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The Path of Integrating Personalized Strength Training into University Physical Education Teaching

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Abstract: This study addresses the critical challenge of integrating Personalized Strength Training (PRT) into large-scale University Physical Education (UPE) teaching to counteract students' increasing physical heterogeneity and prevalent functional deficiencies. The traditional, standardized UPE model fails to adequately serve diverse individual needs and often neglects crucial functional movement assessment and injury prevention. This research constructs a systematic three-path framework to guide the reform. Path I proposes a data-driven system centered on scientific assessment (e.g., FMS) and dynamic personalized prescription using intelligent platforms to ensure training safety and efficacy. Path II advocates for a blended learning model and teacher role redefinition, transforming instructors into "exercise prescribers" supported by specialized training and online resources. Path III \ focuses on inter-departmental collaboration (PE-IT-Medical) and an integrated, process-oriented assessment system that prioritizes the improvement of students' functional movement and health literacy over mere compliance. Implementing this comprehensive path is essential for UPE to transition towards a scientific, student-centered, and health-literacy-focused paradigm, effectively meeting the lifelong health demands of modern society.

Keywords: Personalized strength training, University physical education, Classroom teaching, blended learning.

1. Introduction

In modern society, with the increasing awareness of health, university physical education teaching not only carries the traditional goal of improving students' physical fitness, but also shoulders the contemporary mission of cultivating lifelong exercise habits and a healthy lifestyle. However, the currently widely adopted large-class teaching and standardized teaching models have exposed many limitations in practice (Jones et al., 2023). This "one-size-fits-all" teaching approach often fails to take into account the significant individual differences among students in terms of physical foundation, motor skills, interests and hobbies, as well as physical development levels (Wang et al., 2024). For instance, some students may encounter problems such as being overweight and having insufficient cardiopulmonary function (Alhassan et al., 2022), while others may have a good foundation in sports but lack specialized strength development (Lee et al., 2023). The effect of standardized courses on improving their physical fitness is negligible (Chen et al., 2024).In recent years, the significance of strength training as the cornerstone of physical development, injury prevention and improvement of athletic performance has been widely recognized in the field of sports science. However, in the physical education courses of universities in our country, strength training is usually only briefly touched upon in the form of basic physical fitness exercises, lacking systematic, scientific and personalized guidance. Especially for college students who are not majoring in sports, they have a biased understanding of strength training. Their training methods are often blind and inefficient, and they may even suffer sports injuries due to improper training. This is contrary to the principle of "safety, effectiveness and science" in university physical education. International research on physical education is also increasingly emphasizing the "student-centered" teaching concept and calling for more targeted teaching content and models.

Personalized strength training (PRT) is precisely the key breakthrough to solve the above-mentioned teaching predicaments (Lee et al., 2023). Based on the individual physical fitness assessment data of students (such as maximum muscle strength, muscle endurance, body composition, joint range of motion, etc.) and specific health/exercise goals, it designs a unique training program (Patel et al., 2024), including reasonable load selection, set numbers, repetitions, interval times, and movement technique correction (Ramos et al., 2023). Ensure that every student can make physical progress within the safest, most effective and most targeted range (Chen et al., 2024). Integrating this personalized and scientific strength training method into university physical education courses can not only significantly enhance students' interest and enthusiasm for training, but more importantly, it can effectively improve their physical fitness, correct poor postures, prevent sports injuries, and lay a solid foundation for them to independently engage in scientific fitness in the future. However, at present, both at home and abroad, there is still a lack of research and practical paths on how to systematically and operationally integrate personalized strength training into the large-scale university physical education teaching

system. This not only involves the innovation of teaching content, but also affects multiple dimensions such as the teaching evaluation system, the construction of teaching staff, the configuration of venues and equipment, and the form of teaching organization. Therefore, this study aims to deeply explore the theoretical basis and feasibility of incorporating personalized strength training into university physical education teaching, and to construct specific and operational implementation paths, with the aim of providing new perspectives and empirical evidence for improving the teaching quality and effectiveness of university physical education courses, thereby promoting the development of university physical education teaching reform in China towards a more scientific, refined and human-oriented direction.

2. The connection between the intrinsic logic of personalized strength training and university physical education teaching

2.1 The Concept and Internal Logic of Personalized Strength Training

Personalized strength training (PRT) is an advanced paradigm in sports training science, with the core being to achieve a high degree of customization in training prescriptions (Tellez et al., 2024). It breaks through the "one-size-fits-all" standardized model in traditional collective teaching (García et al., 2023) and regards the training process as a dynamic and iterative optimization process based on scientific data (Zheng et al., 2024). Conceptually, PRT designs a unique resistance training program based on the significant heterogeneity of trainees in terms of physical constitution, body shape, functional movement patterns, past injury history, sports experience, and specific health goals, by applying the principles of sports physiology and sports biomechanics. Its internal logic follows the principle of assessment first: Firstly, through systematic functional movement screening (FMS) and physical fitness tests, it accurately identifies an individual's potential functional defects (such as insufficient core stability, limited joint movement, and muscle imbalance) and movement risks. Secondly, based on these assessment results, the key variables of training are precisely controlled by applying the specificity principle and the progressive overload principle, including: the selection of training movements (whether corrective exercises need to be included), load intensity (based on maximum repetitions or reserve repetitions RIR/RPE), training volume (number of sets, repetitions), and rest intervals. In addition, PRT emphasizes the dynamics and feedback-driven nature of the training process. The training plan is not fixed. Instead, it needs to be adjusted and optimized periodically through real-time monitoring of students' fatigue perception (RPE), training compliance data, and phased assessment results to ensure that the training is always within the safest, most effective, and most compatible with individual recovery capabilities range. This logic ensures the maximization of resource utilization, avoids ineffective training or injuries caused by improper training, and transforms strength training from mere physical exertion into scientific and precise health intervention. This is the key reason why PRT occupies a core position in modern physical training science.

2.2 The Intrinsic Connection between Personalized Strength Training and University Physical Education Teaching

The integration of personalized strength training and university physical education teaching is an inevitable result of modern educational concepts absorbing the development of sports science (Miller et al., 2024). The two have a close intrinsic connection in terms of educational goals, teaching efficiency, and the cultivation of lifelong health literacy. First of all, in terms of educational equity and humanistic demands, university sports shoulder the responsibility of promoting the healthy development of all students. However, the significant heterogeneity among college students in terms of physical fitness, posture and health needs makes standardized teaching inefficient. The introduction of PRT enables college sports to truly implement the concept of "student-centeredness", providing each student with training content that matches their physical condition, health risks (such as scoliosis and obesity), and interests, thereby eliminating the "unfairness" of standardized courses for students of different physical fitness levels. Secondly, in terms of cultivating lifelong health literacy, this is the core mission of university physical education. The implementation process of PRT requires students to transform from passive executors to active "health managers". Students need to learn how to interpret their own assessment data, understand training principles (such as load selection and period division), and dynamically adjust their training plans based on their own feedback. This deep integration of practice and theory internalizes abstract sports science knowledge into students' self-management and scientific decision-making abilities, significantly enhancing their sense of self-efficacy in sports and ensuring that they can continue to conduct self-health management scientifically after graduation. This is more valuable in the long term than merely meeting physical fitness standards. Finally, in terms of the scientific nature and safety of teaching, PRT has greatly enhanced the safety of university sports strength training by precisely assessing and identifying injury risks and incorporating corrective exercises. Meanwhile, precise load setting also ensures the effectiveness of training and avoids the waste of teaching resources. It is an inevitable path for university physical education teaching to shift from experience-based to data-driven and scientific management. Therefore,

PRT is a key structural tool for achieving the modernization, efficiency and lifelong health education goals of university physical education.

3. Analysis of the Demand for Personalized Strength Training in University Physical Education Teaching

3.1 The Demand for Addressing Physical Heterogeneity and Functional Defects among Global college Students

At present, the global higher education system is generally confronted with a core challenge: the significant heterogeneity of physical health among college students and the prevalence of functional motor defects. The standardized and one-size-fits-all college physical education (UPE) curriculum has been unable to effectively meet the increasingly diverse and complex physical needs of students worldwide. International research shows that there is a huge gap in students' physical foundation (Zhang et al., 2023). Some students are at health risks such as obesity, insufficient heart and lung function, weak core stability, and functional movement disorders due to lack of exercise and a sedentary lifestyle (Silva et al., 2024). They urgently need corrective and rehabilitative force intervention. While some other students have a solid foundation and need higher training intensity and more specific loads to achieve physical breakthroughs. The traditional unified training mode not only may cause overtraining or injury to those with weak constitutions, but also is difficult to achieve effective progressive overload stimulation for those with excellent constitutions, resulting in low teaching efficiency. Therefore, the personalized strength training advocated by the international sports science community, based on individual physical fitness assessment, posture screening and sports ability tests of students, accurately identifies potential functional defects such as muscle imbalance and limited joint range of motion, and accordingly designs customized training prescriptions, such as unilateral training, activation exercises and precise load intervals. This transformation of the teaching model is an inevitable requirement for the transition of university physical education from the traditional "physical exertion" model to the modern "refined health management and sports risk intervention" paradigm. It aims to ensure that in the context of globalization, every college student can improve their physical fitness and health level on the safest, most effective and most suitable path for their own needs. This precise intervention targeting individual functional deficiencies is a crucial step in enhancing the effectiveness and safety of university physical education and ultimately ensuring the lifelong health quality of students. It is also an urgent need for international physical education reform.

3.2 The demand for cultivating lifelong health literacy and deeply integrating sports science knowledge

Introducing personalized strength training is a key path for the global higher education system to respond to the demand for cultivating college students' lifelong health literacy and practical abilities in sports science.

The international higher education community generally believes that the core mission of college sports is to endow students with the ability to manage their own health independently and scientifically, rather than merely teaching sports skills (Clark et al., 2024). Strength training, as the scientific cornerstone of modern physical training, involves core knowledge such as exercise physiology, exercise biomechanics and training cycle theory in its principles (Santos et al., 2023). However, in the traditional teaching mode, this knowledge is often disconnected from practice. The implementation of personalized strength training requires students to be deeply involved in the training decision-making process, such as: independently analyzing physical fitness reports, setting training loads based on their own goals, understanding and adjusting training variables (such as the number of sets, repetitions, and intervals), and monitoring fatigue levels. This student-centered participatory learning can effectively internalize the abstract principles of sports science into practical knowledge that can be applied, cultivate their ability to make scientific decisions and self-monitor, and thereby build a strong sense of sports self-efficacy. In the context of global competition, having the ability to manage health scientifically has become an important symbol of high-quality talents. By mastering the methods of personalized strength training, students can acquire a set of scientific and sustainable health management tools to address potential health challenges in the workplace and life in the future, which is crucial for them to form a lifelong exercise habit. In addition, personalized training, by precisely matching abilities with goals, enhances the fun and success experience of training, effectively overcomes the common frustration and low motivation for exercise among students under standardized training models, and thereby significantly improves training compliance. This positive impact on sports psychology and intrinsic motivation is the guarantee that students can maintain the healthy habits they have acquired during college throughout their lives. Therefore, from an international perspective, introducing personalized strength training into university physical education is not merely a simple addition in content, but a comprehensive upgrade in teaching concepts, knowledge structures and practical models, in order to meet the strategic demand of modern society for the lifelong health literacy of high-quality talents.

3.3 The Necessity of Reshaping Teaching Organization models, empowering with technology, and innovating data-driven evaluation systems

To implement personalized strength training on a large scale, it is necessary to overcome the inherent bottlenecks of the existing university physical education teaching system in terms of organizational structure, technical support and evaluation paradigms (Martinez et al., 2023). This constitutes the necessity of conducting an in-depth analysis of the systematic innovation path (Zhao et al., 2024). Traditional university physical education teaching organizations are usually teacher-led and highly centralized, making it difficult to handle and guide customized programs for hundreds of students (Chen et al., 2024).Personalized teaching requires that the role of teachers shift from being action demonstrators to "health data analysts" and "exercise plan designers". This forces the international university physical education teacher training system to undergo major adjustments to incorporate advanced physical training expertise such as functional assessment, exercise prescription design, and injury risk management. In the absence of such professional teachers, personalized training cannot be effectively and safely implemented. Secondly, the in-depth empowerment of information technology (IT) is the key driving force for achieving large-scale and high-efficiency personalization. International leading research in physical education indicates that it is necessary to utilize smart wearable devices, training management apps and cloud computing platforms to establish a data-driven teaching closed loop. These technologies can collect key data such as students' training load, heart rate, and fatigue perception in real time, enabling teachers to efficiently monitor and analyze students' training status and compliance, and dynamically adjust training prescriptions with the assistance of algorithms. This technical approach is the only feasible way to break through the limitations of traditional teaching scale and achieve "thousands of faces for thousands of people" personalized guidance. Finally, the modernization transformation of the evaluation system is of vital importance. The traditional static and summative physical fitness assessment model cannot reflect the efforts of students in personalized training in terms of process, progress and functional improvement. Personalized strength training requires the establishment of a diversified, process-oriented, and goal-oriented assessment system, such as incorporating indicators like the improvement of functional movement screening (FMS) scores, relative strength enhancement rates, training compliance data, and the scientific nature of student-designed training plans. This innovation in the assessment paradigm serves as a systematic guarantee for motivating students to continuously engage, ensuring teaching quality, and enabling university physical education to truly adapt to the demands of international higher education reform.

4. The path direction of integrating personalized strength training into university physical education teaching

4.1 Construction of Data-driven Teaching Evaluation and Precision Prescription System

The primary and most crucial approach to systematically integrating personalized strength training into university physical education lies in establishing a data-driven teaching evaluation and precise prescription system. This system serves as the scientific foundation for the large-scale and efficient implementation of PRT, aiming to completely replace the traditional single physical fitness compliance assessment model. Specifically, this path requires the construction of a multi-dimensional, process-oriented and intelligent evaluation closed loop. First of all, in the assessment stage, a paradigm shift from "meeting physical fitness standards" to "functional health and exercise risk screening" must be achieved. This requires the introduction of a series of personalized assessment tools at the beginning of the semester: including functional movement screening or selective functional movement assessment (SFMA) to identify students' movement pattern disorders, limited joint range of motion and potential muscle imbalances; Conduct body composition analysis (such as body fat percentage and muscle mass) in combination with intelligent physical fitness testing equipment; And conduct relative strength tests (such as the ratio of body weight to squat weight, grip strength, and other indicators). These data will serve as the original basis for prescription design. Secondly, establish a precise training prescription generation mechanism based on data analysis. The assessment data must be integrated and analyzed through a cloud computing platform or a teaching management system. The system can automatically or semi-automatically generate an initial personalized strength training prescription for each student based on their FMS scores and physical fitness indicators. For instance, for students with low FMS scores and a risk of lower cross syndrome, the prescription should prioritize corrective exercises for gluteal muscle activation, core stability, and hip joint range of motion, and strictly control the intensity of free weight-bearing training within a low-load, high-control range. This mechanism ensures the safety, specificity and effectiveness of the training. Finally, establish a real-time data collection and dynamic adjustment mechanism for the training process. Path One requires students to use smart wearable devices, training management apps or sensors during training to record their training load (weight, number of repetitions), fatigue perception (RPE), heart rate and training compliance. Teachers monitor these data in real time through the teaching management system. When it detects that students are overly fatigued, the training load is continuously decreasing, or the RPE value is abnormally elevated, the

system should be able to automatically issue a "warning" to both teachers and students, indicating that teachers can dynamically adjust the training prescription for the next stage (for example, entering a load reduction week or changing the movement mode). This closed loop of "real-time feedback → data analysis → dynamic adjustment" is the technical core for ensuring the quality of large-scale personalized teaching, avoiding sports injuries and maintaining students' enthusiasm for training. Only through this path can university physical education teaching truly transform from experience-based guidance to scientific and data-driven precise teaching.

4.2 Blended Learning Model and the Reconstruction of New Teachers' Capabilities

This section aims to address the bottlenecks in teaching organization and faculty capabilities encountered during the implementation of PRT, which is particularly prominent under the large-class teaching model of university physical education. Therefore, this path requires the reconstruction of the teaching mode as "online-offline blended learning", and the simultaneous realization of the professional upgrade of the teacher's role. First of all, establish an "online learning resource platform" to support personalized knowledge imparting. The traditional physical education class time should mainly be used for movement practice, technical guidance and safety supervision, while the knowledge content such as sports science theory, training plan formulation, assessment data interpretation and basic movement teaching videos should be transferred to online platforms. The platform should offer customized learning paths: for instance, if a student is identified as having "insufficient shoulder joint stability" during the assessment stage, the system will automatically push theoretical knowledge, teaching videos and self-test questions related to shoulder stability and range of motion. This not only enhances the efficiency of classroom time but also ensures that students have the scientific literacy necessary to understand their own training prescriptions before undergoing training. Secondly, reshape the role positioning and professional ability structure of physical education teachers. In the PRT system, the role of teachers must shift from the traditional "action demonstrator" to "exercise prescriber", "health data analyst" and "learning counselor".

This requires universities to establish a new professional development system for teachers: regularly organizing teachers to participate in training led by experts in sports rehabilitation and physical training, with a focus on mastering advanced skills such as functional assessment, risk classification, training cycle division, and operation of sports prescription software. In addition, teachers are encouraged to obtain internationally certified qualifications as physical training experts to ensure that they possess the professional knowledge to guide personalized and high-intensity strength training. Finally, optimize the classroom organization form and implement the "mentor-group" guidance model. Given that it is difficult for teachers to guide dozens of students individually, a model of "main lecturer + physical fitness teaching assistant/senior teaching assistant (TA) + group mutual assistance" can be adopted. The main lecturer is responsible for the macro teaching design and the guidance of high-risk actions. Physical fitness teaching assistants or senior students who have passed the assessment are responsible for making rounds during training to correct movements and record data. At the same time, encourage students to supervise each other's training load and movement norms within their groups, forming a mutually supportive learning community. This hybrid organizational model, which allocates personalized tasks through a technical platform, provides on-site support through a teaching assistant team, and ensures the quality of guidance through professional upgrades, effectively resolves the contradiction between large-scale teaching and personalized demands, and serves as a key organizational guarantee for the implementation of the PRT path.

4.3 Integration and Innovation of Multi-department collaboration and Evaluation System

Incorporating PRT into university physical education teaching is not the sole task of the sports department, but rather requires in-depth collaboration among multiple departments. Ultimately, this transformation should be solidified and incentivized through the integrated innovation of the evaluation system. First of all, establish a cross-departmental collaborative mechanism for "sports - healthcare - information". To implement personalized strength training, support from the school hospital or health service center must be obtained. For instance, school hospitals should be involved in the health screening and classification of high-risk students, providing sports medicine guidance and rehabilitation suggestions for those with specific chronic diseases or serious posture problems, and ensuring that the training prescriptions provided by physical education teachers do not conflict with the students' health conditions. Meanwhile, the Information Technology Department (IT) must provide technical support and data security guarantees for the data platform, training management App, and teacher training required by Path One. This collaborative mechanism ensures the safety and scientific nature of PRT implementation, placing university physical education teaching within the entire university health service system. Secondly, promote the "intelligent" and "multi-functional" upgrade of strength training venues and equipment. Personalized strength training requires a variety of training equipment and

flexible training Spaces, rather than traditional single gyms. Path Three requires the renovation of existing venues: adding multi-functional training areas (for functional movements and corrective exercises), introducing adjustable resistance equipment, intelligent monitoring devices, and strength training racks that facilitate data collection. The venue design should support the simultaneous conduct of group training and individual training, ensuring that students of different training intensities can carry out personalized training in the same space. This kind of facility upgrade is the foundation of PRT's hardware guarantee and teaching efficiency. Finally, establish an integrated innovation of incentive mechanisms and evaluation systems. To solidify the PRT path, it is necessary to incorporate personalized achievements into students' academic evaluation and incentive systems.

The assessment should achieve integrated innovation, including: 1. Process assessment: The scientific nature of training compliance data, RPE and training load records. 2. Outcome Evaluation: The extent of improvement in functional movement scores (such as FMS), the percentage increase in relative strength (such as squat weight/body weight), and the effect of posture correction. 3. Quality assessment: The scientificity and rationality of the self-training plan design report submitted by the student. In addition, link the credits of physical education courses with health literacy certificates or specialized ability certificates to encourage students to actively participate in personalized strength training. Through this multi-departmental collaboration, hardware upgrade and innovation in the evaluation system, personalized strength training can truly become a regular and institutionalized path in university physical education teaching, ultimately enhancing the overall quality of education.

5. Conclusion

This study conducts a systematic and in-depth exploration and construction of the path for integrating personalized strength training (PRT) into university physical education teaching. Facing the increasingly prominent physical Heterogeneity and functional defects of the global college student population, the traditional standardized teaching model is no longer effective in dealing with them. This makes the introduction of PRT an inevitable choice to enhance the effectiveness, safety and scientificity of teaching. The intrinsic logic of PRT - based on scientific assessment, achieving precise prescriptions and dynamic adjustments - is highly consistent with the educational mission of university physical education to cultivate students' lifelong health literacy. This study has established three major implementation paths, providing clear guidance for the modernization transformation of university physical education: Path One emphasizes the construction of a data-driven assessment and precise prescription system, requiring teaching to shift from experience-based to a risk management model centered on functional movement screening (FMS); Path Two proposes a blended learning model and the reconstruction of new teaching staff capabilities, advocating that the role of teachers should be upgraded to data analysts and exercise prescribes, and the problem of personalized guidance in large-scale teaching should be solved through online platforms. Path Three focuses on the integration and innovation of multi-departmental collaboration and the evaluation system, emphasizing the need to incorporate the functional improvement and quality enhancement of students into core assessment indicators through the collaboration of IT departments and medical institutions, as well as the diversified and process-oriented transformation of the evaluation system. These paths together constitute a systematic guarantee for the large-scale and sustainable implementation of PRT. The theoretical significance of this research lies in that it combines the principle of individualized training with the mass education model, providing a systematic solution to the individualized problem in the context of large-scale education and enriching the theoretical framework of physical education in the application of exercise prescriptions. The practical significance lies in that the constructed path provides specific and operational implementation guidelines for university sports departments, which can guide them in carrying out curriculum reforms, teacher training, and intelligent upgrades of venues and equipment. Ultimately, it helps students improve their physical fitness more safely and efficiently, and establish scientific fitness capabilities that will benefit them for life. However, the successful application of PRT in university physical education teaching still faces many challenges, providing a broad space for future research, including: the effectiveness, compliance, and specific quantitative effects on students' physical fitness, mental health, and health literacy improvement after the implementation of these three major paths should be verified through longitudinal empirical studies; Meanwhile, it is necessary to further explore the utilization of artificial intelligence (AI) and Machine Learning technologies to optimize the automatic analysis of training data and the dynamic adjustment model of intelligent training prescriptions, so as to reduce the data processing burden of teachers and improve the efficiency and accuracy of prescription generation. In addition, it is necessary to conduct in-depth research and formulate PRT professional competence certification standards and a continuing education system applicable to university physical education teachers to ensure that the teaching staff can continuously adapt to the latest developments in sports science. Ultimately, through continuous theoretical exploration and practical verification, it is expected that personalized strength training will become a regular and

institutionalized component of university physical education teaching, thereby better serving the country's strategic demand for the healthy development of high-quality talents.

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