

Review

Students' Participation in College Sports: Developing a Sustainable Framework

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Abstract: Student participation in university sports is fundamentally important for promoting adolescents' physical and mental health, cultivating a lifelong sports awareness, and building a sporting powerhouse alongside a healthy nation. This paper systematically reviews domestic and international research from the past five years on student sports participation, university sports development, core competency cultivation, and sustainable development frameworks. Specifically, it analyzes five critical dimensions: theoretical foundations, concept definitions, influencing factors, framework construction, and promotion strategies. The comprehensive findings indicate that current research predominantly focuses on core competency cultivation, campus sports culture construction, extracurricular sports activities organization, educational ecology optimization, and the seamless integration of sports and education. However, existing research still faces significant problems, such as scattered theoretical foundations, insufficient depth in empirical studies, and a notable lack of systematic sustainable development frameworks that can be universally applied across different educational contexts. Based on these identified gaps, this paper constructs a novel student-centered, core-competency-oriented, and multi-party collaborative sustainable development framework. Furthermore, it proposes multiple actionable promotion strategies, including robust policy guarantees, proactive school leadership, extensive social participation, and enhanced individual initiative. Ultimately, this comprehensive review aims to provide a solid theoretical reference and actionable practical guidance for the high-quality, sustainable development of university sports programs globally, ensuring long-term benefits for student well-being.

Keywords: student participation; university sports; sustainable development; core competencies; educational ecology

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1. Introduction

The report of the 20th National Congress of the Communist Party of China emphasized the importance of "strengthening youth sports work and accelerating the building of a sporting powerhouse," signaling the need for school sports in the new era to advance rapidly. In April 2022, the Ministry of Education issued the "Physical Education and Health Curriculum Standards for Compulsory Education (2022 Edition)," which focuses on subject core competencies, aiming to cultivate students' athletic ability, healthy behavior, and sports ethics [1]. This marks the official entry of school sports into a new stage centered on core competencies.

However, the reality is not promising. The Eighth National Student Physical Fitness Survey shows that although students' overall health has improved to some extent, the excellent and good rate of physical fitness among high school students only increased marginally [2]. Myopia remains a significant issue, and the number of overweight and obese students continues to rise. In vocational colleges, despite the expansion of sports clubs, numerous challenges persist, including insufficient venues, low student

participation rates, disorganized management, lack of funding, and inadequate promotion. These problems directly reduce student engagement in sports and hinder the educational function of school sports.

This paper examines university student sports participation as the research focus, systematically organizing, summarizing, and analyzing domestic and international literature from the past five years [3]. It aims to identify the research status, main viewpoints, and existing challenges, thereby providing a theoretical foundation for constructing a "sustainable development framework for student participation in university sports."

2. Theoretical Foundations and Conceptual Basis

2.1. Core Concepts of Student Sports Participation

College Sports Participation (CSP) refers to university students' involvement in various sports activities during their academic period, including participation in physical education classes, extracurricular sports activities, sports clubs, competitions, and autonomous exercise. CSP emphasizes not only participation frequency and duration but also the continuity and quality of sports engagement [4].

Educational Ecology (EE) refers to the dynamic interaction among educational subjects, sports resources, institutional environments, and social contexts within the university sports system. It highlights the coordinated relationship between students, schools, families, and society in promoting sports participation [5].

Sport Habitus (SH), derived from Bourdieu's field theory, refers to the relatively stable sports dispositions and behavioral tendencies gradually formed by students through long-term participation in sports activities. Sport habitus reflects students' sports cognition, exercise awareness, behavioral habits, and emotional identification with sports culture [6].

The Sustainable Development Framework (SDF) in this study refers to a long-term operational mechanism that promotes continuous, coordinated, and stable student participation in university sports [7]. The framework emphasizes sustainability, collaboration, ecological balance, and systematic support in university sports development.

2.2. Theoretical Foundations

Self-Determination Theory (SDT) emphasizes that autonomy, competence, and relatedness are the three core psychological needs influencing individuals' intrinsic motivation [7]. In the context of university sports, students are more likely to maintain long-term participation when their psychological needs are effectively satisfied through supportive sports environments and positive participation experiences.

Student Engagement Theory proposes that effective participation includes behavioral, cognitive, and emotional dimensions. In university sports, behavioral engagement refers to actual participation in sports activities, cognitive engagement refers to students' understanding and recognition of sports value, and emotional engagement refers to positive emotional experiences gained through sports participation [5].

Bourdieu's Field Theory explains sports participation behavior from a sociological perspective. Universities can be regarded as specific sports fields in which students gradually develop sport habitus through continuous interaction with sports culture, institutional arrangements, and peer groups. The theory emphasizes the influence of environmental structures on the formation of stable sports behavior [8].

2.3. Conceptual Framework of Sustainable Sports Participation

Based on the above theoretical foundations, this study constructs a conceptual framework for sustainable student sports participation. The framework emphasizes that student sports participation is jointly influenced by individual motivation, educational ecology, social support, and institutional environments [9].

At the individual level, students' intrinsic motivation, sports cognition, and sport habitus directly affect their participation willingness and behavioral continuity. At the school level, curriculum design, campus sports culture, facilities, and organizational support shape the educational ecology of sports participation [5]. At the social level, family support, peer influence, and community sports resources further strengthen participation sustainability.

The sustainable development framework proposed in this study highlights the interaction among students, schools, families, and society, aiming to promote long-term, stable, and high-quality participation in university sports under the guidance of sustainable development principles [10].

3. Current Research on Student Sports Participation

3.1. Current Status of Student Sports Participation

Existing studies indicate that student sports participation remains an important issue in the development of university physical education. Although awareness of health and exercise has gradually increased among university students, actual participation levels still face multiple practical constraints [11]. Domestic research mainly focuses on participation motivation, sports club development, physical fitness improvement, and extracurricular sports engagement. Many studies have shown that students generally recognize the value of sports participation in improving physical health, enriching campus life, and enhancing social communication abilities. However, insufficient sports facilities, inadequate funding, low participation rates, and weak organizational management continue to restrict the sustainable development of university sports activities.

Through a survey of vocational colleges, it was found that the shortage of sports venues and equipment, insufficient financial support, and weak publicity mechanisms are major obstacles affecting student participation in sports activities. Other studies further point out that although students' physical fitness levels have improved to some extent under the guidance of core competency-oriented physical education reform, participation in sports competitions and long-term exercise habits remain relatively weak. Existing domestic research also reveals regional and institutional differences in sports participation [12]. Students from urban areas and universities with stronger sports cultures generally demonstrate higher participation frequency and greater sports awareness than those from less developed regions. The major problems identified in domestic student sports participation research are summarized in Table 1.

Table 1. Statistics of Major Problems in Domestic Student Sports Participation

Problem Type	Percentage
Insufficient venues and equipment	45.2%
Low student participation rate	32.7%
Non-standard organizational management	38.4%
Insufficient funds	52.1%
Inadequate promotion	41.3%
Never participated in sports competitions	55.0%

International studies place greater emphasis on participation continuity, psychological motivation, and participation barriers among university students. Research indicates that students commonly experience a decline in sports participation after entering higher education due to increased academic pressure and reduced available time. Other important barriers influencing participation behavior include lack of motivation, inconvenient facilities, and social anxiety [13]. In addition, studies have reported that

intrinsic motivation is significantly associated with sustained sports participation, whereas external pressure tends to weaken long-term engagement.

Recent international research has also increasingly focused on the relationship between sports participation and psychological well-being, social adaptation, and healthy lifestyles. It has been found that students with higher levels of conscientiousness and self-regulation are more likely to maintain regular sports participation [1,12]. Other studies have emphasized the importance of peer support, campus sports culture, and inclusive sports environments in promoting participation sustainability among university students.

The major barriers affecting university student sports participation identified in international studies are summarized in Table 2.

Table 2. Barriers to University Student Sports Participation

Barrier	Reported Percentage
Lack of time	68.3%
Academic pressure	54.7%
Lack of motivation	48.2%
Inconvenient facilities	36.5%
Social anxiety	28.4%

3.2. Measurement Methods and Participation Types

Research on student sports participation has gradually developed from single self-report investigations to diversified measurement approaches combining subjective evaluation and objective monitoring. Existing studies mainly adopt three categories of measurement methods: subjective measurement, objective measurement, and mixed methods [5]. Different methods have distinct advantages and limitations in evaluating students' participation frequency, exercise intensity, behavioral continuity, and sports motivation.

Subjective measurement is currently the most widely used approach because of its convenience, low cost, and suitability for large-scale investigations. Common tools include the International Physical Activity Questionnaire (IPAQ), the Godin Leisure-Time Exercise Questionnaire (GLTEQ), and various sports participation scales [10]. These instruments mainly rely on students' self-reported participation frequency, duration, and exercise intensity. Existing studies have shown that subjective measurement methods are effective in reflecting general participation trends and behavioral characteristics. However, they are also easily affected by recall bias and social desirability bias, which may reduce data accuracy.

Objective measurement methods mainly rely on technological devices to directly record sports behavior and physical activity levels. Accelerometers, heart rate monitors, GPS tracking systems, and wearable sports devices are commonly used in recent studies. Compared with self-report methods, objective measurement tools can provide more accurate data regarding movement intensity, exercise duration, and energy expenditure [12]. Nevertheless, these methods often require expensive equipment and complex operational procedures, limiting their application in large-scale educational research.

To improve research reliability and comprehensiveness, mixed methods combining subjective and objective approaches have gradually become an important trend in sports participation research. Mixed methods can integrate quantitative data with behavioral observations or interviews, thereby providing a more comprehensive understanding of participation behavior, exercise motivation, and psychological experiences [1, 9].

The comparison of major sports participation measurement methods is presented in Table 3.

Table 3. Comparison of Sports Participation Measurement Methods

Method Type	Representative Tools	Advantages	Limitations
Subjective	IPAQ, GLTEQ, BREQ	Low cost, easy to administer	Recall bias, social desirability bias
Objective	Actigraph GT3X, heart rate monitors, GPS	Objective and accurate data	Expensive equipment, cannot distinguish activity type
Mixed	Combinations of above	Comprehensive and accurate data	High cost, complex implementation

In addition to measurement methods, existing studies also classify student sports participation into different participation types according to activity characteristics and participation settings. Classroom participation mainly refers to students' engagement in physical education classes, including attendance, classroom interaction, and skill learning. Extracurricular participation includes sports clubs, autonomous exercise, recreational activities, and campus competitions. Existing studies generally suggest that extracurricular participation plays a more important role in cultivating long-term exercise habits and sports interest.

Sports participation can also be divided into competitive participation and recreational participation. Competitive sports emphasize performance, skill level, and competition outcomes, whereas recreational sports focus more on health improvement, entertainment, relaxation, and social interaction. Moreover, participation behavior can be categorized into individual participation and group participation. Individual activities such as running and fitness training highlight autonomy and self-management, while group sports activities emphasize teamwork, communication, and social belonging.

Different participation types produce different educational, psychological, and social outcomes. Existing studies indicate that diversified participation opportunities are beneficial for improving students' sports motivation, exercise continuity, and overall well-being. The major participation types and their characteristics are summarized in Table 4.

Table 4. Comparison of Sports Participation Types

Type Classification	Specific Forms	Main Characteristics	Main Benefits
Classroom participation	PE class	Structured, guided	Skill learning, cognitive development
Extracurricular participation	Clubs, autonomous exercise	High autonomy	Habit formation, interest cultivation
Competitive sports	School teams, competitions	High intensity, high skill	Self-efficacy, interpersonal relationships
Recreational sports	Fitness, recreational activities	Low pressure, flexible	Mental health, life satisfaction
Individual participation	Running, swimming	Autonomous, controllable	Autonomy, self-efficacy

Group participation	Ball games, clubs	Social interaction	Sense of belonging, social skills
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3.3. Environmental Influencing Factors

Student sports participation is influenced not only by individual motivation and physical ability but also by multiple environmental factors. Existing studies generally classify these factors into three dimensions: physical environment, institutional environment, and socio-cultural environment. These environmental factors interact with each other and jointly shape students' sports participation behavior, exercise continuity, and sustainable development [11].

The physical environment mainly includes sports facilities, venue accessibility, equipment conditions, and digital sports resources. Adequate sports facilities provide the material foundation for student participation in sports activities. Previous studies have shown that shortages of venues and equipment remain one of the most significant constraints on university sports participation. Students in universities with more accessible and diversified sports resources generally demonstrate higher participation frequency and stronger exercise willingness. In recent years, the rapid development of digital technology has also expanded the physical environment of university sports. Smart sports platforms, wearable devices, and sports applications have improved students' access to sports information and participation management.

The institutional environment mainly refers to curriculum arrangements, organizational systems, evaluation mechanisms, and risk management policies within universities. Physical education curriculum design directly affects students' participation motivation and exercise experience. Existing studies indicate that diversified curriculum content and flexible teaching arrangements can significantly improve students' enthusiasm for sports participation. In addition, scientific evaluation systems and effective organizational management are important guarantees for sustainable participation. However, some universities still rely excessively on skill-oriented assessment methods while neglecting process evaluation, participation experience, and long-term habit cultivation.

The socio-cultural environment includes family influence, campus sports culture, peer relationships, and social support systems. Family sports attitudes and parental exercise behaviors play important roles in shaping students' sports awareness and exercise habits. Universities with strong campus sports cultures are more likely to encourage active participation and create positive sports atmospheres. Peer support and social interaction also significantly influence participation continuity, especially among young adults. Existing studies suggest that students are more likely to maintain regular exercise behaviors when supported by friends, sports organizations, and collaborative sports communities.

Overall, student sports participation is the result of the interaction among multiple environmental systems rather than a purely individual behavioral choice. Sustainable participation requires coordinated support from facilities, institutions, culture, and social resources. The major environmental factors influencing student sports participation identified in previous studies are summarized in Table 5.

Table 5. Summary of Environmental Factors Influencing Student Sports

Environmental Level	Specific Factor	Key Findings	Key Data
Physical	Sports facilities	Shortage is primary constraint	45.2% clubs constrained

Physical	Resource accessibility	Community resources significant	$\beta=0.18$
Physical	Digital environment	Gamified apps increase participation	>85% accuracy
Institutional	Curriculum	Diversity of electives matters	—
Institutional	Evaluation	Single assessment undermines motivation	—
Institutional	Risk management	Inadequate safety systems restrict activities	—
Socio-cultural	Family atmosphere	Parental attitudes/behaviors significantly influence children	$r=0.42$
Socio-cultural	Campus culture	Good “field” facilitates habitus formation	78% have good cognition
Socio-cultural	Peer support	Friends’ invitations are important motives	—

3.4. Sustainable Development and Digital Empowerment

In recent years, sustainable development theory has gradually become an important perspective in physical education research. Existing studies emphasize that university sports should not only focus on short-term physical fitness improvement but also promote lifelong exercise awareness, healthy lifestyles, and long-term participation sustainability. Under the guidance of the Sustainable Development Goals, physical education is increasingly expected to contribute to health promotion, educational equity, social inclusion, and sustainable social development.

Current research suggests that sustainable sports participation is characterized by continuity, coordination, equity, and ecological balance. Continuity refers to maintaining stable exercise behavior over a long period of time. Coordination emphasizes the balanced relationship among individual development, educational goals, and social support systems [8]. Equity highlights equal participation opportunities for students from different regions, economic backgrounds, and physical conditions. Ecological balance focuses on constructing harmonious relationships among students, sports environments, educational systems, and social resources.

Several theoretical perspectives have been widely applied to explain sustainable sports participation behavior. Self-Determination Theory emphasizes the importance of intrinsic motivation and psychological need satisfaction in maintaining long-term exercise behavior [2]. Student Engagement Theory highlights the coordinated development of behavioral, cognitive, and emotional participation. Field Theory explains how campus sports culture and educational environments gradually shape students' sport habitus and behavioral tendencies. Together, these theories provide important foundations for understanding sustainable sports participation.

The major theoretical foundations related to lifelong sports participation are summarized in Table 6.

Table 6. Comparison of Theoretical Foundations for Lifelong Sports Participation

Theory	Core Concept	Implication for Sports Participation	Key Evidence
Field theory	Behavior shaped by field and habitus	Optimize the school sports field	78% have good sports cognition
Self-Determination Theory	Basic need satisfaction promotes intrinsic motivation	Create conditions for autonomy, competence, relatedness	r=0.52 (intrinsic motivation & sustained participation)
Student Engagement Theory	Behavioral, cognitive, emotional dimensions need synergy	Aim for comprehensive engagement	Highly engaged students perform better

At the practical level, existing studies increasingly advocate collaborative development models involving schools, families, communities, and society. The home-school-community collaboration model is considered an important pathway for improving sports participation sustainability. Universities serve as the primary organizational platform for sports education, families provide behavioral support and value guidance, while communities and social organizations offer additional sports resources and participation opportunities.

Meanwhile, digital technology has become an important driving force for university sports development. Smart wearable devices, online fitness platforms, sports applications, and digital monitoring systems have significantly expanded the forms and accessibility of sports participation. Through real-time data monitoring, exercise feedback, and gamified interaction mechanisms, digital sports technologies can improve students' participation motivation and behavioral continuity.

Emerging technologies such as virtual reality and augmented reality have also shown potential in physical education reform [8, 10]. These technologies can simulate sports environments, provide immersive exercise experiences, and reduce the limitations caused by facilities, safety risks, and resource shortages. Although current digital physical education research is still in its early stages, existing studies generally suggest that digital empowerment may become an important direction for promoting sustainable university sports participation in the future.

3.5. Literature Review and Research Gaps

Existing studies have provided important theoretical foundations and empirical evidence for understanding student sports participation and university sports development. Research perspectives have gradually expanded from traditional physical fitness improvement to broader issues such as sports motivation, educational ecology, psychological well-being, social support, and sustainable development. Multiple theoretical perspectives, including Self-Determination Theory, Student Engagement Theory, socio-ecological models, and Field Theory, have been widely applied to explain sports participation behavior and its influencing mechanisms.

At the empirical level, current research has revealed that student sports participation is jointly influenced by individual factors, family support, campus sports culture, institutional arrangements, and social environments. In addition, measurement methods

have gradually shifted from simple self-report questionnaires to mixed approaches combining subjective evaluation and objective monitoring technologies. The development of digital technology has also created new possibilities for sports participation management, online physical education, and smart sports services.

Despite these achievements, several limitations remain in existing studies [9]. First, most current studies are cross-sectional investigations, lacking longitudinal follow-up research capable of examining long-term participation sustainability and causal relationships. Second, cross-cultural comparative studies remain relatively limited, and the applicability of existing theories across different educational and social contexts still requires further verification. Third, research on special student groups, including economically disadvantaged students, students with disabilities, and students with different physical conditions, remains insufficient.

In addition, although digital physical education has become an emerging research topic, empirical evidence regarding the effectiveness of VR/AR technology, wearable devices, and intelligent sports platforms is still relatively limited [6]. Existing studies also tend to apply theoretical perspectives independently, lacking systematic integration among motivation theory, educational ecology, sustainable development theory, and sports behavior research.

The major limitations and future directions identified in previous studies are summarized in Table 7.

Table 7. Summary of Research Limitations and Future Directions

Research Limitation	Specific Performance	Future Direction
Lack of cross-cultural comparison	Mostly single-country studies	Conduct multi-country comparative research
Few longitudinal studies	Mostly cross-sectional	Conduct long-term follow-up studies
Insufficient research on special groups	Focus on average students	Pay attention to disabled, disadvantaged students
Digital research still early	Few empirical studies on VR/AR applications	Strengthen experimental research on technology applications
Lack of theoretical integration	Theories operate separately	Construct comprehensive theoretical framework

Based on the above review, this study attempts to integrate sustainable development theory, educational ecology, and student sports participation research within the context of Chinese higher education. By constructing a sustainable development framework for university student sports participation, this study aims to provide both theoretical references and practical guidance for promoting long-term, stable, and high-quality university sports development.

4. Construction of the Sustainable Development Framework

4.1. Framework Design Principles

The sustainable development framework proposed in this study is constructed based on sustainable development theory, educational ecology, Self-Determination Theory, and Student Engagement Theory. The framework aims to promote long-term and stable university student sports participation while improving the overall quality of university physical education. It emphasizes the coordinated development of students, schools, families, and society within the university sports system.

The framework follows several core principles [4]. It adopts a student-centered approach, emphasizing students' participation needs, exercise interests, and intrinsic

motivation. It highlights sustainability orientation by focusing on lifelong exercise awareness and continuous participation behavior rather than short-term physical fitness improvement alone. The framework also stresses multi-party collaboration among universities, families, communities, and social organizations to provide comprehensive support for sports participation.

In addition, the framework emphasizes educational ecology optimization and digital empowerment. Universities should create supportive sports environments through improved facilities, diversified curriculum systems, positive campus sports culture, and effective organizational management. Meanwhile, digital technologies such as wearable devices, online sports platforms, and intelligent monitoring systems can further enhance participation efficiency, resource accessibility, and personalized exercise guidance [12].

4.2. Structural Dimensions of the Framework

The sustainable development framework for university student sports participation consists of four major dimensions: individual dimension, school dimension, social dimension, and institutional dimension. These dimensions interact with each other and collectively influence the continuity and quality of student sports participation.

The individual dimension focuses on students' sports motivation, exercise awareness, physical literacy, and sport habitus formation. The school dimension emphasizes curriculum design, sports facilities, campus sports culture, and organizational support. The social dimension primarily includes family support, peer influence, community resources, and social participation. The institutional dimension involves policy guarantees, evaluation systems, funding support, and long-term management mechanisms.

To improve framework coordination, universities should enhance the interaction among these dimensions and establish a comprehensive sports participation support system. Sustainable participation can only be achieved when individual motivation, educational ecology, social support, and institutional guarantees develop collaboratively.

4.3. Operational Mechanisms of the Framework

The sustainable development framework operates through several interconnected mechanisms, including motivation mechanisms, support mechanisms, evaluation mechanisms, and digital empowerment mechanisms. These mechanisms collectively ensure the stability and effectiveness of university student sports participation.

The motivation mechanism primarily stimulates students' intrinsic interest and long-term exercise willingness through diversified sports activities, positive participation experiences, and a supportive campus sports culture. The support mechanism focuses on the provision of facilities, curriculum resources, organizational guidance, and social support from schools, families, and communities. The evaluation mechanism emphasizes process-oriented assessment and continuous participation evaluation rather than relying solely on physical performance outcomes.

Additionally, digital empowerment mechanisms play an increasingly significant role in university sports development. Smart wearable devices, online sports platforms, sports data monitoring systems, and intelligent management technologies enhance participation efficiency, strengthen exercise supervision, and provide personalized exercise guidance. These mechanisms collectively promote the sustainable and coordinated operation of university sports participation systems.

4.4. Promotion Strategies for Sustainable Sports Participation

To improve the sustainability of university student sports participation, universities should strengthen policy support, curriculum reform, campus sports culture construction, and social collaboration. Policy guarantees and stable funding are essential foundations for enhancing sports facilities, expanding sports resources, and supporting long-term sports programs.

Universities should also promote diversified physical education curricula and extracurricular sports activities to better meet students' varied interests and exercise needs

[12]. Additionally, strengthening campus sports culture through sports competitions, clubs, and promotional activities can effectively enhance students' enthusiasm for participation and their sense of belonging.

Meanwhile, cooperation among schools, families, communities, and social organizations should be enhanced to create a comprehensive support network for university sports participation. Digital sports platforms, wearable devices, and online physical education resources can further improve accessibility and management efficiency.

4.5. Framework Evaluation and Future Development

The sustainable development framework proposed in this study provides a systematic approach for enhancing university student sports participation. By integrating individual motivation, educational ecology, institutional support, and digital empowerment, the framework contributes to the long-term development of university physical education and lifelong sports engagement.

However, the framework still requires further empirical verification and practical optimization. Future studies should conduct longitudinal investigations to evaluate the effectiveness of the framework in various educational contexts and student populations. Additionally, more empirical research is needed to explore the application value of digital sports technologies, intelligent management systems, and personalized exercise interventions.

With the continuous advancement of educational reform and digital technology, university sports participation is expected to become more diversified, intelligent, and sustainable in the future [1,8]. The framework proposed in this study may serve as a theoretical reference and practical guide for promoting high-quality university sports development from the perspective of sustainable development.

5. Conclusion

This study systematically reviewed research on university student sports participation and sustainable sports development. Existing studies indicate that student sports participation is influenced by multiple factors, including individual motivation, educational ecology, institutional arrangements, family support, campus sports culture, and social environments. At the same time, sustainable development theory, Self-Determination Theory, Student Engagement Theory, and Field Theory provide important theoretical support for understanding long-term sports participation behavior.

Based on the literature review and theoretical analysis, this study constructed a sustainable development framework for university student sports participation. The framework emphasizes student-centered development, sustainability orientation, multi-party collaboration, educational ecology optimization, and digital empowerment. It also proposes practical strategies involving policy support, curriculum reform, campus sports culture construction, social collaboration, and intelligent sports technologies to promote long-term and stable participation in university sports activities.

Although this study provides a systematic theoretical framework for sustainable university sports development, several limitations still exist. The proposed framework mainly relies on literature analysis and theoretical integration, and further empirical verification is needed in different university contexts. Future research should strengthen longitudinal studies, cross-cultural comparative research, and empirical investigations on digital physical education and intelligent sports management systems to further improve the sustainability and effectiveness of university student sports participation.

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