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AI-Empowered Innovation in the Management Model of "Balancing Study and Training" for College Student-Athletes with Special Talents

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Abstract

The rapid development of artificial intelligence (AI) technology offers new pathways to address the contradiction between academic study and athletic training in the cultivation of college student-athletes with special talents. Based on an objective analysis of the causes of the "study-training contradiction," this paper proposes a transformation in governance philosophy centered on "data governance," "personalized customization," and "proactive early warning." By constructing an "intelligent sensing" data infrastructure, designing a "dual-track parallel" algorithmic model, and establishing a "human-machine collaboration" closed-loop feedback mechanism, the study elaborates the implementation pathways for AI-enabled "study-training balance." This approach aims to advance the cultivation of student-athletes from traditional extensive and reactive management towards precise, personalized, and forward-looking intelligent governance, thereby providing theoretical and practical insights for deepening the national strategy of "integrating sports with education."

Keywords: Artificial Intelligence (AI), college student-athletes with special talents, study-training balance, management model, precision governance

1. Introduction

With the breakthrough development of generative artificial intelligence, computer vision, and wearable device technology, AI is penetrating various fields of higher education to an unprecedented depth. In January 2025, the "Outline of the Plan for Building a Leading Country in Education (2024–2035)" issued by the Central Committee of the Communist Party of China and the State Council clearly stated: "Promote artificial intelligence to facilitate educational reform… deepen the role of AI in strengthening the teaching workforce and build a large-scale AI education model" (Central Committee of the Communist Party of China, State Council, 2025). In March 2026, Premier Li Qiang further emphasized in the "Government Work Report" the need to "continue to advance the digital transformation of manufacturing and the 'AI+' initiative, accelerate the implementation of industry applications, and continuously introduce new types of intelligent terminals" (Xinhua News Agency, 2026). College student-athletes with special talents represent a vital force in the cultivation of reserve talents for competitive sports in China, yet their "study-training balance" has always been a core bottleneck restricting the quality of their development.

Based on an analysis of the causes of the pervasive "study-training conflict" among college student-athletes with special talents, this paper proposes actionable core AI-empowered philosophies and innovative pathways for management models, providing decision-making references for university sports management departments, coaches, and academic administrators, and thereby contributing to the in-depth advancement of China's "integration of sports and education" strategy.

2. Causes of the "Study-Training Contradiction" Under the Traditional Management Model

2.1 The Physical Conflict of Time and Energy

The core root of the "study-training contradiction" for college student-athletes with special talents lies in a structural resource scarcity. High-intensity skill training and intensive academic coursework place exceptionally high demands on physical function and cognitive ability, respectively. A fundamental, irreconcilable physical conflict exists between the two in terms of time and energy, leading to the normalization and frequent escalation of the contradiction (Li Guangning, 2015).

Currently, many Chinese universities adopt a "block-based" time management model, attempting to resolve the conflict through simple chronological segmentation, such as "training in the morning, studying in the afternoon" or vice versa. While seemingly well-organized, this model essentially uses a static, fixed schedule to frame dynamic, differentiated physical and cognitive recovery curves. For student-athletes, high-intensity specialized skill training in the morning induces a state of deep physical fatigue. Immediately transitioning to coursework requiring high levels of concentration and mental energy results in a significant decline in cognitive function and low learning efficiency. Conversely, the psychological anxiety caused by heavy academic burdens and exam pressure can lead to technical movement distortion, decreased focus, and increased risk of sports injuries during training (Wu Aihua & Zhang Jingjun, 2007). Furthermore, this block-based approach overlooks individual differences in circadian rhythms, potentially scheduling training or study during an individual's physiological and psychological trough, further exacerbating efficiency loss and fatigue accumulation. Consequently, neither study nor training can reach an optimal state, resulting in mutual hindrance and difficulty in achieving expected heights in both academic performance and athletic achievement.

2.2 "Experiential" and "Extensive" Management Mechanisms

In non-sports-specialized institutions, a normalized mechanism for information sharing and collaborative decision-making among academic affairs offices, student affairs departments, and coaching teams has yet to be established. Academic data, psychological state assessments, and physical fitness monitoring remain isolated from one another, forming de facto "data silos." The handling of the "study-training contradiction" for student-athletes exhibits pronounced "experiential" and "extensive" characteristics.

Coaches and academic administrators, as the primary decision-makers in student-athletes' study and training, often rely on personal experience and past practices when arranging courses or training sessions. Their first consideration is usually the availability of classrooms or training venues, rather than scientific assessments based on students' physical recovery curves, course difficulty cycles, or individual adaptability. This "experiential" management approach carries significant randomness and is heavily dependent on the individual capabilities of the manager, making it difficult to form stable, replicable, and effective solutions.

The "extensive" approach manifests as a "one-size-fits-all" strategy. When faced with academic warnings or training bottlenecks, management measures often fall into a dilemma of "suspending training to preserve academics" or "suspending academics to preserve training," treating "study" and "training" as irreconcilable opposites. This simplistic severance interrupts the continuous accumulation process in both professional academics and skill training. Suspending training to catch up on studies leads to a decline in physical fitness and technique with increased recovery costs, while suspending studies to maintain training results in academic disconnection, knowledge fragmentation, and dramatically heightened psychological stress.

The experiential and extensive nature of the management mechanism prevents any party from making optimal decisions based on comprehensive information, causing management actions to be delayed, one-sided, and passive, ultimately unable to achieve the dynamic optimal allocation of resources for both study and training or to provide process-oriented risk early warning.

2.3 "Singular" and "Fragmented" Evaluation Systems

Within the traditional evaluation system for student-athletes, outcome-based assessment characterized by "singularity" and "fragmentation" replaces comprehensive, developmental considerations of their growth process, further aggravating the "study-training contradiction."

In academic learning, course examination scores and grade point averages serve as the sole criterion for determining academic performance and scholarship eligibility, neglecting factors such as effort, improvement, and time lost due to training and competitions. In skill training, evaluation focuses on quantifiable competitive indicators like competition rankings, standard achievement scores, and athletic grades, with insufficient attention given to process-oriented qualities such as training attitude, team spirit, tactical understanding, and psychological resilience. This singular, "score-only" or "result-only" evaluation standard leads some students to make utilitarian trade-offs based on the evaluation "baton," making it difficult to cultivate an intrinsic pursuit of holistic self-development.

The fragmentation of the evaluation system mainly manifests in treating student-athletes' academic performance and athletic performance as two separate modules, assessed independently by academic affairs departments and sports departments, with a lack of effective linkage and integration between the two. When it comes to awards and scholarships, academic and athletic scores are often simply added together, lacking a comprehensive consideration of "excellence in both sports and academics, well-rounded development." This fragmented evaluation institutionally solidifies the opposition between "study" and "training," failing to establish an effective incentive and transfer mechanism that enables students to transfer qualities cultivated in skill training—such as perseverance, focus, and stress resistance—to academic learning, or to apply strategic thinking and systematic analysis skills developed through academics to skill enhancement. The complete identity of student-athletes as "student athletes" is thus dismembered within this evaluation system.

3. Core Concepts of the AI-Empowered "Study-Training Balance" Management Model

3.1 From "Experience-Based Management" to "Data Governance"

Through wearable devices, learning management systems, and other technologies, AI can collect multi-dimensional data on student-athletes' training load, physiological indicators, learning behavior, and psychological state in real time. This drives the management model from "experience-based management" reliant on individuals towards "data governance" grounded in objective data. This not only effectively compensates for the shortcomings of traditional physical education teaching methods but also powerfully promotes the updating and transformation of physical education teaching practices (Yang Jie & Xu Yuxuan, 2026).

Specifically, the AI-empowered data governance system primarily consists of three layers: The physiological data layer, which uses smart wristbands, heart rate monitors, oximeters, and other wearable devices to monitor physiological indicators such as heart rate variability, blood oxygen saturation, sleep quality, and exercise load in real time, accurately gauging physical fatigue and recovery status. The behavioral data layer, which integrates data sources like campus smart cards, academic affairs systems, and online learning platforms to obtain learning behavior data such as class attendance rates, online learning duration, and assignment submissions, constructing a quantitative profile of individual learning engagement. The environmental data layer, which captures external contextual factors including competition schedules, course timetables, exam arrangements, and weather conditions, building a repository of environmental variables influencing student status. These data, after cleansing, integration, and analysis, construct a virtual model that synchronously maps and dynamically updates alongside the real student-athletes.

Based on this virtual digital model, coaches, counselors, and academic administrators can achieve a shift from "post-event response" to "real-time perception" and from "experience-based judgment" to "precise quantification." The system can calculate each student's "comprehensive load index" and automatically issue alerts when the combined training load and academic pressure exceed safety thresholds. It can mine historical data to analyze key risk factors leading to academic decline or training injuries and simulate the effects of different study-training arrangement scenarios, providing scientific decision-making support for managers. This data-driven governance model not only improves the scientific validity and accuracy of decisions but also, through data accumulation and model iteration, forms an accumulative, replicable, and optimizable management knowledge base, reducing reliance on individual experience and achieving a systemic enhancement of management capacity.

3.2 From "Uniform Model" to "Personalized Customization"

Through machine learning algorithms that deeply mine multi-source heterogeneous data, AI breaks the shackles of uniform management, accurately identifying the uniqueness and differences of individual student-athletes. It generates dynamically adjusted personalized plans, achieving genuine "teaching according to aptitude" and "personalized customization."

The realization of AI-driven personalized customization depends on three key types of algorithms: First, cluster analysis algorithms are used to identify student-athlete typologies, classifying them into categories such as "morning training efficient type," "night study active type," or "high fatigue recovery demand type," providing a basis for differentiated management. Second, predictive modeling algorithms are employed to estimate individual responses, judging changes in academic performance under specific training loads or predicting the impact of course scheduling on training status based on historical data. Third, optimization algorithms are mainly used to generate optimal plans, seeking Pareto optimality among multiple objectives such as "training effectiveness," "academic performance," and "physical and mental health," outputting the optimal time allocation and task arrangement for each student. This ultimately achieves a "one student, one plan" approach with round-the-clock, companion-style guidance (Wei Kunlun, 2026).

3.3 From "Reactive Response" to "Proactive Early Warning"

The AI-empowered management model enables the front-loading of risk control and the precision of intervention measures, driving a shift from "firefighting-style" reactive response to "preventive" proactive governance. Under the traditional model, managers often only intervene when student-athletes exhibit obvious problems such as failed courses, injuries, or psychological crises, by which point the damage is already done, leading to high intervention costs and poor outcomes. By constructing predictive analytical models, AI identifies potential risk signals in advance and triggers early warning mechanisms at the nascent stage of a problem, securing a valuable time window for "nipping problems in the bud."

The proactive early warning system encompasses two core types of models: The first is the academic risk early warning model, which integrates historical grades, attendance records, assignment performance, online learning behavior, and other data. Using logistic regression, random forest, or deep learning algorithms, it predicts the probability of course failure and academic regression risks. When the model identifies risk signals such as a recent decline in attendance, an increase in late homework submissions, or a sharp drop in online learning duration, it automatically sends alerts to coaches, counselors, course instructors, and the students themselves, triggering academic support interventions. The second is the training risk early warning model, which, based on physiological data from wearable devices and training logs, monitors early signs of overtraining syndrome—such as a sustained increase in resting heart rate, decreased heart rate variability, and deteriorating sleep quality. Combined with historical sports injury data and sport-specific characteristics, it predicts the probability of injury occurrence and promptly advises coaches to adjust training plans, increase recovery modalities, or conduct medical examinations. The significance of proactive early warning lies not only in "early detection" but also in the precision of "early intervention." It avoids the extensive, one-size-fits-all approach, safeguarding both the physical and mental health of student-athletes and protecting the continuity of study and training activities, thereby truly realizing a "preventive treatment" philosophy in student management.

4. Implementation Pathways for the AI-Empowered "Study-Training Balance" Management Model

4.1 Constructing an "Intelligent Sensing" Data Infrastructure

The cornerstone of AI-empowered "study-training balance" management for student-athletes lies in constructing a comprehensive, multi-dimensional, real-time, and dynamic "intelligent sensing" data infrastructure. This infrastructure, supported by modern information technologies such as the Internet of Things, big data, and cloud computing, breaks down the information silos inherent in traditional management, enabling the systematic collection, integration, and analysis of full-process, full-scenario data on student-athletes, thereby providing a scientific basis for precision management.

The construction of the data infrastructure must follow the principles of "comprehensive perception, dynamic integration, and security compliance." At the data acquisition level, multi-source heterogeneous data access technologies integrate various data sources, including intelligent wearable devices, classroom behavior analysis systems, online learning platforms, training monitoring equipment, psychological assessment systems, and medical health records. This multi-modal data collectively constitutes a digital twin reflecting the physical and mental state of the student-athlete.

At the data integration level, unified data standards and interface specifications must be established. ETL technologies are used to clean, align, and fuse multi-source heterogeneous data, forming a full-life-cycle data warehouse centered on the individual student-athlete. This warehouse contains not only static basic information (such as personal characteristics, sport specialty, academic background) but, more importantly, continuously accumulates dynamic process data, forming a traceable student development trajectory. Through a data middle-platform architecture, standardized data management and service encapsulation are achieved, providing high-quality, easily accessible data services for upper-level intelligent applications.

At the data security and ethics level, a strict data privacy protection system must be instituted. All data collection, storage, and use must be conducted with the informed consent and authorization of the student-athletes and follow the principle of minimal necessity. Technical measures such as data anonymization, encrypted transmission, and access permission restrictions must be used to ensure personal information security. Simultaneously, ethical norms for data usage should be established, explicitly stating that data is used solely to promote student development and prohibiting any form of inappropriate use.

4.2 Designing a "Dual-Track Parallel" Intelligent Algorithm Model

Based on the "intelligent sensing" data infrastructure, a "dual-track parallel" intelligent algorithm model must be designed, targeting the two core dimensions of training and academics for student-athletes, to achieve personalized, adaptive study-training synergistic optimization.

On the intelligent training track, the system achieves scientific and personalized training through the collection of multi-dimensional data. First, based on motion capture technology and biomechanical analysis algorithms, it conducts real-time quantitative assessments of student-athletes' technical movements, identifying inefficient segments and potential injury risks in movement patterns. Second, combining physiological monitoring data such as heart rate, blood lactate, and VO2max with subjective fatigue scales, it constructs a personalized training load quantification model to dynamically assess fatigue accumulation and recovery status. Finally, machine learning algorithms establish an "academic pressure–training adaptability" prediction model, analyzing the influence patterns of academic stressors—such as exam cycles, course difficulty, and learning performance—on training adaptability. During peak academic pressure periods, it automatically suggests adjustments to training intensity, volume, or content, preventing the dual decline of overtraining and academic performance. Practical results show that this effectively helps student-athletes enhance their competitive performance capabilities (Li Duanying, Li Jie, Yang Qun, et al., 2021).

On the precision academics track, the system utilizes educational big data and learning analytics technologies to design customized academic support plans for student-athletes. First, addressing common issues such as weak foundational knowledge, fragmented study time, and missed classes due to training and competitions, the system uses knowledge graph technology to construct disciplinary knowledge structures and adaptively pushes micro-courses, explanatory videos, targeted exercises, and error collections matching their cognitive level and learning style. Second, it designs a "fragmented learning optimization algorithm" that intelligently recommends the most suitable learning content and format for available time slots in a student-athlete's schedule, enhancing time utilization efficiency. Third, the system integrates natural language processing technology to provide functions such as intelligent Q&A and assignment grading. Fourth, it establishes a "training load–cognitive function" correlation model, intelligently adjusting the difficulty and presentation of learning content based on real-time physiological fatigue data, avoiding high-intensity cognitive activities during high-fatigue states to ensure learning efficiency.

4.3 Establishing a "Human-Machine Collaboration" Closed-Loop Feedback Mechanism

The AI-empowered management model for "study-training balance" in college student-athletes does not replace human decision-making. Instead, it constructs a "human-machine collaboration" closed-loop feedback mechanism that organically combines AI's strengths in data processing and pattern recognition with managers' experiential judgment and emotional communication abilities, forming a decision-making community with complementary advantages.

Within this mechanism, the AI system assumes the roles of "intelligent perception" and "analysis and recommendation." Based on the data infrastructure and algorithm models, the AI continuously monitors multi-dimensional status indicators of student-athletes. When anomalies are detected—such as a trend of declining academic performance, an abnormally elevated training load index, or physiological indicators suggesting insufficient recovery—the system automatically triggers alerts and, drawing on historical data and case libraries, generates preliminary cause analyses and intervention recommendation plans.

Coaches, counselors, academic advisors, and others play the core roles of "decision execution" and "humanistic care." They receive the analysis reports and recommendations provided by the AI but do not execute them passively. Instead, they judiciously evaluate and adjust the AI's suggestions based on their in-depth understanding of the students, professional experience, and the specific context, making the final decision. For example, a coach, relying on their knowledge of an athlete's personality and psychological state, might determine that reducing intensity is inappropriate during a critical training phase and that psychological motivation should be supplemented. A counselor might discover, through face-to-face communication, family-related factors behind a student's declining grades and thus adopt a different intervention method from the AI's suggestion. The managers implement the decisions and continuously observe student reactions during implementation, collecting new data to feed back into the AI system.

This process forms a complete "monitoring – analysis – decision – execution – feedback" management loop. AI's involvement makes monitoring more comprehensive and real-time, and analysis more objective and profound; the participation of coaches and counselors ensures flexibility and a human touch in decision-making. More importantly, the outcome data from each decision execution are fed back into the system to optimize the algorithm models. Through this human-machine interaction and continuous iterative loop, the entire management system can continuously learn and evolve, increasingly adapting to the dynamic developmental needs of individual students, ultimately realizing a fundamental transformation from experience-driven to data-intelligence-driven management and from extensive management to precision governance.

5. Conclusion and Outlook

The era of AI empowerment presents new opportunities for universities to achieve "study-training balance" for student-athletes with special talents. By constructing a data-driven intelligent management model, it is possible not only to effectively resolve the "study-training contradiction" but also to enhance the comprehensive quality and core competitiveness of student-athletes. In the future, as AI technology continues to mature, universities should focus on building a "smart sports" ecosystem, applying big data theories and methods under the guidance of systematic training principles, and ultimately achieving the high-quality development of "sports-education integration" (Li Jie, Qiu Sheng, Wang Xiaojun, et al., 2019).

References

Central Committee of the Communist Party of China, State Council. (2025). Outline of the Plan for Building a Leading Country in Education (2024–2035). [2025-2-10]. https://www.gov.cn/zhengce/202501/content_6999914.htm.

Li Duanying, Li Jie, Yang Qun, et al. (2021). Research on digital monitoring of high-level athlete physical training in the era of big data. *Journal of Guangzhou Sport University, 41*(05), 104-108.

Li Guangning. (2015). Study on the current situation of "study-training contradiction" in university high-level sports teams and optimization of management countermeasures. *Contemporary Sports Technology, 5*(18), 254-256.

Li Jie, Qiu Sheng, Wang Xiaojun, et al. (2019). Understanding and positioning of big data application in competitive training and the development of high-level athletic training. *China Sports Coaches, 27*(1), 14-18.

Wei Kunlun. (2026). AI should become an "amplifier" of physical education teachers' teaching capabilities. *China Education Daily*, 2026-02-27(4).

Wu Aihua, Zhang Jingjun. (2007). Practical research on resolving the "study-training contradiction" for college student-athletes. *Shandong Sports Science & Technology*, (04), 74-76.

Xinhua News Agency. (2026). Premier Li Qiang's Government Work Report at the Fourth Session of the 14th National People's Congress on March 5, 2026. [2026-3-30]. https://www.gov.cn/yaowen/liebiao/202603/content_7062625.htm.

Yang Jie, Xu Yuxuan. (2026). "AI+Sports" empowering college physical education and the exploration of campus sports application scenario transformation. *Shaanxi Education (Higher Education)*, (3), 22-24.