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Enhancing Physical Literacy of University Students: Current Status and Intervention Strategies

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Abstract: *In response to the imperative for holistic development—academic, moral, physical, aesthetic, and labor skills—in higher education, this study examines the current status and intervention strategies for improving university students' physical literacy in China. Employing a combination of literature review, questionnaire analysis, and logical reasoning, this research outlines a multi-dimensional approach to physical literacy enhancement under the guiding principles of "people-centered" and "health-first." Through a structured pathway incorporating motor skills, behavioral practices, physical fitness, knowledge acquisition, and physical activity awareness, this framework seeks to integrate sports into curricula, encourage active participation, and promote lifelong benefits for students.*

Keywords: *Physical Literacy, Intervention Strategies, Holistic Education, Sports Integration*

1. Introduction

The importance of fostering comprehensive development in higher education is paramount, with physical literacy recognized as a crucial component for assessing the quality of talent cultivated by universities. Building on the philosophy of balanced development in education, physical literacy entails not only physical abilities but also the motivation, confidence, knowledge, and understanding required for lifelong physical activity engagement [1]. Within the context of Chinese higher education, enhancing students' physical literacy has become increasingly vital for aligning with national educational mandates, as well as responding to the unique challenges presented by modern sedentary lifestyles. Studies have shown that improving citizens' physical literacy contributes to long-term health, resilience, and an active lifestyle [2].

This study undertakes an in-depth analysis of the current state of physical literacy among university students, examining it through five core modules: motor skills, physical behaviors, fitness levels, sports knowledge, and awareness. Drawing from a survey conducted in March 2023 among 3,790 students at Shanghai University of Technology, we delve into these areas with the aim of identifying barriers and formulating targeted strategies to advance physical literacy among university students in China. The proposed intervention pathways, rooted in the concepts of "competition integration," "universal participation," and "lifelong benefit," address students' specific needs while supporting national objectives in talent development and sustainable education reform.

2. Need for Enhancing Physical Literacy in University Students

2.1. Theoretical Foundations of Physical Literacy

The concept of physical literacy has been widely accepted internationally, with foundational contributions by Whitehead (2001) defining it as the combination of motivation, confidence, physical competence, knowledge, and understanding necessary for lifelong physical activity [1]. In China, physical literacy research has evolved with diverse interpretations; Zhang Chengyun (2003) first introduced the term as physical literacy, sparking scholarly interest in examining its components. This research regards physical literacy as a comprehensive ability encompassing emotional (awareness), cognitive (knowledge), and behavioral (skills, physical fitness) dimensions [3].

In light of both global and domestic perspectives, physical literacy for university students is defined here as a multidimensional capability enabling lifelong engagement in physical activities. The framework developed in this study acknowledges the evolving nature of students' physical abilities, preferences, and contextual needs, which play a significant role in fostering voluntary and beneficial physical activity.

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Accordingly, this research addresses knowledge, skill, behavior, fitness, and awareness as the foundational elements of physical literacy among university students.

2.2. Theoretical and Policy Foundations for Physical Literacy Enhancement

The development of physical literacy is underpinned by educational, psychological, and philosophical frameworks. Rooted in Marxist theories of comprehensive development, physical literacy is further informed by embodied cognition, which posits that physical and cognitive experiences shape one another in dynamic interaction [4]. This integration of theory supports the notion that physical literacy encompasses cognitive, affective, and psychomotor domains, aligning with Bloom's taxonomy in educational psychology, which classifies learning objectives into cognitive, emotional, and psychomotor domains [5].

In recent years, physical literacy has gained prominence globally, supported by institutions like the International Physical Literacy Association, established in 2019. Educational reforms in countries such as the United States and Australia have incorporated physical literacy as a central goal within curricula, emphasizing the importance of lifelong engagement in physical activities. The U.S. National Physical Education Standards, for instance, advocate for students to develop as "physically educated" individuals [6], while Australia's "Getting Australia Moving" initiative highlights the role of structured physical education in fostering physical literacy [7].

In China, national education policy has also placed growing emphasis on physical literacy. In 2002, the Ministry of Education issued the "Guidelines for Physical Education Teaching in Regular Higher Education Institutions," identifying physical literacy as an essential goal for university physical education. The 2016 "Opinions on Strengthening School Physical Education" further underscored the importance of physical literacy as a basic tenet of school sports initiatives, while subsequent policy documents, such as the "Healthy China 2030" Plan, reinforce the role of physical literacy in national health strategies. These policies reflect a collective commitment to enhancing physical literacy as an educational priority, recognizing its role in cultivating well-rounded, resilient individuals equipped for future societal contributions.

3. Current Needs for Physical Literacy Development in University Students

Physical literacy embodies a lifelong tendency toward physical activity and includes personalized, adaptive growth in physical ability. To achieve the goal of enhancing university students' physical literacy, it is essential to assess the level of physical competence developed over twelve years of physical education and adapt this foundation to the specific needs, resources, and policies within each institution. Based on the previously established definition and dimensions of physical literacy, this study categorizes university students' physical literacy into five key areas: physical fitness, sports knowledge, physical behaviors, motor skills, and awareness.

This study collected data from 3,790 students at Shanghai University of Technology (see Table 1), employing cluster and convenience sampling methods. The sample consisted of 1,730 male students (45.65%) and 2,060 female students (54.35%), with an average age of 18.58 (±1.112). Primarily comprising first- and second-year students, this sample reflects a broad perspective on physical literacy across the university's lower-level cohorts, which account for 98.81% of the student population.

Table 1: Sample Demographics

Category	Details	Count	Proportion
Gender	Male	1,730	45.65%
	Female	2,060	54.35%
Year Level	First-year	1,564	41.27%
	Second-year	2,181	57.54%
	Preparatory	29	0.77%
	Other	16	0.42%
Course Type	Specialized PE	3,711	97.91%
	Competition PE	58	1.53%
	Health PE	15	0.40%
	Other	6	0.16%

The following sections analyze the current state of university students' physical literacy across these

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five dimensions.

1) Physical Fitness

Student physical fitness levels indicate a need for improvement, with only 0.55% achieving an "Excellent" rating, 10.53% rated "Good," 68.68% "Pass," and 20.24% "Fail." These results highlight that a significant proportion of students do not meet national fitness standards, with muscle strength and cardiorespiratory endurance notably below average. Among the lowest-performing categories are pull-ups for males, the 1,000-meter run for males, the 800-meter run for females, lung capacity, and standing long jump performance (see Table 2).

Table 2: Physical Fitness Statistics

Fitness Level	Count	Proportion
Excellent	21	0.55%
Good	399	10.53%
Pass	2,603	68.68%
Fail	767	20.24%

2) Physical Behavior

The data show low physical activity levels, with 50.68% of students engaging primarily in low-intensity physical activities, while 16.49% and 32.82% engage in high and moderate intensity activities, respectively. The average daily sedentary time is 7.5 hours (±10.393), with 63.6% of students classified as highly sedentary. Despite the high rate of sedentary behavior, 86.44% of students report watching sports events or news through media, suggesting indirect engagement with sports (see Table 3).

Table 3: Physical Behavior Statistics

Physical Activity Level	Count	Proportion
Low Intensity	1,921	50.68%
Moderate Intensity	1,244	32.82%
High Intensity	625	16.49%
Sedentary Group	2,410	63.6%

3) Sports Knowledge

The results indicate limited knowledge regarding sports and exercise among students. Only 20.48% reported understanding exercise planning, injury prevention, and treatment, while 48.66% had a moderate level of understanding, and 30.86% were unfamiliar with these areas. Though nearly 70% of students engage in self-directed learning through online resources, approximately 80% lack knowledge of how to create an effective exercise plan, indicating a substantial gap in practical sports knowledge (see Table 4).

Table 4: Sports Knowledge Statistics

Knowledge Level	Count	Proportion
Knowledgeable	776	20.48%
Moderately Knowledgeable	1,844	48.66%
Not Knowledgeable	1,170	30.86%
Self-Learning Through Online	2,653	70.00%
Lack of Exercise Planning Knowledge	3,032	80.00%

4) Motor Skills

A notable disparity exists in students' motor skill levels. About 3% of students held sports certification in various disciplines prior to university, primarily in team sports and swimming. Furthermore, 63.86% have more than three years of experience in specific sports, with badminton, basketball, and table tennis being the most practiced (see Table 5).

Table 5: Motor Skills Statistics

Skill Level	Count	Proportion
Holds Sports Certification	113	3.00%
Over Three Years of Experience	2,420	63.86%

5) Physical Activity Awareness

The survey indicates that 48.66% of students rate their skills as average compared to their peers and express a strong interest in improving their fitness, particularly in endurance events (e.g., 1,000 meters

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for males and 800 meters for females), general body fitness, and upper body strength (e.g., pull-ups for males). However, a small portion of students (6.53%) reported a negative attitude toward sports, with 1.18% expressing strong dislike. The primary motivations for physical activity include health improvement, physical appearance, stress relief, and skill development, while perceived obstacles include limited access to training methods, sports facilities, peer encouragement, and coaching support (see Table 6).

Table 6: Physical Activity Awareness Statistics

Awareness Level	Count	Proportion
Skills at Average Level	1,844	48.66%
Skilled Above Average	1,137	30.00%
Dislike of Physical Activity	247	6.53%
Strong Dislike of Physical Activity	44	1.18%

In summary, this analysis reveals several key gaps in physical literacy among university students, including low levels of physical fitness, limited sports knowledge, and varying motor skill proficiency. These factors underscore the need for targeted interventions to support comprehensive physical literacy development, encompassing fitness, knowledge, skills, and awareness. Consequently, a pathway model focusing on curriculum reform, infrastructure enhancement, and activity integration is proposed to foster physical literacy as an essential educational outcome.

4. Pathways for Enhancing Physical Literacy in University Students

This section presents a structured pathway for physical literacy enhancement that encompasses motor skills, behavioral practices, physical fitness, sports knowledge, and activity awareness, tailored to the distinct needs and motivations of university students (see Figure 1).

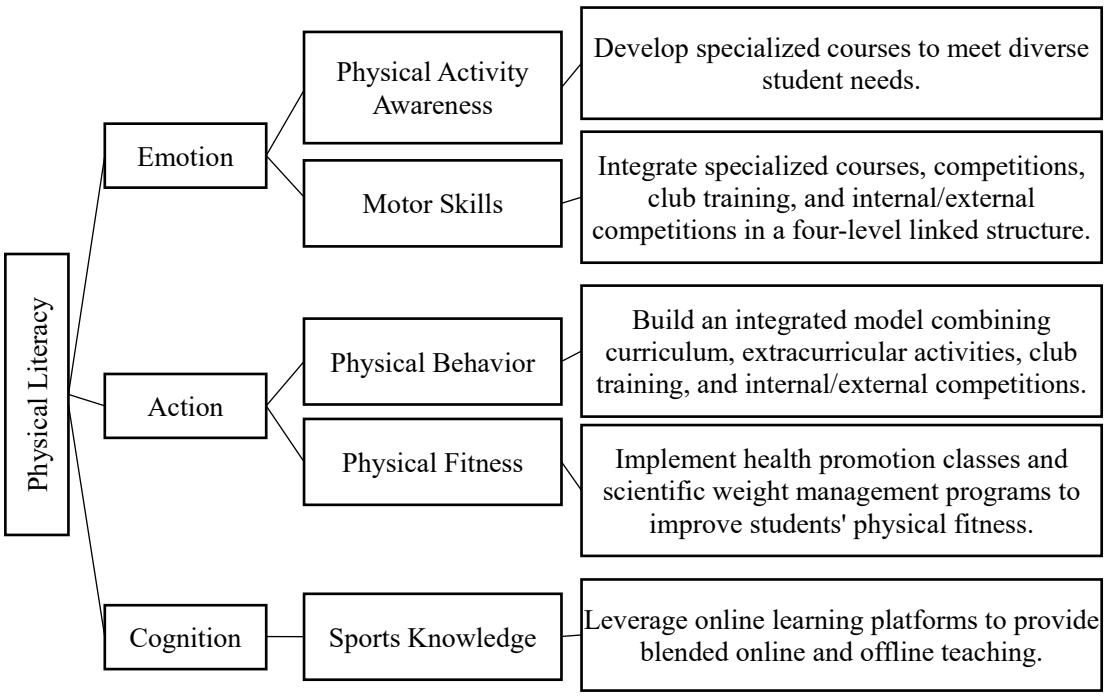

Figure 1: Model for Enhancing Physical Literacy in University Students

1) Pathway for Motor Skill Development

Motor skills represent a critical dimension of physical literacy, encompassing both basic and specialized sports abilities. According to our survey, insufficient motor skills are a significant barrier to consistent physical activity among students. Enhancing students' physical literacy requires cultivating proficiency in at least one to two specific sports skills, benefiting them well beyond university life. As Ji Liu (2020) notes, integrating competitive activities within physical education is essential for the effective acquisition of motor skills, allowing students to apply technical skills within real-world contexts [8]. Additionally, Mao Zhenming (2019) advocates for classroom-based competition leagues that leverage

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the structured resources available at universities, including high-quality sports facilities and trained faculty [9].

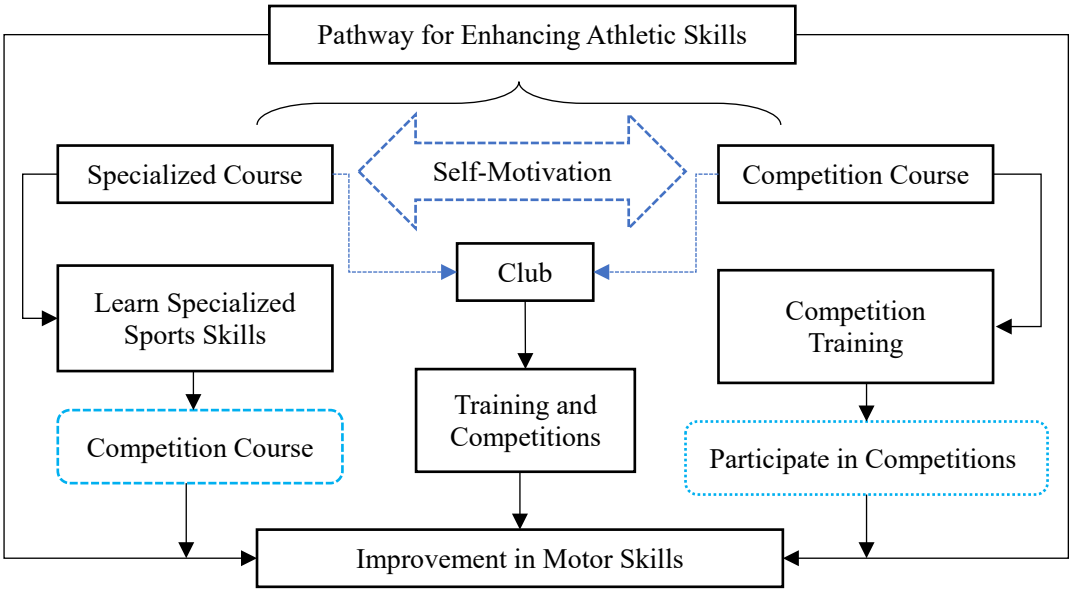

Figure 2: Athletic Skills Improvement Pathway

The proposed pathway for skill enhancement includes transitioning from traditional classes to specialized sports courses, intramural competitions, club-based training, and internal and external competitions (see Figure 2).

Implementation steps include:

• **Integrate Competitions with Physical Education:** Physical education courses should incorporate simplified competitive activities in each session, tailored to the technical objectives of the course. Regular competitions throughout the term can help students evaluate their skill progression, identify weaknesses, and set improvement goals under the guidance of their instructors. For advanced students, competition-based courses can include semester-long league formats, allowing students to apply their skills in a structured, competitive setting.

• **Leverage Sports Clubs for Skill Development:** University sports clubs, supervised by physical education faculty, provide a crucial platform for extracurricular training. Clubs also serve as incubators for school teams, hosting competitions and fostering advanced skills among members through regular practice and peer interaction.

2) Pathway for Physical Activity Behavior Enhancement

Physical activity behavior refers to the habitual engagement in sports and exercise, shaped by the surrounding environment and support systems. Our findings indicate that nearly half of university students participate only in low-intensity activities and are generally sedentary. This highlights the importance of fostering an active campus environment that encourages regular exercise and builds long-term, positive behavioral patterns. The proposed model integrates coursework with extracurricular activities, club training, and competitions to ensure that students fulfill a minimum of ten extracurricular exercise sessions each semester, making them eligible for assessment.

To support this goal, a digital platform can facilitate online learning, bridging theoretical and practical components. A smart sports management system, integrated with functions like venue reservations, health tracking, and competition management, can streamline sports engagement. Through this platform, students can access fitness information, book exercise spaces, connect with peers, and track their progress, enhancing their physical literacy journey.

3) Pathway for Physical Fitness Improvement

Physical fitness encompasses the essential components of body composition, endurance, and overall health status, forming the basis of physical literacy. The “National Student Physical Health Standards” established in 2014 set specific fitness benchmarks, yet many university students currently fall short of these standards. To address this gap, a multi-faceted approach is recommended:

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• **Policy Enforcement:** Link fitness test results to graduation criteria, with credits allocated for meeting health standards. Establish mandatory fitness courses for upperclassmen, focusing on areas requiring improvement such as strength and endurance.

• **Targeted Fitness Programs:** Implement specialized courses on health promotion and weight management, designed to support students with specific fitness needs. Organize fitness boot camps under faculty supervision to promote effective, scientifically-informed training practices.

4) Pathway for Sports Knowledge Enhancement

Sports knowledge is a foundational aspect of physical literacy, empowering students to understand and apply exercise principles in a way that encourages lifelong physical engagement. Feng Gushou et al. (2019) emphasize that sound sports knowledge fosters active participation and the formation of positive exercise habits [10]. While many students demonstrate an interest in learning through digital platforms, their current level of understanding remains limited.

To enhance sports knowledge, we propose a blended learning model that combines online theoretical courses with hands-on, practice-based sessions. The “One-Net Learning” platform offers comprehensive resources covering exercise benefits, injury prevention, fitness practices, and technical sports theory. Through online assessments and real-time feedback, students gain critical knowledge that supports their physical literacy growth.

5) Pathway for Developing Physical Activity Awareness

Physical activity awareness encompasses students' self-perception and motivation related to sports engagement, including their desire to improve physical health. University students' awareness and motivation are shaped by both intrinsic factors and environmental influences. The survey data revealed that most students have internalized the concept of "health-first" but require additional support to overcome perceived limitations in skills and access to resources.

In the classroom, adopting a student-centered approach that emphasizes individualized learning is essential. Layered course design and diverse instructional methods cater to varied skill levels, while goal-oriented tasks build confidence and engagement. To further reinforce awareness, students are encouraged to participate in competitions, fostering a deeper connection to the sport and increasing their enjoyment. Campus-wide sports events, scholarships, and well-designed facilities create a supportive atmosphere, making physical activity an accessible and appealing part of daily life.

5. Discussion

The integration of metaverse technologies into libraries presents significant opportunities for enhancing user experiences through personalized learning environments, virtual collaboration spaces, and improved accessibility for remote users. Personalized learning environments can adapt to individual learning styles, offering tailored and interactive content that enhances comprehension. Virtual collaboration spaces enable real-time, immersive interactions among users from different locations, fostering a sense of community and collaboration. Enhanced accessibility ensures that users in remote or underserved areas, as well as those with disabilities, can access a wide range of resources and services, bridging the digital divide and promoting equal access to information.

However, the implementation of metaverse technologies also presents challenges that must be addressed to ensure successful integration. Data privacy and security are critical concerns, necessitating robust protection measures and clear policies. Significant investment in technological infrastructure, including high-speed internet and advanced computing resources, is required to support immersive experiences. Comprehensive training programs for users and library staff are essential to ensure effective utilization of metaverse applications. Addressing the digital divide by providing access to necessary devices and internet connectivity is crucial for equitable access. By proactively addressing these challenges, libraries can leverage metaverse technologies to create dynamic, inclusive environments that enhance user engagement and access to information, positioning themselves as leaders in technological innovation in the information sector.

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