

Analysis of Educational Pathways for Sports Teacher Training based on Dissipative Structure Theory

Lei Yue

Graduate University of Mongolia, Ulaanbaatar 999097, Mongolia

ABSTRACT

Physical education teacher training is a crucial component of the teacher education system, entrusted with the mission of cultivating high-quality physical education teachers and enhancing the physical health of youth. Guided by dissipative structure theory, this study investigates the evolutionary mechanisms and optimization pathways within this system. It elucidates the defining characteristics of physical education teacher training as an open system namely, openness, being far-from-equilibrium, nonlinear interactions, and fluctuation-induced transitions and employs an entropy change model to reveal the internal drivers and conditions for its evolution from disorder to order. The study proposes a multifaceted approach: continuously introducing negative entropy flows through open concepts, teaching, and resources; leveraging digital technology to disrupt equilibrium states and stimulate innovation; establishing a "Four-in-One" collaborative training paradigm to strengthen nonlinear interactions among diverse stakeholders; and implementing dynamic monitoring and evaluation mechanisms to amplify minor fluctuations into significant ones. These pathways are designed to enhance the system's self-organization and adaptive capabilities, thereby providing a theoretical foundation and practical guidance for constructing a high-quality, modern physical education teacher training system.

KEYWORDS

Physical Education Teacher Education; Dissipative Structures; Talent Development.

1. INTRODUCTION

Teacher education is a cornerstone of national educational quality and talent development. The Party and state have prioritized its advancement, having launched policies to spur innovation with notable results. In 2017, the Ministry of Education issued the "Implementation Measures for the Certification of Teacher Education Programs in General Higher Education Institutions (Interim)," promoting a quality-management phase for teacher education anchored in the principles of "student-centeredness, outcome orientation, and continuous improvement." In January 2025, the first policy document dedicated to physical education (PE) teachers, "Notice on Several Measures to Strengthen the Development of Primary and Secondary School Physical Education Teachers in the New Era," was promulgated. It stipulates that by 2035, a comprehensive capacity-building mechanism for school PE teachers will be established, advancing the integration of sports and education, cultivating a high-quality and professional teaching workforce, and consistently enhancing students' physical health and holistic competence[1]. However, PE teacher education currently faces multiple challenges, including outdated training models, weak practical components, and insufficient instructor understanding of new curriculum standards, resulting in a disconnect between educational philosophy and practice that hinders the cultivation of high-quality PE teachers.

Dissipative structure theory, an important epistemology and methodology for revealing system self-organization, explains how open systems far from equilibrium spontaneously form new ordered structures through element interactions. Applying this theory to physical education teacher training allows us to conceptualize it as a dynamic system evolving toward higher-order states. The interactive synergy among various elements, such as curriculum systems, faculty teams, and practical platforms demonstrates the system's openness and nonlinear dynamics. Through their dynamic adaptation, the educational model can transition from traditional approaches to more adaptive and innovative forms. Therefore, exploring pedagogical pathways through this theoretical lens helps develop actionable, scalable practical paradigms, providing a referential framework that integrates theoretical depth with practical applicability for innovating physical education teacher training.

2. THE THEORETICAL IMPLICATIONS OF DISSIPATIVE STRUCTURES

Dissipative structure theory, proposed in 1969 by Belgian scientist Ilya Prigogine, posits that a nonlinear open system far from equilibrium can evolve from chaotic disorder into an ordered state in time, space, or function through continuous exchange of matter and energy with its surroundings. This transformation occurs when internal parameter variations reach a critical threshold generating sufficient negative entropy flow triggering self-organization through fluctuations and sudden changes. The resulting stable macroscopic structure, sustained by ongoing material/energy exchange, is termed a "dissipative structure"[2]. Its core characteristics include: 1) Openness-the prerequisite for introducing negative entropy to counteract internal entropy increase; 2) Non-equilibrium-the driving force for evolution beyond maximum entropy states; 3) Nonlinear interactions-generating synergies that propel qualitative system changes; 4) Fluctuations-random variations that, at critical thresholds, catalyze transitions to higher-order states. By transcending traditional linear thinking, this theory provides crucial methodological guidance for understanding complex system evolution.

3. DISSIPATIVE CHARACTERISTICS AND EVOLUTION OF THE PHYSICAL EDUCATION TEACHER EDUCATION SYSTEM

3.1. Dissipative Characteristics of the Physical Education Teacher Education System

(1) System Openness. Within the broader educational ecology, the physical education (PE) teacher education system functions as an open and evolving subsystem that constantly exchanges material, energy, and information with its environment. No academic field develops in isolation; each operates as a symbiotic organism sustained through multidimensional interactions with external elements [3]. As a complex open system, PE teacher education draws vitality from continuous exchanges across three interrelated dimensions. At the resource-exchange level, the system imports external "negative-entropy flows" such as policy guidance, fiscal investment, infrastructure improvement, and institutional safeguards-inputs that provide the fundamental energy for sustained development. At the cooperation and exchange level, it establishes multidirectional linkages with education authorities, K-12 schools, and research institutes. Joint practice bases, shared course resources, and reciprocal faculty mobility foster complementarity and functional coupling. At the information-feedback level, evaluations from employers, graduates, and society feed back into curriculum renewal, pedagogical innovation, and governance improvement. Through these channels, the system maintains openness and adaptability, enabling continuous knowledge renewal and greater educational effectiveness. Sustaining this openness is essential for PE teacher education to align with educational modernization and achieve sustainable growth.

(2) Far-from-Equilibrium Condition. An open system generates new order only when maintained in a state of dynamic non-equilibrium[4]. While ensuring openness, the PE teacher education system

must remain sufficiently “far from equilibrium” through ongoing transformation. Dynamic policy adjustments by government and educational authorities provide directional forces guiding systemic evolution. Primary and secondary schools, sports organizations, and research institutions respond to these policy shifts by aligning their training practices and resource support with emerging talent-development needs. Universities continuously update educational philosophies, curriculum frameworks, and teaching methodologies, while the diversity of faculty and student profiles sustains internal dynamism. Educational entities capable of promptly perceiving external changes and proactively restructuring gain heightened vitality in adaptation. This persistent tension between order and disorder becomes the intrinsic engine driving innovation and renewal within PE teacher training.

(3) Nonlinear Interactions. The PE teacher education system is composed of multiple interdependent actors—universities (training institutions), K–12 schools (practice settings), education authorities (policy guidance), sports industry organizations (resource support), and research institutions (theoretical empowerment). Based on their distinct functions and resources, these actors engage in complex nonlinear interactions through collaborative training, joint research, and resource sharing. This networked interplay manifests in three key outcomes. First, innovation activation: the convergence of diverse ideas, methods, and resources stimulates the emergence of novel models of PE teacher preparation. Second, resource optimization: the reorganization of elements and multidirectional exchanges enable teaching cases, research findings, and equipment resources to be distributed more efficiently, enhancing overall effectiveness. Third, systemic resilience: through multidimensional feedback loops, the system maintains stability and adaptability amid environmental volatility. Such nonlinear dynamics transcend traditional linear governance models, facilitating efficient circulation of ideas, resources, and practices. Ultimately, they cultivate an educational ecosystem characterized by continual innovation, self-regulation, and sustainable development.

(4) Fluctuations and Discontinuities. Internal and external fluctuations act as the primary catalysts propelling the system from one equilibrium to a higher-order state. Within the PE teacher education system, individual variations, policy adjustments, and technological innovations all serve as sources of fluctuation. At the micro level, when teacher candidates learn digital teaching technologies or youth-sports health management, these experiences interact nonlinearly with their existing instructional and curriculum-design competencies, forming new integrated capacities. At the macro level, universities undertaking program reforms collaborate with education authorities, K–12 schools, and research institutions to reassess youth health demands, policy orientations, and pedagogical trends. Such interactions trigger internal energy redistribution, where critical fluctuations can catalyze structural mutations leading to new organizational orders. Therefore, PE teacher education systems must enhance their ability to recognize and regulate fluctuation mechanisms. By integrating internal and external variables, sustaining non-equilibrium dynamics, and reinforcing inter-element coupling, they can develop self-repairing and continuously optimizing capabilities—ensuring structural upgrading and coordinated evolution throughout their developmental trajectory.

3.2. Dissipative Evolution of the Physical Education Teacher Education System

As a typical open system, the evolution of the physical education (PE) teacher-education system conforms to the core principles of dissipative-structure theory. From the perspective of entropy change, its developmental state can be expressed through total entropy variation (ds), determined jointly by two components: the internal entropy flow ($dis > 0$), arising from internal contradictions such as imbalanced faculty structures, outdated training models, and inefficient resource allocation, which increase systemic disorder; and the negative-entropy flow ($des < 0$), generated through the system’s exchanges with the external environment. Policy support, industry–education integration, and digital-technology innovation continuously inject ordered energy into the system through this negative-entropy flow. Their relationship is captured in the equation $ds = dis + des$, which reveals the intrinsic logic of the system’s evolution. When the imported negative entropy (des) effectively offsets internal entropy growth (dis), total entropy (ds) becomes negative. The system then attains a

qualitative leap, manifesting in higher training quality for teacher candidates and the emergence of innovative educational outcomes—a process of self-organization and upward evolution toward a higher-order state. Conversely, when the capacity to absorb external negative entropy weakens and internal disorder accumulates, total entropy becomes positive; the system drifts toward chaos and risks regression. When $ds = 0$, the system reaches temporary equilibrium between internal and external flows, maintaining relative stability. Yet such stability is transient: without sustained inflows of negative entropy, rigidity develops and the system loses adaptive capacity in the face of changing educational demands.

The evolutionary trajectory thus alternates between fluctuation and mutation. When the total-entropy change remains within a moderate range, minor fluctuations promote gradual optimization along the existing path—seen in incremental curriculum refinement, strengthened practicum components, and improved pedagogy. When the inflow of negative entropy rises sharply, driving ds below a lower critical threshold, large-scale fluctuations occur, catalyzing phase transitions such as restructuring training models or innovating institutional mechanisms. Evolution is therefore bidirectional: it may advance through accumulated negative entropy or decline under external shocks and internal dysfunctions. To ensure progressive evolution, the PE teacher-education system should establish an entropy-monitoring and regulation mechanism. Quantitative analysis of correlations between key indicators and entropy fluctuations can guide timely adjustment of development strategies. Maintaining a moderate non-equilibrium state is essential—stimulating creative vitality while introducing continuous negative-entropy inflows to preserve systemic stability. Through this dynamic balance, the system can self-organize, self-renew, and evolve toward higher-order structures, providing a sustainable mechanism for cultivating high-quality PE teachers in the new era.

4. DISSIPATIVE OPTIMIZATION PATHWAYS FOR PHYSICAL EDUCATION TEACHER EDUCATION SYSTEMS

The physical education (PE) teacher education system constitutes a complex, dynamic ecosystem involving multiple stakeholders—universities, government agencies, primary and secondary schools, and research institutions—whose operational mechanisms align closely with the principles of dissipative-structure theory. Surveys on teacher education program accreditation indicate that, despite substantial progress in aligning training curricula with national policies and student needs, a gap remains between pre-service preparation and the actual competency requirements of secondary school teaching. This misalignment between training objectives and professional practice has become a critical issue requiring systematic improvement[5]. Viewed through the lens of dissipative-structure theory, the evolution of the PE teacher education system should be characterized by systemic openness, dynamic non-equilibrium, enhanced nonlinear interactions, and effective regulation of fluctuations. By continuously importing external negative-entropy flows—such as policy innovation, technological support, and collaborative resources—while curbing internal entropy growth caused by inefficiencies, the system can achieve transformations from disorder to order and from lower to higher organizational states. Ultimately, this enables the establishment of a modern, self-organizing, and adaptive PE teacher training system capable of sustained innovation and continuous optimization.

4.1. Enhancing the Openness of Physical Education Teacher Education Systems Across Multiple Dimensions

(1) Open Educational Philosophy. The optimization of PE teacher education must begin with comprehensive openness in educational philosophy. Externally, the ongoing digital transformation—driven by artificial intelligence, big data, and intelligent learning environments—is reshaping the form and value of school sports, demanding that teacher education adopt a forward-looking and inclusive mindset. Educationally, the function of school sports has evolved from the transmission of discrete athletic skills to the cultivation of students' holistic physical, mental, and moral development.

However, existing PE teacher education philosophies often remain inward-looking and discipline-bounded, rendering them less responsive to the requirements of integrating physical education into general education and advancing educational modernization. Survey data show that during periods of rapid external change—particularly in the contexts of sports-education integration and digital transformation—42.7% of PE teacher candidates experience a disjunction between their professional ideals and their practical adaptability. This tension hinders their ability to translate a sense of professional mission into the emotional motivation and behavioral readiness required to navigate change effectively [6]. To address this, training institutions must proactively introduce and internalize concepts such as sports-education integration, smart physical education, and multi-dimensional collaborative training. Building upon these principles, they should construct an open educational perspective aligned with reforms in basic education and the nation’s broader health and well-being agenda.

(2) Open Teaching Process. Opening the teaching process is vital for breaking rigid internal structures and facilitating the inflow of external negative entropy. At present, PE teacher education continues to face challenges in connecting theory with practice and in integrating off-campus resources. Therefore, it is imperative to reconstruct a cross-disciplinary, collaborative instructional framework that promotes openness across teaching domains, participants, and resources. First, teaching domains should be expanded to integrate theory and practice more deeply. Classroom learning must extend into authentic PE contexts, transforming isolated skill instruction into situated teaching experiences. This enables pre-service teachers to accumulate practical knowledge through field observations, micro-teaching sessions, and guided reflection, thereby achieving an organic progression from skill acquisition to comprehensive teaching competence. Second, teaching participants should be diversified to form a collaborative instructional community. University faculty, exemplary PE teachers, and educational researchers should engage in co-designing instructional content, conducting joint evaluations, and mentoring pre-service teachers. Through this dual structure of theoretical instruction and practice-based cultivation, complementary expertise can converge to generate shared pedagogical knowledge. Finally, teaching resources should be further opened to amplify the pedagogical value of authentic cases. By utilizing exemplary classroom episodes and real-world scenarios drawn from schools, programs can emphasize practical skill development in areas such as instructional design, class organization, and sports-injury prevention—thereby compensating for the inherent limitations of university-based resources and enhancing the authenticity of teacher preparation.

4.2. Digital Empowerment of Physical Education Teacher Education Systems: Breaking Equilibrium for Dynamic Renewal

When a system remains in long-term equilibrium, internal positive entropy inevitably accumulates, leading to rigidity and stagnation. Only by continuously importing external negative-entropy flows, disrupting inherent equilibrium, and maintaining a moderate state of non-equilibrium can the system’s innovative vitality be activated and its evolution toward higher-order organization sustained. In line with the national agenda of advancing educational digitalization and building a lifelong learning society, the process of intelligent and smart education is accelerating dramatically [7]. For decades, physical education (PE) teacher training has largely centered on cultivating basic instructional skills, leaving it insufficiently responsive to the emerging requirements of digital pedagogy and intelligent sports guidance in K–12 contexts. Consequently, the system faces a developmental bottleneck caused by the ossification of its equilibrium state. Digital technology—with its intelligent, data-driven, and interactive features—functions as a key non-equilibrium driver, permeating all aspects of education and injecting negative entropy that propels systemic evolution toward a new digital-adaptive order.

To harness this transformation, universities must coordinate efforts across objectives, systems, and implementation pathways. At the goal and systemic levels, training objectives should be redefined in anticipation of the widespread integration of artificial intelligence and the growing need for

autonomous, data-informed learning. The knowledge structure should require teacher candidates to master basic digital technologies and sports data interpretation, while the competency framework should emphasize intelligent tool application, data visualization, ethical awareness in intelligent education, and digital teaching innovation. Institutional safeguards must also be established—such as credit weighting for digital courses and expanding their scale within teacher-education programs—to ensure standardized and sustainable development of digital competencies. At the implementation level, three pathways are essential. First, reconstruct the PE curriculum system. Universities should leverage institutional strengths and draw on successful practices such as Beijing Sport University’s Digital Sports curriculum and Central China Normal University’s AI+ research–training initiatives to develop specialized courses[8]. Such courses build systematic cognitive frameworks for digital education and disrupt the equilibrium of traditional single-course models. Second, strengthen the digital capabilities of PE faculty. Through targeted recruitment and in-service training, universities can develop teaching teams with strong digital proficiency, establishing practical exemplars for teacher candidates and breaking the internal “closed-loop” of traditional faculty development. Third, advance the digital transformation of teaching practice. Embedding digital tasks into internships and practicum programs helps integrate digital literacy into teacher candidates’ professional cognition, bridging the gap between classroom learning and real-world application. Collectively, these initiatives systematically introduce digital negative-entropy flows into the PE teacher education system. They dismantle equilibrium structures that constrain innovation, establish a dynamic non-equilibrium state conducive to continuous creativity, and provide the foundational driving force for the system’s orderly evolution toward higher levels of quality and adaptability in the digital era.

4.3. Strengthening Nonlinear Interactions through a Four-in-One Collaborative Cultivation Paradigm

The transformation of physical education (PE) teacher education systems from disorder to order fundamentally depends on the establishment of nonlinear interactions among their internal components. Such interactions transcend additive effects; through dynamic coupling and recursive feedback among multiple stakeholders, they generate synergistic outcomes that exceed the sum of individual functions, injecting sustained vitality into the system’s continuous evolution. Traditional training models—characterized by university dominance and limited external participation—have long exhibited linear, mechanistic relationships that accumulate entropy and diminish system efficiency. Overcoming this impasse requires constructing a four-in-one collaborative cultivation paradigm in which universities lead, governments provide macro-level guidance, K–12 schools engage deeply in practice, and research institutions offer theoretical and technological support. This paradigm represents a crucial pathway for strengthening nonlinear interactions and fostering systemic transformation.

At its core, the four-in-one paradigm reshapes the role positioning and interaction logic within the education ecosystem, forming a nonlinear network where multiple stakeholders and teacher candidates co-evolve. Universities leverage disciplinary and curricular advantages to lead program design and pedagogical innovation; governments coordinate collaboration rhythms and ensure institutional safeguards through policy design and resource allocation; K–12 schools act as authentic practice fields, offering opportunities for teaching rehearsal and action research; and research institutions empower the system through technological innovation and knowledge transfer, introducing elements such as digital teaching tools and health-monitoring technologies. To ensure the effectiveness of this collaborative mechanism, the four-in-one model operates on a structural framework characterized by “dual identities, dual mentors, dual bases, and dual cycles.” Teacher candidates achieve the integration of learning and practice through progressive identity transitions; university and K–12 mentors provide bidirectional guidance, deepening the connection between theory and practice; experimental and practical bases complement each other, promoting skill transformation and knowledge application; and pre-service and in-service cycles interact dynamically,

forming a continuous loop of educational improvement. Within this structure, nonlinear effects are amplified through two primary mechanisms. The first is the practice–feedback mechanism: universities and K–12 schools dismantle the traditional separation of theory and practice by forming collaborative alliances. K–12 teachers engage in curriculum co-design and reflective dialogue, transforming experiential knowledge into codified pedagogical resources, while university faculty integrate advanced theoretical insights into authentic teaching contexts. This bidirectional recursion between theory and practice continuously introduces both “experience entropy” and “innovation entropy” into the system, enhancing its adaptability. The second is the resource-linkage mechanism: governments and research institutions promote resonance between training objectives, pedagogical needs, and technological R&D through policy incentives and technical collaboration. Governments encourage research institutes to develop intelligent teaching tools aligned with regional digital transformation agendas, while universities integrate these applications into curricula, generating cross-system synergy driven by policy alignment, demand-based innovation, and technological empowerment. Through this nonlinearly coupled network, resource flows, feedback channels, and innovation pathways interweave to form a self-organizing, co-evolutionary mechanism. This not only transcends the linear growth constraints of traditional teacher training but also provides a dynamic foundation for the high-quality, adaptive development of PE teacher education systems in the digital era.

4.4. Promoting Effective Fluctuations through Dynamic Monitoring and Evaluation Mechanisms

The exchange of matter, information, and energy between a system and its external environment inevitably produces micro-fluctuations. Yet their initial potential is weak, insufficient to propel the system beyond its existing equilibrium. Only through mechanisms that continuously detect, accumulate, and amplify these fluctuations—elevating their energy to a critical threshold—can the system undergo qualitative transformation, triggering deep structural reconfiguration and evolutionary leaps toward higher-order organization. Within the physical education (PE) teacher education system, effective fluctuations function as dynamic adjustment signals that emerge when key parameters deviate from equilibrium states. Traditional single-channel evaluation models, constrained by closed information loops, often fail to detect such signals promptly, allowing micro-fluctuations to dissipate before they accumulate critical impact. In contrast, a scientific dynamic monitoring and evaluation mechanism—characterized by multi-stakeholder participation, multi-dimensional feedback, and multi-stage regulation—can capture these weak signals in real time, amplify them through feedback loops, and transform them into driving forces for systemic evolution. In this process, micro-fluctuations evolve into macro-dynamics that push the system beyond traditional equilibrium states, facilitating orderly and adaptive development.

Establishing a dynamic monitoring and evaluation mechanism requires coordinated efforts across three interrelated dimensions: diversified evaluation, supervisory feedback, and quality assurance. First, a diversified evaluation community should be built around universities as the central actors, integrating the complementary strengths of government agencies, K–12 schools, and industry associations. Universities must establish comprehensive, full-cycle evaluation systems encompassing teacher candidates’ professional competencies, teaching processes, and educational outcomes—assessing both “hard” skills (subject expertise, teaching proficiency) and “soft” attributes (pedagogical philosophy, reflective awareness). Governments should conduct tiered supervision through program accreditation and data-driven monitoring to optimize resource distribution. K–12 schools need to engage in standard-setting and provide authentic feedback on candidates’ practical competencies, such as classroom management and student engagement. Industry associations should develop early-warning mechanisms aligning talent cultivation with labor-market demand, ensuring that evaluation criteria remain responsive to societal needs. Second, supervisory feedback and data empowerment must be strengthened. Multi-source data should feed back dynamically into curriculum

design, teaching assessment, and professional development. Continuous information circulation across different stakeholders will sustain adaptive optimization and prevent evaluation stagnation. Third, a rigid linkage and assurance mechanism should be institutionalized. Evaluation outcomes should be substantially linked to institutional resource allocation, faculty appraisal, and teacher candidates' developmental trajectories. For instance, if evaluations consistently reveal deficiencies in practical skills, universities must revise curricula and organize targeted faculty training; candidates failing repeated assessments should undergo remedial micro-teaching or structured internships. These feedback actions ensure that incremental changes penetrate systemic inertia and accumulate energy through iterative cycles, eventually converging into a decisive force that drives structural transformation. Through this dynamic supervision and evaluation mechanism, continuous feedback transforms dispersed fluctuations into systemic innovation energy. This mechanism thus serves as both a stabilizer and a catalyst, ensuring that the PE teacher education system evolves adaptively, sustains vitality, and continuously advances toward higher levels of order and quality.

5. CONCLUSION

Reconstructing physical education (PE) teacher education through the lens of dissipative structure theory constitutes a paradigm innovation in educational mechanisms, grounded in systemic evolution and synergistic dynamics. By dismantling traditional closed linear models, fostering deep stakeholder integration, continuously importing negative-entropy flows, and reinforcing nonlinear interactions, this approach effectively activates the system's self-organizing vitality and structural transformation capacity. It thereby enhances pre-service teachers' professional competence, practical teaching skills, and innovative awareness in a comprehensive manner. Although paradigms such as the four-in-one collaborative cultivation model and dynamic supervision–evaluation mechanism still encounter challenges in implementation—including stakeholder coordination and mechanism integration—their intrinsic features of openness, adaptability, and iterative improvement are steering PE teacher education from “isolated cultivation” toward “systemic empowerment.” These paradigms mark a shift from fragmented institutional reforms to an organically integrated, co-evolutionary mode of teacher preparation. Looking ahead, the continued optimization of PE teacher education should further enhance systemic openness and non-equilibrium dynamism, refine multi-stakeholder collaboration and feedback-regulation mechanisms, and explore new models of PE teacher preparation that integrate Chinese characteristics with an international outlook through deeper recursive feedback between theory and practice. These efforts hold profound practical significance for constructing a high-quality, adaptive PE teacher education system and provide essential human capital and intellectual support for realizing China's dual vision of becoming both an education powerhouse and a sports powerhouse in the new era.

REFERENCES

- [1] Ministry of Education Notice on Several Measures to Strengthen the Development of Physical Education Teacher Teams in Primary and Secondary Schools in the New Era [EB/OL]. (2020-05-28) [2025-09-18]. https://www.gov.cn/zhengce/zhengceku/202501/content_7001148.htm
- [2] Du Yufan, Li Shuang. Driving Mechanisms and Optimization Strategies for High-Quality Development of Vocational Education Groups from the Perspective of Dissipative Structure Theory [J]. *Education and Vocational Training*, 2023(13):13-20.
- [3] Bai Qiang. The Generative Logic and Development Pathways of World-Class Disciplines: An Examination Based on the Growth Histories of Two First-Class Disciplines at Universities in China and Abroad [J]. *Journal of University Education Science*, 2019(04):47-52+65.
- [4] Zou Hongmei. Research on the Education Mechanism of Modern Industry Colleges from the Perspective of Dissipative Structure Theory [J]. *Jiangsu Higher Education*, 2024, (11): 94-98.

- [5] Yu Dawei, Tao Tao. A New Model for Practical Teaching of Physical Education Teacher Education Students Through Integrated Training by Secondary School Master Teachers [J]. Journal of Harbin Sport University, 2025, 43(04): 1-8.
- [6] Yang Aining, Qu Bo. Cultivating Career Development Awareness Among Physical Education Teacher Candidates in China [J]. Journal of Shenyang Sport University, 2025, 44(04): 36-42+50.
- [7] Zhang Jing, Li Shuhua, Zheng Xin. Cultivating Teacher Candidates in the Intelligent Era: Foundational Logic, Practical Challenges, and Pathways [J]. Research on Educational Technology, 2025, 46(08):121-128.
- [8] Ma Yanhong, Mu Jiawen. Digital Empowerment for Physical Education Teachers' Professional Development: Triple Logic, Implementation Mechanisms, and Pathway Orientation [J]. Journal of Guangzhou Sport University, 2025, 45(02):43-52.