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The Transformation of Physical Education Teachers' Roles in the Digital Transformation of Physical Education: Logical Rationale, Realistic Dilemmas, and Promotion Strategies

Yun Guo[1*]

[1]School of Physical Education, Jiangxi University of Technology, Jiangxi, 330022, China
Corresponding Author*: Yun Guo E-mail: 393673863@qq.com

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ABSTRACT

In the process of the digital transformation of physical education, the transformation of teachers' roles is of great significance. It is not only the key to promoting the transformation but also an inevitable requirement for implementing the concept of "health first" and cultivating new talents for the times. It represents the unity of historical, value, and practical logics. Historically, technological innovation, the upgrading of educational goals, and the reconstruction of professional identity drive the evolution of teachers' roles. At the value level, it has the value of promoting educational transformation, facilitating students' development, and enhancing teachers' competence. In practice, teachers take the initiative to reshape their roles driven by the digital scenario. However, in the initial stage of the transformation, the transformation of teachers' roles faces dilemmas, such as the contradiction between role change and inertia, the predicament of multiple expectations and cognitive ambiguity, the dilemma of new role requirements and insufficient capabilities, and the situation of role disorder and weak support. To address these issues, it is necessary to cultivate teachers' role literacy and strengthen their role identity; strengthen the construction of school digital culture to optimize the ecological environment for role development; improve the mechanism of social role construction to create a favorable environment; and establish multiple guarantee mechanisms to promote the orderly transformation of teachers' roles from aspects such as professional guidance, technical platforms, and theoretical research, so as to promote the digital reform of physical education.

1. Introduction

With the iterative development of emerging digital technologies such as big data, the metaverse, and generative artificial intelligence, and their deep application in the field of physical education, the traditional sports education system is undergoing unprecedented transformations,

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accelerating its shift from the stage of informatization to that of digitalization. In 2025, China's Ministry of Education launched a strategic initiative to accelerate the digital transformation of education (Wan et al., 2025). Policy documents such as the Outline for Building a Strong Sports Nation and the Physical Education and Health Curriculum Standards for Compulsory Education (2022 Edition) were successively issued, explicitly identifying digitalization as an important engine for promoting innovation and development in sports education. The aim is to build a high-quality sports education system and support the building of a strong sports nation and the modernization of education with Chinese characteristics (Hu, 2025).

The digital transformation of sports education is a dynamic process of deep reform that uses digital technologies to catalyze change across all elements (such as educational objectives, teaching content, teaching methods, and evaluation systems), all processes (including curriculum design, classroom instruction, extracurricular training, and competition organization), all business domains (such as school sports, community sports, and reserve talent training for competitive sports), and all educational sectors (including basic education, higher education, and vocational education). This complex systems project not only requires government departments to play an overarching role in policy guidance and resource allocation, and depends on schools to actively innovate in teaching reform and platform construction, but also demands coordinated efforts from social institutions and technology enterprises in content provision and technical support (Chen et al., 2025).

As the core human resource driving the development of sports education, PE teachers bear a key mission in promoting the digital transformation of sports education. UNESCO emphasizes that "in an era of globalization and rapid technological iteration, education must respond to multiple demands, including individual health promotion, sociocultural inheritance, and competitive talent cultivation, and must re-examine teachers' professional positioning and role connotations" (Yuan, Yang, et al., 2025). In the new stage of the digital transformation of sports education, PE teachers urgently need to break through the traditional role constraints of "movement demonstrators" and "skill transmitters," to reconstruct their educational roles under the empowerment of digital technologies, and to enhance their digital literacy in order to implement the "health first" concept and cultivate a new generation with strong bodies and sound personalities.

However, what is the internal logic behind PE teachers' role transformation in the context of the digital transformation of sports education? What specific dilemmas do they currently face? And how should their roles be reshaped in light of the disciplinary characteristics of sports? These questions have become critical issues that must be addressed in the field of sports education. Based on the practical context of the digital transformation of sports education, this study systematically explores the logical framework, practical obstacles, and promoting strategies for PE teachers' role transformation, with a view to providing theoretical references for PE teachers' professional development and the digital reform of sports education.

2. The Logical Trajectory of PE Teachers' Role Transformation in the Digitalization of Sports Education

Against the backdrop of the digital wave penetrating deeply into sports education, PE teachers' role transformation is not only an inevitable result of technology-enabled educational innovation, but also a necessary choice for implementing the "Healthy China" strategy and cultivating a comprehensively developed new generation. At the same time, it is an ongoing process of

reconstructing teachers' professional identities within the digital education ecosystem, reflecting the dialectical unity of historical logic, value logic, and practical logic.

2.1 Tracing the Origins: The Historical Logic of PE Teachers' Role Transformation

The historical logic of PE teachers' role evolution embodies the intrinsic connection between the laws of sports education development and the demands of the times (Hu, Huang, & Zhang, 2025b). The trajectory of transformation has been jointly driven by technological innovation, the iterative upgrading of sports education goals, and the escalating social expectations of PE teachers.

First, the fundamental driving force behind role transformation is modern technological innovation. From the perspective of the history of human sports education, technological progress has always been the core factor propelling the iteration of PE teachers' roles. In the pre-industrial era, PE teachers mainly existed as "movement demonstrators," transmitting survival skills through oral instruction and personal example, including physical training for hunting and farming as well as traditional sports cultures such as martial arts and folk sports. After the Industrial Revolution, as disciplines such as exercise physiology and sports training science emerged, PE teachers' roles shifted toward that of "scientific training guides," beginning to use tools such as exercise-load monitoring and physical training plans to implement standardized instruction.

Entering the digital age, the popularization of technologies such as sports biomechanics analysis systems, smart wearables, and virtual reality sports training systems has driven PE teachers to transition from single-dimensional skill transmitters to "digital sports designers." They are now required to master new skills such as exercise data collection and analysis, virtual sports scenario creation, and personalized training program design, in order to adapt to a new educational paradigm in which "technology is embedded into the body."

Second, the upgrading of sports education objectives is a demand of the times that pushes role transformation. With social development, the value positioning of sports education has evolved from focusing solely on "improving physical fitness" to a composite educational goal of "fostering sound personality and tempering willpower." This change directly drives the reconstruction of PE teachers' roles. Guided by policy documents such as the Outline for Building a Strong Sports Nation and the Physical Education and Health Curriculum Standards for Compulsory Education (2022 Edition), sports education has been endowed with increasingly diversified missions (Yue, Cao, et al., 2025). It is expected not only to promote students' physical and mental health, but also to transmit the Chinese spirit of sports and to cultivate reserve talents for competitive sports. These new requirements push PE teachers to move beyond the single role of "classroom organizer" and to undergo multidimensional transformation amid the tide of digital education.

Third, the reconstruction of PE teachers' professional identity constitutes the inner logic of role transformation. The digital age poses new professional competency requirements for PE teachers: they must retain the traditional basics of sports teaching—such as movement demonstration and classroom management—while also acquiring the ability to deeply integrate digital technology with sports instruction. This "dual-competence" requirement prompts PE teachers to redefine their professional identities, shifting from "experience-based teachers," who rely primarily on intuition, to "research-based teachers," who ground decisions in data. By optimizing training programs through sports big data analysis and using AI technologies to carry out exercise risk assessments, teachers realize a role leap from "teaching by feel" to "guiding by data." This is not only a result of external technological pressures, but also an active reconstruction

of professional identity in the digital era (Yue, Wang, et al., 2025).

2.2 Value Coupling: The Value Logic of PE Teachers' Role Transformation

The value logic of PE teachers' role transformation is reflected in the bidirectional empowerment between the instrumental value of sports education and the developmental value of teachers as individuals, focusing on three interrelated dimensions: promoting the digital transformation of sports education, supporting students' holistic development, and enhancing teachers' digital teaching competence (Chen et al., 2025).

First, instrumental value is the key fulcrum driving the digital transformation of sports education. As the "primary implementers" of sports education reform, PE teachers' role transformation is central to overcoming the persistent problem of "technology and education operating in parallel but not integrated." On one hand, PE teachers must assume the role of "digital designer of sports education," deeply integrating digital technologies into course development—such as designing VR-based martial arts courses and building online sports competition platforms; into teaching implementation—such as using motion-capture technologies to correct students' techniques; and into assessment reform—such as constructing digital profiles of students' exercise capabilities and promoting digital re-engineering of the entire sports education process.

On the other hand, teachers must become "sports digital-ecosystem builders," working with technology enterprises to develop exercise and health monitoring systems suitable for young people, and participating in the construction of public-service platforms for sports education resources (Hu, Bin, Zhang, et al., 2025). In applying technology, they must adhere to the essence of sports education and use digital tools to empower the goals of "teaching well, exercising often, and competing regularly," while avoiding the pitfall of "technology for technology's sake."

Second, educational (formative) value is an inevitable choice for supporting students' personalized development. In the digital era, students' exercise needs have become increasingly diversified: some seek to improve competitive performance, others to enhance physical fitness, and still others hope to cultivate teamwork skills through sports. PE teachers must leverage digital technologies to achieve "precise education." As "exercise-personality analysts," they collect students' exercise data via wearables and develop differentiated training plans—for example, designing fun-based physical fitness programs for obese students and building specialized technical improvement models for student-athletes. As "exercise-psychology guides," they use VR to create high-pressure competition scenarios to enhance students' resilience and use data visualization to strengthen their sense of self-efficacy. As "guides to lifelong exercise," they employ exercise social platforms (such as campus sports apps) to cultivate students' autonomous exercise habits, extending sports education from the classroom into everyday life and realizing the educational goals of "enlightening the mind through sports" and "nurturing the heart through sports."

Third, developmental value is the necessary path for enhancing PE teachers' digital competence. Digital technologies have reshaped teachers' work scenarios: from physical playgrounds to hybrid "online + offline" and "real + virtual" instruction; from face-to-face guidance to real-time cloud-based exercise feedback. In this process, PE teachers, through role transformation, achieve professional upgrading: improving their technical application skills, such as operating exercise data collection tools (e.g., MyoWare EMG sensors, sports simulation software); enhancing data literacy, such as extracting educational value from multi-dimensional information like exercise trajectories, heart rates, and movement efficiency; and strengthening

cross-disciplinary integration abilities by combining sports teaching with knowledge from psychology, nutrition, and computer science to form "sports + digital" composite teaching capacities. Such competency improvements not only benefit student development but also increase teachers' competitiveness in the digital era, enabling an identity transition from "traditional coach" to "digital sports mentor."

2.3 Practical Construction: The Practical Logic of PE Teachers' Role Transformation

PE teachers' role transformation is not a passive adaptation but an active reconstruction realized through a bidirectional interaction of "environmental drive and subject construction" in digital sports-education settings.

First, role adaptation driven by digital sports scenarios. The emergence of new scenarios such as smart sports venues, virtual sports competitions, and blockchain-based exercise growth archives requires PE teachers to reconstruct their role perceptions. In virtual PE classes, they must become "digital exercise guides," leading students to grasp key points of movement within VR skiing environments (Hu, 2025.). In smart playgrounds, they must serve as "exercise data interpreters," analyzing students' running posture data in real time and providing targeted advice. Such scenario shifts compel teachers to move beyond the traditional mindset of "prioritizing bodily demonstration" and to learn to use digital technologies to extend teaching capabilities—such as using slow-motion replay to break down complex movements and leveraging game-based programming in sports to improve student engagement. In this process of virtual–real integrated practice, new patterns of role behavior are gradually formed.

Second, dual construction through "external discipline" and "self-awakening." PE teachers' role transformation is jointly shaped by policy directions and individual agency. Externally, policies such as the Education Informatization 2.0 Action Plan and the New Era Basic Education Strong-Teacher Plan explicitly call for enhancing teachers' digital literacy. Local initiatives such as digital-skills training for PE teachers and smart sports teaching competitions provide "external momentum" for role transformation. Internally, teachers' identification with the mission of sports education in the digital era—such as recognizing the value of data-driven teaching in preventing sports injuries and improving training efficiency—generates intrinsic motivation for "self-reconstruction."

3. Practical Dilemmas in PE Teachers' Role Transformation Amid the Digitalization of Sports Education

While the digital transformation of sports education creates new opportunities for PE teachers' role reconstruction, it also presents them with multiple practical challenges (Deng et al., 2025). As the core executors of sports education reform, PE teachers must reposition their roles under the empowerment of digital technologies to meet the new-era requirements of "teaching well, exercising often, and competing regularly." However, their current role transformation is constrained by traditional role inertia, ambiguous role boundaries, gaps in digital competence, and incomplete support systems.

3.1 Conflict Between Rapid Technological Iteration and Traditional Role Inertia

With the deep application of digital technologies such as smart sports equipment, sports big-data platforms, and virtual simulation training systems in sports education, PE teachers' roles are rapidly evolving from "experience-led" to "data-intelligent" (Yang et al., 2025). Smart playground

systems require teachers to have the capacity to conduct real-time analysis of exercise data; VR-based sports teaching demands that teachers master virtual movement demonstration skills. These new requirements are pushing teachers toward roles such as "digital exercise coach" and "virtual scenario designer."

However, long-standing traditional teaching habits have become a major obstacle to role transformation. Some PE teachers still rely on the traditional "whistle + demonstration" model and show resistance to using smart devices such as heart-rate monitors and motion-capture cameras. In practice, many teachers prefer to judge exercise load by observing observable behavior rather than trusting real-time data from intelligent devices; some believe that virtual sports teaching "lacks the tactile feedback of real bodily movement" and are reluctant to change their face-to-face, hands-on instructional habits. This path dependence on traditional roles leads to a situation where digital technologies and sports instruction coexist only as "physical overlays rather than chemical integrations," making it difficult to achieve deep reform through "technology-empowered teaching."

In addition, some teachers have cognitive misunderstandings about the use of generative AI in designing training plans, worrying that such technologies will replace their core instructional functions, which in turn leads to role anxiety and resistance to transformation (Yuan, et al., 2025).

3.2 Dilemmas of Plural Role Expectations and Ambiguous Role Positioning

In the digital era, expectations for PE teachers' roles have become increasingly diverse. Society expects them to be "scientific exercise guides" and "health-promotion planners," while educational practice and students hope they can balance the dual duties of "offline exercise coach" and "online health consultant." These overlapping expectations have left PE teachers facing both "role overload" and "blurred positioning."

In the absence of clearly defined role boundaries, teachers hold significantly divergent understandings of new roles. Some view themselves mainly as "technology demonstrators," focusing on showcasing new devices; others see themselves primarily as "data recorders," passively collecting information without integrating it into instruction. This cognitive ambiguity has produced two extremes in practice. At one end, some teachers blindly chase technological forms, overemphasizing tools such as apps and VR while neglecting motor skills and value education. At the other, some cling stubbornly to traditional roles, refuse to engage with digital tools, and reject hybrid teaching models.

Moreover, academic research on new roles such as "AI coach" and "AI referee" is still underdeveloped, with a lack of clear definitions and competency standards. This further deepens teachers' confusion about their own roles.

3.3 Mismatch Between Emerging Digital Roles and Existing Professional Competence

The digitalization of sports education has spawned a series of new professional roles that require teachers to possess composite "sports + digital" competencies. Teachers must not only master traditional sports knowledge, such as exercise anatomy, but also acquire digital skills such as exercise data cleaning, smart device operation, and virtual scenario design. For example, constructing digital exercise profiles of students requires integrating multidimensional data (e.g., physical test scores, daily exercise volume, heart-rate changes); running online sports communities demands knowledge of new media communication and platform development logic.

However, there is currently a pronounced gap between PE teachers' competence structures and the requirements of these new roles. Surveys show that only a small number of teachers can skillfully use professional data-analysis tools; some are unfamiliar with the calibration and maintenance of smart equipment; more than half lack experience in designing virtual simulation teaching modules. In terms of data literacy, many teachers are stuck at the level of "viewing data," struggling to use data modeling to optimize training plans or identify exercise risks. In some schools, smart sports devices are used only for basic functions, with technological applications limited to attendance recording and step counting.

3.4 Growing Pains of Role Transformation and Absence of Support Systems

PE teachers face multiple sources of pressure during role transition. In offline classes, they must juggle operating smart devices and providing in-person movement guidance; in online teaching, they must simultaneously handle live exercise instruction, interactive Q&A, and data feedback, increasing their workload substantially. Some teachers engaged in digital teaching report that troubleshooting technical glitches consumes large amounts of class time, and switching between virtual and real environments easily disrupts instructional pacing.

However, current support systems have not effectively addressed these transition needs.

First, there is a lack of institutional norms. Educational authorities have yet to issue ethical guidelines specifically for PE teachers' digital roles. There are regulatory gaps in areas such as the scope of exercise-data collection and health-privacy protection, leaving teachers exposed to data-security risks in technology use.

Second, theoretical research is lagging behind. Existing literature mainly focuses on the effectiveness of technological applications and lacks foundational studies on the digital role conflicts of PE teachers and the mechanisms of role coordination in virtual–real teaching scenarios. As a result, teachers are forced into blind trial and error in practice.

Third, training systems are unbalanced. Current digital literacy training for teachers emphasizes general technology skills but lacks specialized content for sports contexts—such as using sports biomechanics software and livestreaming technologies for competitions. There is also an absence of closed-loop mechanisms that link "instructional reflection–technology application–role adaptation."

This absence of support systems has left PE teachers feeling "isolated and unsupported" in role transformation. Without clear behavioral guidelines or targeted pathways for competence enhancement, many teachers retreat to the comfort zone of traditional teaching, ultimately producing a dilemma of "enthusiasm for technology application but coldness toward role transformation."

4. Strategies for Promoting PE Teachers' Role Transformation in the Digitalization of Sports Education

The dilemmas facing PE teachers' role transformation under the digitalization of sports education stem not only from inadequate digital literacy and role competence at the individual level, but are also closely related to lagging digital-culture development in school sports and incomplete

social-support mechanisms for sports-education roles. Therefore, it is necessary to systematically advance change from the dimensions of enhancing PE teachers' role literacy, constructing a digital campus sports ecosystem, and improving social-support mechanisms, so as to facilitate adaptive role transformation.

4.1 Cultivating PE Teachers' Role Literacy and Strengthening Digital Role Identity and Agency

The reshaping of PE teachers' professional roles is not something imposed externally, but a developmental process built through proactive construction grounded in an understanding and acceptance of the essence of the digitalization of sports education. Enhancing teachers' digital-role literacy and strengthening their identification with and agency in new sports-education roles is a core pathway for overcoming transformation dilemmas.

First, updating conceptions of professional roles and deepening awareness of digital sports roles. Establishing role understandings that align with the digitalization of sports education is the logical starting point for PE teachers' role transformation. The American sport educator Daryl Siedentop has pointed out that in the digital era, sports education should break through the single model of "demonstration–imitation practice" and build a three-dimensional teaching system of "technology empowerment–exercise experience–health promotion" (Hu, et al., 2025a).

PE teachers need to fully understand that the digital transformation of sports education is not merely a change in teaching tools, but a systemic restructuring of sports-education concepts and educational models. On one hand, they must transcend a narrow "technology-as-tool" view and recognize the empowering value of digital technologies in areas such as movement-skill analysis, personalized exercise plan development, and dynamic monitoring of students' physical health. On the other, they must adhere to the essential attribute of sports education as "educating people through exercise," maintaining attention to humanistic values such as emotional engagement in exercise, transmission of the spirit of sports, and cultivation of teamwork in digital teaching.

In particular, they should be wary of the misconception of "technology replacing teachers," and clearly recognize that digital technology is an auxiliary means to enhance the efficiency of sports instruction, while teachers' core roles in professional exercise guidance, affective teacher–student relationships, and exercise-safety protection remain irreplaceable. This helps build a rational conception of digital sports roles and mitigates anxiety over technology use.

Second, reinforcing role learning and improving competence for digital sports instruction. PE teachers' role competencies comprise a composite system including movement-skill instruction, digital teaching implementation, and sports-health guidance. Facing the digital transformation of sports education, teachers should embrace the concept of being "lifelong learners in exercise" and enhance their role competencies through multiple learning pathways.

They should first systematically study the theoretical foundations of digital sports instruction, understand the integration logic of new technologies—such as intelligent sports equipment, PE apps, and virtual simulation training systems—with sports teaching, and clarify their role positioning as digital PE teachers: they are not only precise guides of movement skills but also analysts of students' exercise data and organizers of online sports communities.

Next, they must master practical strategies for digital sports teaching. At the technical level,

they should learn to use tools such as motion-tracking devices (e.g., AI-based movement analysis systems), heart-rate monitoring wearables, and sports MOOCs. At the instructional level, they should experiment with hybrid teaching models such as "offline skill practice + online exercise check-ins + cloud-based data feedback," improving their ability to provide personalized exercise guidance and risk warnings through digital technologies.

In addition, by participating in digital sports teaching workshops, observing exemplary digital PE lessons, and carrying out action research on exercise instruction, teachers can accumulate practical experience, forming a positive cycle of "technology application–instructional reflection–strategy optimization," and effectively address potential challenges such as technical malfunction and low student engagement in digital exercise.

Third, nurturing role agency and enhancing confidence in digital sports education. PE teachers' role agency stems from deep recognition of their professional value and a proactive commitment to self-development. On one hand, teachers should accumulate positive experiences in digital sports teaching, internalizing societal needs for the "Healthy China" initiative and schools' expectations for digital sports education into their own role pursuits. For example, by using digital technologies to help students improve performance and physical indicators in scientifically sound ways, teachers can directly perceive the value of their work through data feedback, strengthening their emotional identification as "digital sports educators."

On the other hand, they should build a sense of efficacy in digital sports instruction and understand that technological competency can be improved through continuous learning. Even when facing challenges such as insufficient interaction in online classes, they should adopt a positive mindset, analyze causes, adjust strategies, and transform difficulties into opportunities for upgrading role competencies. Once a stable belief in digital sports roles has been formed, teachers will actively explore innovative ways to integrate technology and sports instruction—such as developing digital exercise-based school curricula and designing virtual sports competitions—and continuously reconstruct behavioral norms for digital sports teaching in practice, thereby avoiding role discontinuity or confusion caused by technological setbacks and achieving an upgrade from "passive adaptation" to "proactive leadership."

4.2 Building a Digital Campus Sports Culture Ecosystem to Reshape PE Teachers' Role-Development Environment

PE teachers' role transformation depends not only on individual intrinsic motivation but also on a campus digital culture environment that aligns closely with their professional development needs (Hu, Zhang, & Huang, 2025). As the main battlefield of the digital transformation of sports education, schools should build a three-dimensional ecosystem that supports role reconstruction through upgrades in digital sports infrastructure, innovation in school-based professional development, and reform of management mechanisms (Zhang et al., 2025).

First, strengthening digital sports infrastructure and building new intelligent teaching scenarios. The construction of a digital campus sports culture should center on "technology-empowered sports instruction" and create an integrated support system of "hardware + software + institutions."

At the hardware level, schools should focus on building intelligent sports teaching facilities. These include installing AI-based motion-capture systems (e.g., 3D pose analyzers), wearable

exercise-monitoring devices (heart-rate bands, trajectory-tracking shoes), and virtual simulation training pods, thereby creating smart PE classrooms that integrate movement-skill analysis, physical fitness data collection, and risk warning. Schools should also build campus sports data platforms, integrating students' physical fitness, performance, and extracurricular exercise data to form visualized digital twin systems for sports education.

At the institutional level, schools should establish sports data-security management systems defining the scope, usage norms, and privacy-protection measures for student exercise data; and develop operating guidelines for smart sports equipment, standardizing the implementation procedures for new instructional formats such as VR sports teaching and online exercise livestreaming. These measures provide standardized frameworks for PE teachers' digital instruction and help avoid classroom disruptions caused by disorderly technology use.

Second, innovating school-based professional development models and enhancing digital sports teaching competence in a tailored manner. In light of the cognitive differences and competency gaps among PE teachers in the digital transformation, schools should build a closed-loop professional development system of "needs diagnosis–targeted training–practice transformation."

First, through the analysis of teaching logs and reviews of digital teaching artifacts, schools can precisely identify teachers' gaps in areas such as smart-equipment operation, online-course design, and exercise-data interpretation. For example, if some teachers struggle to interpret AI-generated movement-correction reports, schools can design targeted workshops on "visual analysis of exercise data."

Second, schools can adopt a "scenario-based PE training" model by integrating virtual simulation technologies into professional development. Examples include simulating realistic scenarios such as "livestreaming PE classes on rainy days" and "organizing inter-school virtual sports meets," allowing teachers to learn digital sports teaching strategies through immersive experience. Schools can also form "digital PE learning communities" where teachers share innovative practices such as tiered instruction using smart jump-rope apps and AR-based physical fitness games, creating a collaborative improvement mechanism of "observation–discussion–adaptation–practice."

In addition, schools can develop micro-credential systems tailored to sports, awarding digital PE teaching certificates to teachers who master specialized skills such as smart exercise prescription design and short-form sports video production, thereby boosting teachers' sense of accomplishment in role development.

Third, optimizing management mechanisms for PE teachers and activating intrinsic motivation for digital role development. Schools should break out of traditional sports-teaching management models and establish modern management systems that integrate "value recognition–diversified incentives–role balance."

In terms of role positioning, schools should clearly articulate PE teachers' core value in the digital transformation: they are both inheritors of campus sports culture and designers of intelligent sports education. They must undertake traditional tasks such as movement-skill instruction and extracurricular training while also assuming new responsibilities such as digital sports curriculum

development (e.g., AI-assisted martial arts MOOCs) and the creation of student exercise-data archives.

For incentives, schools can establish digital innovation awards for sports, offering special recognition to teachers who develop high-quality virtual school-based sports curricula, lead smart sports clubs, or guide students to win honors in digital sports competitions. Digital teaching achievements should be incorporated into criteria for professional title evaluation, and scholarly contributions such as research on sports apps and big-data applications in sports education should receive academic recognition.

In terms of pressure management, schools can build workload-evaluation mechanisms focusing on PE teachers' digital roles. Smart scheduling systems can be used to reduce overlapping burdens from offline proctoring and online data management. Schools might also alternate "traditional PE days" and "digital sports innovation days," ensuring that teachers have both stable routines for conventional instruction and dedicated time for technological exploration, thereby preventing burnout due to role overload and achieving an organic unity between traditional values and digital innovation in sports education.

4.3 Improving Social Mechanisms for PE Teachers' Role Construction and Fostering a Collaborative Ecosystem

The transformation of PE teachers' roles is fundamentally a dynamic coupling of societal expectations for sports education, professional value norms, and the logic of technological empowerment. A three-dimensional support system involving government, schools, and society must be built through three dimensions—adherence to the essence of sports education, reconstruction of role norms, and innovation in risk governance—to create a favorable ecosystem for role transformation (Huang et al., 2025a).

First, anchoring the essential attributes of sports education and building appropriate systems of social role expectations. Social expectations of PE teachers should always revolve around the core mission of "educating people through sports." Under the "Healthy China" strategy, society must rationally recognize both the changes and continuities in the digital transformation of sports education. What remains unchanged is the essential function of sports education in improving students' health, fostering a fighting spirit, and shaping sound personalities through movement-skill instruction; what has changed is the pathway—using digital technologies to improve the precision of exercise guidance and expand the coverage of sports education.

On one hand, society must avoid reducing PE teachers to mere "technical operators" and instead safeguard their core roles as "cultivators of key sports literacy" and "transmitters of sports culture." On the other, differentiated and stratified role-expectation standards should be established: for example, emphasizing the role of "digital exercise-safety guardian" for PE teachers at the compulsory-education level, while highlighting "intelligent sports curriculum developer" as a key positioning for university PE teachers. This helps avoid unrealistic expectations of "all-round" roles that create professional pressure. Policies such as the 14th Five-Year Plan for Sports Development can be leveraged to clarify the core responsibilities of PE teachers at different educational levels in the digital era and to form a shared and rational expectation framework among governments, schools, and parents.

Second, reconstructing digital role norms for PE teachers and fostering a healthy public-

opinion environment. Role norms for PE teachers in the digital era must balance the ethics of technology use with the inherent laws of sports education.

At the behavioral level, an "Occupational Code for Digital PE Teachers" should be established to clarify boundaries for technology use—for instance, specifying that exercise data must be used only for individualized guidance and must not be excessively commercialized; and standardizing movement-demonstration criteria in virtual sports instruction to prevent sports-injury risks caused by technical errors.

At the level of rights and obligations, teachers should be granted rights such as reasonable use of intelligent sports-analysis systems and the ability to apply for special research projects on digital sports teaching, while also being required to protect students' exercise-privacy data and to continuously update their knowledge of digital sports.

Regarding public opinion, the wider community should be guided to accurately appreciate the role value of PE teachers. The myths of "VR sports classes replacing offline instruction" should neither be uncritically celebrated, nor should the positive impact of tools such as smart jump-rope apps on students' engagement be ignored. Professional sports media can launch columns such as "Digital PE Teachers' Voices" and organize national exhibitions of exemplary intelligent sports teaching cases to showcase the educational innovations of teachers under technological empowerment, thereby dispelling extreme views of "technology omnipotence" and "technology uselessness." This helps form a social consensus that "technology supports education while teachers lead innovation," enhancing the professional prestige and role recognition of PE teachers.

Third, establishing risk-governance mechanisms for the digitalization of sports education to safeguard safe role transformation. Given the distinctive risks in digital sports education—such as exercise data-leak risks, risks of injury in virtual sports, and risks of weakened sports spirit due to technology dependence—a full-chain governance system of "prevention–monitoring–intervention" is required.

Before risks occur, sports institutes and technology enterprises should collaborate to develop Safety Standards for Digital Technologies in Sports Education, setting entry thresholds for aspects such as encryption levels of data collected by wearables and safety parameters of virtual simulation sports environments. A knowledge base on digital-role risks for PE teachers should be built, compiling typical cases and response strategies—such as "over-quantification in smart exercise prescriptions causing student burnout" and "disorderly management in online exercise communities triggering public opinion crises."

During implementation, schools should set up dedicated risk-assessment teams for digital sports teaching, periodically reviewing the compliance of exercise data use and the scientific validity of virtual-course content. Educational authorities can build monitoring platforms for digital-technology use in sports education, tracking key indicators in real time, such as malfunction rates of intelligent sports devices and the workload indices of teachers in digital roles.

After incidents, rapid-response mechanisms should be activated when issues such as data leaks arise, immediately initiating data tracing and accountability procedures. For implicit risks such as weakened teacher–student interaction resulting from excessive reliance on technology, schools can organize special seminars on "Inheriting the Spirit of Sports in the Digital Era" and workshops on

traditional sports projects to help teachers reconstruct teaching concepts that integrate technology with humanistic values, avoiding role-identification crises triggered by risk events. Through multi-stakeholder collaboration in risk governance, a safe and orderly developmental environment can be provided for PE teachers' role transformation.

4.4 Building Multi-Dimensional Safeguard Mechanisms to Support Orderly Role Transformation

In the process of educational digital transformation, the deep transformation of PE teachers' roles depends not only on their active professional development, but also on constructing a multi-layered support system from the dimensions of professional leadership, technological empowerment, and theoretical construction, thereby providing systematic guarantees for role reconstruction (Huang et al., 2025b).

First, strengthening professional leadership and collaborative support in sports to precisely facilitate role transformation. Existing PE research frameworks suffer from insufficient emphasis on disciplinary characteristics, weak cross-school collaboration, and lagging technological integration, and have not fully played a professional guiding role in PE teachers' role transformation. It is therefore necessary to promote the professional upgrading of PE research organizations.

On one hand, a dual-drive model of "master-teacher studios + project communities" should be built. Model teachers in sports—especially those with advanced titles—can provide exemplary guidance in digital sports instruction and scientific physical training. Through workshops and mentoring programs, they can help solve practical challenges in smart-equipment use and hybrid (online–offline) instruction, thereby fostering role wisdom in digital teaching contexts.

On the other hand, "sports–education integration communities" should be established, strengthening cross-disciplinary collaboration among PE teachers, sports scientists, sports-technology enterprises, and community sports organizations. This can provide professional support for emerging roles in intelligent monitoring of students' physical health, exercise-risk assessment, and personalized training design, alleviating professional anxiety associated with role expansion.

Second, building sports-specific technology platforms to empower new spaces for role development. The innovative application scenarios of digital technologies such as sports biomechanics analysis, motion capture, and VR in PE instruction should be deeply explored to create integrated intelligent platforms for teaching, learning, practicing, and assessment.

By building VR sports training rooms and AI-based movement-correction systems, schools can provide immersive environments for role experience. Sports big-data analysis technologies can be used to create "role competence profiles" for PE teachers: by collecting behavioral indicators such as load regulation, safety guidance, and customized plan design during classes, visualized portraits of teachers' development in roles such as "exercise guide," "health promoter," and "technology user" can be constructed, precisely identifying strengths and weaknesses in role competence.

Third, deepening theoretical research on PE teachers' roles to consolidate the theoretical foundation for transformation (Hu et al., 2025). Cutting-edge research methods from sports sociology and sports psychology should be used, closely linked with the unique context of digital transformation in sports education, to carry out systematic empirical research on PE teachers' roles.

Methods such as virtual ethnography can be flexibly employed to track the role practices of online PE teachers, with grounded theory used to analyze core elements of the "cloud-based PE coach" role and to reveal role conflicts encountered during digital instruction. Furthermore, using models of digital elements in sports education (teachers–students–technology–sports events–teaching environment), researchers can systematically re-examine relationships among these elements and clarify the connotations of PE teachers' roles in the digital age. While preserving the traditional role of "movement-skill instructor," clear boundaries and competency requirements should be proposed for new roles such as "sports data analyst," "AI coach," and "AI referee."

By deeply exploring the mechanisms of digital-role formation in PE, a role-development theoretical model consistent with the laws of sports instruction can be constructed, providing robust theoretical support and practical guidance for PE teachers' role transformation.

5. Conclusion

The digital transformation of sports education presents PE teachers with unprecedented opportunities and challenges. In this reform process, their role transformation is of critical importance: it not only affects the depth of digitalization in sports education but also bears on students' holistic development and the realization of the goal of building a strong sports nation.

By analyzing the logical trajectory of PE teachers' role transformation, this study clarifies its historical inevitability, value orientation, and practical pathways. At the same time, the many dilemmas encountered in reality underscore that the digital transformation of sports education cannot be achieved overnight; it requires overcoming a series of challenges, including traditional role inertia, competence gaps, and deficiencies in support systems.

Looking to the future, the path of digital transformation in sports education remains long. PE teachers should actively embrace change, continuously enhance their digital literacy and role competencies, and fully leverage the advantages of digital technologies in teaching practice, deeply integrating the formative value of sports education with digital technologies. Meanwhile, governments, schools, and society must work together to improve support systems and create a favorable environment for role transformation.

Only in this way can the digital reform of sports education be continuously deepened and a high-quality sports education system be built, contributing the unique power of sports education to cultivating socialist builders and successors with all-round development in morality, intelligence, physique, aesthetics, and labor. In doing so, sports education can shine with new brilliance in the digital era and inject a steady stream of energy into the realization of a strong sports nation and the modernization of education with Chinese characteristics.

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