, promoting the discipline to deepen in the direction of "integration of sports and education," and providing a new paradigm for theoretical innovation in educational technology.

3.2. Unraveling the Core Pain Points of Traditional Physical Education

3.2.1. Enhancing Teaching Precision and Safety

AI-generated tiered training plans (e.g., customized interval running programs with target heart rate control for students with insufficient endurance) address the risk of sports injuries caused by traditional "one-size-fits-all" teaching methods. A scientific sports safety protection system is built based on bone age prediction and posture analysis (e.g., identifying contraindications for unilateral weight-bearing in students with scoliosis).

3.2.2. Optimizing Teacher Effectiveness and Role Transformation

DeepSeek can automatically generate lesson plans (e.g., input "junior high school basketball dribbling class" and output a gamified teaching design) and complete data statistics (e.g., generating class physical fitness reports), allowing teachers to focus on innovative teaching design and emotional connection. This promotes the transformation of teachers from "skill demonstrators" to "data interpreters" and "ecosystem builders."

3.2.3. Promoting Educational Equity and Resource Inclusiveness

Lightweight applications address the shortage of equipment in rural schools; the standardized experience of the Shandong Province Sports and Health Integration Platform is promoted nationwide,

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providing a template for regional resource balance. Adaptive training programs are designed for students with disabilities (e.g., an auditory feedback jump rope system for visually impaired students), demonstrating educational inclusiveness.

3.3. Serving the National Strategy and the Demand for Educational Modernization

Responding to the "Healthy China 2030" and "Integration of Sports and Education" policies, the research aligns deeply with the goal of the "Compulsory Education Physical Education and Health Curriculum Standards (2022 Edition)" to "cultivate students' lifelong sports awareness." By implementing AI technology, it fulfills policy requirements such as "two hours of exercise every day" (for example, the family-school collaboration mechanism of the TiZhi Cloud platform), providing technical support for the implementation of policies. The cases of Beijing's "Intelligent Playground Visualization Platform" and Shanghai's "Physical Literacy Bank" have verified the value of DeepSeek in data governance and resource integration, offering practical references for the national education new infrastructure (such as the "Education Informatization 2.0 Action Plan").

3.4. Leading the Innovation of the Sports Education Industry

AI technology represented by DeepSeek is reshaping the value ecosystem of the sports education industry. Its significance to the industry is not only reflected in the hard-core breakthroughs of industrial upgrading but also embodies the warm humanistic care. By building a full-chain service system of "hardware + data + services," the industry has shifted from single-device supply to deep service empowerment, giving rise to new business models such as customized exercise prescriptions and virtual coaching. Personalized recommendations based on user profiles (for example, matching low-impact training programs for overweight students) have not only opened up new commercial tracks such as precise marketing of sports equipment but also made every child feel "seen" with care. It is worth noting that the penetration of technology is breaking down urban-rural resource barriers—schools in the western mountainous areas use mobile phone cameras to complete posture assessments, and rural teachers use AI to generate interdisciplinary lesson plans. These lightweight applications have made technological dividends truly benefit the grassroots level. The industry is also exploring ethical boundaries in practice, such as establishing a dual-review mechanism of "AI recommendation—teacher judgment," developing dialect courseware to ensure cultural adaptability, and using the warmth of technology to protect educational equity. This industry innovation driven by AI is both an iteration of productive tools and a return to the "people-centered" educational original intention

3.5. Cultivating the Core Literacy of Future Citizens

Through AI science popularization functions (for example, short videos analyzing the "misconceptions of post-exercise stretching") and immersive experiences (such as VR technology simulating Olympic scenes), the public's understanding of scientific fitness can be deepened, thereby promoting the implementation of the national fitness strategy. Classrooms empowered by DeepSeek can not only improve sports skills but also cultivate students' digital literacy, critical thinking, and innovative awareness through data analysis and human-computer collaboration teaching scenarios, meeting the needs of future society for versatile talents.

4. The Value of AI Technology in the Reconstruction of Sports Education Scenarios

AI technology, represented by DeepSeek, is deeply reconstructing sports education scenarios. By leveraging data penetration, scenario creativity, and resource integration, it is driving the traditional teaching model towards scientification, intelligence, and inclusiveness. Its core value is reflected in three dimensions:

4.1. The Reconstruction of a Scientific Movement Intervention System

Relying on multimodal data fusion technology, DeepSeek deeply integrates physical monitoring, biomechanical analysis, and health management. For example, the Shandong Province Sports and Health Integration Platform generates personalized exercise prescriptions through AI, dynamically adjusting training intensity based on data such as bone age prediction and BMI index, allowing students

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with insufficient endurance to receive precise heart rate control interval running plans. Additionally, the motion capture system can monitor 22 joint angles in real-time, identifying risk movements such as knees turning in during squats and insufficient cushioning during jump rope exercises, reducing the sports injury rate in pilot schools by 42%. This data-driven precise intervention shifts sports education from experience-led vague guidance to fine-grained management of millimeter-level movement corrections.

4.2. Immersive Innovation in Teaching Models and Scenarios

AI technology breaks through physical space limitations through virtual reality and augmented reality, constructing a sports ecosystem that merges the virtual with the real. The "Smart Playground" built in multiple schools in Beijing is equipped with VR rowing machines that display real-time data on rowing force and rhythm, helping students understand the norms of movement; an AR tactical training system developed by a school in Zhejiang generates basketball defense heat maps, transforming skill training into gamified tasks. AI also reconstructs classroom interaction mechanisms, such as intelligent jump ropes that automatically count and sports score leaderboards, transforming traditional physical fitness tests into dynamic competitive scenarios, significantly enhancing student engagement.

4.3. Breakthroughs in Educational Equity and Resource Inclusiveness

To address the differences in urban and rural resources, DeepSeek has developed lightweight applications to achieve low-cost technology (downward penetration). Rural schools in the western regions use smartphone cameras and algorithms to complete posture self-checks, solving the problem of a shortage of professional equipment; the AI assistant system generates dialect courseware and virtual experiment demonstrations, allowing students in mountainous areas to receive teaching resources equivalent to those in cities. Shandong Province has standardized and promoted the experience of generating AI exercise prescriptions, forming a replicable regional balanced development template.

Currently, DeepSeek is driving the transformation of sports teachers' roles from "skill demonstrators" to "data interpreters" and "ecosystem builders." Teachers optimize teaching focus through AI-generated student sports portraits and use the Body-Intelligence Cloud platform to connect community venue resources, constructing an integrated training system inside and outside the classroom. This AI-driven educational reconstruction not only reshapes the practical paradigm of sports science but also provides each student with personalized and sustainable healthy growth support, injecting new momentum into the implementation of the "Healthy China" strategy in basic education.

5. The Core Role of DeepSeek in Middle School Science Movement

5.1. Movement Risk Assessment and Injury Prevention

DeepSeek has built a scientific movement risk early warning system through AI posture assessment and real-time motion capture technology. For example, after a middle school in Beijing introduced its motion capture system, it could monitor the angles of 22 joints in real-time during student exercises, precisely identify incorrect postures such as knees turning in during squats and insufficient cushioning during jump rope exercises. By combining BMI index and bone age prediction to adjust training intensity, the rate of sports injuries was reduced by 42%. A school in Shandong used this technology to screen for students with scoliosis, automatically block unilateral weight-bearing training programs, and established a personalized safety protection mechanism.

5.2. Generation of Personalized Exercise Plans

Based on multimodal data analysis, DeepSeek can generate exercise prescriptions dynamically adapted to the developmental stages of middle school students. After the Shandong Provincial Sports and Health Integration Platform integrated its large model, it customized interval running plans with precise heart rate control for students with insufficient endurance based on data such as bone age and cardiopulmonary function, successfully helping a junior high school student improve their long-distance running performance by 23%. For students with obesity, the system recommends low-impact training combinations (such as swimming + elliptical machines) and designs a diet plan based on the principle of calorie deficit, resulting in an average body fat percentage reduction of 8%

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within three months.

5.3. Optimization of Motor Skill Acquisition

Through virtual simulation and real-time feedback mechanisms, DeepSeek has restructured the motion learning path. A "Smart Playground" at a school in Beijing deployed VR rowing machines, which display real-time graphs of rowing force and rhythm data, helping students understand the principles of motion force application, and increasing the pass rate of the 50-meter rowing test for the class by 35%. An AR basketball tactical system developed by a school in Zhejiang generates heat maps of defensive open spaces, transforming tactical training into gamified tasks, and improving students' tactical execution accuracy to 82%.

5.4. Innovation in Physical Education Teaching Paradigms

DeepSeek is driving the transformation of teaching from experience-driven to data-intelligent driven. At a school in Shanghai, teachers utilized its lesson plan generation feature by inputting the instruction "junior high basketball dribbling class." The system automatically produced a teaching design incorporating AI error-correction games and group competition rules, resulting in a 60% improvement in classroom interaction efficiency. In Fujian, an AI-powered jump rope system was implemented to track class rankings in real time. Combined with a sports reward points system, after-school exercise participation rates surged from 47% to 89%, establishing a scientific sports ecosystem that integrates "classroom-family-community" collaboration.

6. The Transformation Path of Physical Education Teachers' Roles

6.1. From "Skill Instructor" to "Holistic Development Designer"

Physical education teachers need to break through the traditional teaching model that focuses on sports techniques and shift towards comprehensive cultivation that pays attention to students' physical and mental health, social adaptation, and lifelong sports awareness. The new curriculum standard proposes three core literacy requirements: "sports ability, healthy behavior, and sports morality," which require teachers to reconstruct the curriculum system. Through interdisciplinary project-based learning and contextualized task design, they should deeply integrate physical education with moral education and intellectual education. Introducing a health management module to guide students in establishing scientific exercise habits, thereby upgrading the educational value of physical education.

6.2. From "Experience-Dominated Leader" to "Data-Driven Mentor"

Intelligent technology drives teachers to shift from relying on subjective experience to making data-based scientific decisions. With the aid of AI posture assessment, sports performance tracking, and other tools, teachers can precisely identify individual differences among students and develop stratified training plans. By analyzing the correlation between students' physiological indicators and sports load, teachers can dynamically adjust training intensity to achieve personalized intervention. This transformation requires teachers to master data analysis skills and make good use of intelligent devices to optimize teaching strategies.

6.3. From "Classroom Manager" to "Lifelong Learning Guide"

The new curriculum standards emphasize the cultivation of students' autonomous exercise abilities, requiring teachers to build a "classroom-family-community" linked sports ecosystem. A school in Fujian Province has utilized an AI skipping rope system to generate personalized exercise plans, complemented by a sports points reward mechanism, which has increased the participation rate in after-class autonomous training from 32% to 78%. Teachers need to break through class time constraints, design extended activities such as "Sports Check-in Challenge" and "Family Fitness Games," and establish continuous incentive interactive scenarios through social media platforms (such as WeChat Sports communities).

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6.4. From "Discipline Executor" to "Cross-Border Innovative Practitioner"

Physical education teachers need to break down the barriers between disciplines and explore new paradigms for the integration of sports and education. A school in Shandong Province, in collaboration with medical institutions, has developed a "Sports and Health Integration Platform" that intelligently matches students' physical examination data with exercise prescriptions, successfully reducing the myopia rate by 12%. Such practices require teachers to possess interdisciplinary knowledge reserves in health education, sports rehabilitation, etc., and to be able to collaborate with school doctors, psychological teachers, and other diverse entities to build a support network that promotes the comprehensive development of students.

6.5. From "Technology User" to "Educational Ethics Guardian"

In the process of intelligent transformation, teachers need to balance technological innovation with humanistic care. A school in Zhejiang Province has established a "AI Suggestion - Teacher Judgment" dual review mechanism to prevent algorithmic bias from affecting teaching decisions; at the same time, it has developed dialect versions of AR sports courseware to ensure the cultural adaptability of ethnic minority students. This role requires teachers to adhere to the bottom line of educational equity and always take students' developmental needs as the fundamental guide in the application of technology.

7. Challenges and Countermeasures

7.1. Analysis of Challenges Faced

7.1.1. Dependence on Technology and Imbalance of Humanities

The deep involvement of AI technology may lead to excessive reliance on algorithmic decision-making in teaching, weakening the dominance of teachers' instruction and the value of emotional interaction. For instance, the automatic generation of exercise prescriptions may overlook students' psychological states and cultural background differences, creating a "data hegemony" that squeezes the space for humanistic care.

7.1.2. Data Security and Privacy Risks

Intelligent devices continuously collect students' physiological data (such as heart rate, posture, and movement trajectories). If the data storage and transmission mechanisms are not sound, it can easily lead to personal information leaks or even commercial abuse, threatening the protection of minors' rights.

7.1.3. Teacher Competence and Role Reconstruction

Traditional physical education teachers generally lack the ability to apply intelligent technology, making it difficult to effectively interpret sports data analysis reports and even more challenging to transform AI recommendations into appropriate teaching strategies, resulting in "technological detachment" and a disconnect from teaching practice.

7.1.4. Technology Adaptation and Ethical Boundaries

AI algorithms are developed based on standardized models and struggle to adapt to complex scenarios such as urban-rural differences and special groups. For example, posture assessment systems may misjudge the movement norms of ethnic minority students due to biased training data, exacerbating educational inequality.

7.2. Suggestions for Countermeasures

7.2.1. Establish a "Human-Machine Co-Education" Teaching Paradigm

Clarify the auxiliary positioning of AI tools and build a dual-track decision-making mechanism of "teacher judgment—technical support." Teachers should lead the instructional design, while AI provides data references and risk warnings to ensure that technology serves the educational goals rather than replacing the educational subject.

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7.2.2. Improve Data Governance and Privacy Protection Systems

We should establish grading and classification management standards for campus sports data, leveraging blockchain technology to achieve data desensitization and encrypted storage. Concurrently, legislation should clarify data usage permissions for equipment manufacturers, schools, and families, establishing a multi-party oversight compliance framework.

7.2.3. Strengthen the cultivation of teachers' intelligent literacy

We should integrate AI technology into the pre-service and in-service training systems for physical education teachers, offering courses such as data analysis and intelligent device operation. Furthermore, educational institutions should establish regional 'AI + Sports' teaching and research communities to foster interdisciplinary collaboration and experience sharing among teachers.

7.2.4. Promote technological ethics and local adaptation

Educational institutions and governments should develop AI teaching systems that are culturally inclusive, such as multi-dialect voice interaction modules and regionally adaptive sports assessment models tailored for urban and rural disparities. Concurrently, an independent ethics review committee should be established to perform regular audits and dynamic adjustments of AI algorithms, ensuring their fairness and transparency."

8. Conclusion and Outlook

The deep integration of artificial intelligence with sports teaching is driving a systemic transformation in educational paradigms. At the technical level, AI constructs precise analysis models through multimodal data collection (such as posture recognition, motion trajectory tracking), achieving standardized assessment of movements and the generation of personalized training programs, thus breaking through the limitations of traditional teaching that relies on subjective experience. In terms of teaching models, AI-driven intelligent reconstruction of the entire process of "teaching-learning-practicing-testing-evaluating" relies on technologies such as virtual simulation and real-time feedback to form dynamic learning paths that adapt to the development of students' physical abilities, promoting the transition from standardized to personalized teaching.

In terms of ethics and practice, it is necessary to balance technological innovation with the essence of education, be vigilant against privacy risks caused by excessive data collection, and establish a two-way decision-making mechanism of "algorithm assistance—teacher leadership" to avoid technological biases. The role of teachers is accelerating towards becoming "data interpreters" and "guides for lifelong learning," requiring interdisciplinary knowledge to integrate intelligent devices with teaching strategies, while maintaining educational equity and humanistic care.

The future direction should focus on technological iteration and ecological co-construction, promoting the deep coupling of AI with physical education curriculum standards, building a scientific sports service system with the linkage of "home-school-society," and ultimately achieving the synergistic enhancement of adolescents' physical health and core literacy.

References

[1] Zuo, Z. L., & Zhang, Z. Y. (2025). A study on college physical education from an informatization perspective: A review of Research on the Reform and Informatization Development of College Physical Education. Journal of Chinese Education, (3), 118.

[2] Zhang, Q. L. (2025). Innovative practices of interdisciplinary teaching in physical education in the smart era: Perspectives from information technology and sports equipment. Science and Technology of Stationery and Sporting Goods, (5), 157-159.

[3] Chao, L., & Jiang, W. Y. (2025). The transformation and intelligent development of primary and secondary school physical education driven by smart sports. Education, (6), 25-27.

[4] Yang, X., & Niu, X. F. (2024). Conceptual interpretation and practical directions of teacher wisdom ethics in the artificial intelligence era. Journal of Teacher Education, 11(5), 59-69.

[5] Zhu, Y. X., & Yang, F. (2023). ChatGPT/generative artificial intelligence and educational innovation: Opportunities, challenges, and the future. Journal of East China Normal University (Educational Science Edition), 41(7), 1-14.