



Integrating Emerging Sports into Primary Physical Education: A Four-Dimensional Curriculum Framework for Holistic Student Development in China

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Abstract: In response to the ongoing educational reform and the global movement toward diversified physical education, this study explores effective strategies for integrating emerging sports into primary school physical education (PE) curricula in China. Using literature analysis, teaching experiments, and comparative research, the study examines the application of rope skipping, roller skating, and orienteering as innovative modules in PE instruction. A four-dimensional integration framework—comprising progressive skill reconstruction, spiral physical fitness enhancement, interactive and interest-oriented pedagogy, and multi-dimensional evaluation—was developed and tested in teaching practice. Results indicate that curriculum integration of emerging sports significantly improves students' motor skills, physical fitness, and learning motivation while promoting teamwork and self-efficacy. The study concludes that effective integration should adhere to the principles of scientific design, enjoyment, and practicality, using gamification, situational learning, and competition-based instruction. This framework offers a new pathway for promoting holistic physical literacy and health-oriented development among primary school students.

Keywords: Emerging Sports; Physical Education; Curriculum Integration; Primary School; Teaching Innovation

1. Introduction

The twenty-first century has witnessed a paradigm shift in physical education (PE), emphasizing not only physical competence but also enjoyment, social participation, and lifelong health awareness. In China, the implementation of the New Curriculum Standards for PE has created opportunities to reform traditional teaching models and integrate new forms of physical activity that align with the global trend toward diversified and student-centered learning ^{[1], [2]}.

Emerging sports—such as rope skipping, roller skating, and orienteering—are increasingly recognized for their novelty, fun, and adaptive learning potential. These activities go beyond traditional sports by combining creativity, teamwork, and physical challenge, thereby fostering students' comprehensive development. Studies have shown that such sports enhance students' engagement, self-efficacy, and motivation in PE settings ^{[3], [4]}. In the broader international context, similar innovations are observed in Finland, Japan, and Australia, where educators integrate alternative physical activities to cultivate physical literacy and holistic well-being ^{[6], [7]}.

However, despite the growing recognition of emerging sports, the challenge remains in how to integrate these activities systematically within the existing curriculum framework. Many PE programs continue to follow traditional models emphasizing performance and discipline over creativity and exploration ^[5]. This results in limited student engagement and underutilization of available resources. Therefore, the integration of emerging sports requires not only pedagogical innovation but also theoretical support, curriculum reconstruction, and assessment reform.

This study aims to construct and validate a four-dimensional integration framework for emerging sports in primary physical education (PE), addressing both theoretical and practical needs. The framework encompasses four interrelated dimensions: progressive skill-based content reconstruction, which emphasizes students' cognitive and motor development through sequential learning; spiral training design for fitness enhancement, ensuring continuous and sustainable physical improvement; interactive and interest-oriented pedagogical innovation, which applies gamified and situational teaching methods to foster engagement and enjoyment; and multi-dimensional evaluation, integrating assessments of skill mastery, physical fitness, and affective growth to provide a comprehensive measure of student development.

Existing models of physical literacy development and PE curriculum design emphasize holistic growth, they are rarely tailored to the pedagogical realities, cultural expectations, and structural constraints of Chinese compulsory education. Furthermore, prior frameworks often remain conceptual in nature, lacking clear mechanisms for implementation, assessment, and contextual adaptation. In contrast, the present framework integrates skill acquisition, fitness development, cognitive understanding, and affective engagement into a coherent, actionable structure aligned with national curriculum reforms and the developmental needs of younger learners. By testing this model through a controlled intervention in emerging sports such as (insert sport), the study not only demonstrates its practical feasibility but also offers empirical evidence of its effectiveness in enhancing multidimensional physical literacy.

2. Theoretical Framework and Literature Review



2.1 Theoretical Foundations

The integration of emerging sports into primary physical education is grounded in multiple educational and psychological theories that emphasize active participation, experiential learning, and holistic development.

2.1.1 Constructivist Learning Theory

According to Piaget and Vygotsky's constructivist perspectives, learning occurs through the active construction of knowledge based on prior experiences and social interaction. Within the context of physical education, this implies that students construct their understanding of movement, coordination, and teamwork through hands-on exploration and peer collaboration rather than passive imitation [6], [8]. Emerging sports such as rope skipping and orienteering naturally lend themselves to constructivist principles because they require students to analyze movement patterns, solve spatial problems, and engage in reflective learning. Teachers act as facilitators, guiding students to discover movement solutions and adapt to dynamic challenges. This aligns with the modern pedagogical shift from teacher-centered instruction to learner-centered exploration [7], [8].

2.1.2 Experiential Learning Theory

Kolb's Experiential Learning Theory (ELT) emphasizes the cyclical process of learning through concrete experience, reflective observation, abstract conceptualization, and active experimentation. In the context of PE, ELT underscores the importance of direct engagement in physical tasks followed by reflection on performance outcomes. Emerging sports, which often combine physical challenge and creativity, provide a fertile environment for experiential learning. For example, roller skating and orienteering promote real-world engagement through problem-solving and environmental adaptation, helping students translate physical knowledge into personal understanding. Previous studies show that experiential learning approaches significantly improve motivation and long-term retention of movement skills in young learners [9], [10].

2.1.3 Physical Literacy Framework

The concept of physical literacy has become a cornerstone in international PE research, particularly in countries like Canada, the United Kingdom, and Australia. Whitehead [6] defines physical literacy as "the motivation, confidence, physical competence, knowledge, and understanding to value and take responsibility for engaging in physical activities for life." Integrating emerging sports contributes to physical literacy by expanding students' movement vocabulary, promoting intrinsic motivation, and developing both physical and affective competencies. For instance, rope skipping enhances rhythm and coordination, roller skating improves balance and agility, and orienteering fosters spatial awareness and cognitive engagement. Together, these elements advance not only motor proficiency but also confidence, social connection, and lifelong participation in physical activity [6], [11].

2.1.4 The Theory of Multiple Intelligences

Gardner's Theory of Multiple Intelligences (1983) posits that education should cultivate various dimensions of human intelligence beyond the linguistic and logical. Emerging sports, by combining physical, spatial, interpersonal, and intrapersonal dimensions, offer an ideal context for activating multiple intelligences. Students participating in cooperative sports challenges demonstrate both bodily-kinesthetic intelligence and interpersonal intelligence, while reflective activities (such as self-assessment or peer feedback) promote intrapersonal growth. This holistic approach supports contemporary educational goals of nurturing creativity, empathy, and teamwork in PE environments [12].

2.2 Literature Review

2.2.1 Emerging Sports in Chinese Primary Education

In China, recent years have witnessed a gradual shift from traditional PE models to more diverse, inclusive, and interest-driven programs. Xiao [1] and Kong [2] emphasized that emerging sports integration under the New Curriculum Standards enhances students' enthusiasm for participation and helps develop comprehensive motor skills.

Zhang [3] highlighted the influence of national events such as the Beijing Winter Olympics in promoting innovative sports activities—including skating and skiing—within school settings, thereby broadening students' exposure to new physical experiences. Similarly, Liu [4] found that students in Shanghai who engaged in emerging sports displayed stronger self-regulation and social adaptability than those following conventional PE routines.

Mo [5] applied a SWOT analysis to evaluate implementation strategies for emerging sports, identifying teacher competency, facility limitations, and curricular rigidity as key challenges. These studies collectively underscore that while the potential of emerging sports is widely recognized, their systematic curricular integration remains underdeveloped.

2.2.2 Global Perspectives on Physical Education Innovation

Internationally, the reform of PE has centered on cultivating physical literacy and lifelong activity habits rather than competitive performance [6], [9]. Kirk [7] and Hastie et al. [8] proposed student-centered pedagogical models that emphasize cooperation, autonomy, and reflective learning. These approaches resonate strongly with the principles behind emerging sports, which encourage creativity and intrinsic motivation.

Research from Finland and Australia demonstrates that incorporating non-traditional physical activities—such as parkour, orienteering, and dance—significantly increases students' engagement and self-efficacy in PE [10], [11]. Moreover, international policy frameworks (UNESCO's Quality Physical Education Guidelines, 2019) advocate for inclusive and innovative PE curricula that address cognitive, emotional, and social dimensions of learning.

2.2.3 Research Gaps

Despite growing attention, several research gaps remain evident:

- (1) Empirical Evidence Deficit: Most studies describe the benefits of emerging sports qualitatively, with limited quantitative or longitudinal data to verify learning outcomes.
- (2) Curriculum Integration Frameworks: Few studies propose a structured theoretical model for integrating emerging

sports systematically into national curricula.

- (3) Cross-Cultural Validation: Current research is largely localized; comparative studies that connect Chinese practice with international theoretical discourse are scarce.
- (4) Teacher Professional Development: Limited focus has been given to how teachers can be trained to implement innovative sports activities effectively.

Addressing these gaps, the present study proposes and validates a Four-Dimensional Integration Framework—grounded in constructivism, experiential learning, and physical literacy—to provide a replicable model for integrating emerging sports into primary PE both within and beyond China.

2.3 Conceptual Model of the Study

Based on the theoretical and empirical foundations discussed, this study constructs a four-dimensional framework that integrates four key dimensions: progressive skill reconstruction, aligned with constructivist principles to promote active, student-centered learning; spiral physical fitness enhancement, informed by experiential learning cycles to ensure continuous physical development; interactive and interest-oriented teaching innovation, grounded in multiple intelligences and motivation theory to stimulate engagement and creativity; and multi-dimensional evaluation, incorporating physical literacy indicators to measure skill proficiency, affective growth, and cognitive understanding.

3. Methodology and Research Design

3.1 Research Purpose and Design Overview

This study adopts a mixed-methods research design to investigate effective strategies for integrating emerging sports into primary school physical education (PE) curricula. The objectives are threefold:

- A. To examine the pedagogical effectiveness of emerging sports integration on students' physical fitness, motor skills, and learning motivation;
- B. To construct and validate a Four-Dimensional Curriculum Integration Framework—comprising progressive skill reconstruction, spiral fitness enhancement, interactive teaching innovation, and multi-dimensional evaluation;
- C. To provide empirical evidence supporting curriculum reform and teacher professional development in the context of Chinese primary PE.

Following Creswell's framework for mixed-methods design ^[13], this study combines quasi-experimental quantitative analysis with qualitative case study methods, enabling both statistical verification and contextual understanding of classroom dynamics.

3.2 Research Setting and Participants

The study was conducted in three public primary schools located in Jinan, Shandong Province, China—hereafter referred to as School A, School B, and School C. A total of 180 students aged 9 to 11 years (Grades 3–5) participated in the study. Within each school, students were randomly divided into experimental and control groups to ensure comparable demographic and physical characteristics. Within each school, students were assigned to experimental and control groups through a structured randomization procedure designed to ensure baseline equivalence. Instead of simply dividing classes arbitrarily, the research team conducted individual-level randomization using a computer-generated random number sequence. All eligible students within each grade were listed, assigned numbers, and then allocated to either the experimental or control group based on the randomized sequence. This procedure ensured that demographic and physical characteristics were evenly distributed between groups, addressing potential selection bias and enhancing internal validity.

Group	Participants	School Sites	Duration	Teaching Model
Experimental	90 students	School A, B, C	12 weeks	Emerging sports-integrated curriculum
Control	90 students	School A, B, C	12 weeks	Traditional PE curriculum (track, gymnastics, ball games)

The experimental groups implemented the Four-Dimensional Integration Framework designed by the research team, while control groups continued with the conventional curriculum prescribed by the National PE Standards. To prevent cross-group contamination, several implementation safeguards were put in place. First, the unit of randomization was the individual student rather than the entire class, which allowed both groups to remain comparable while reducing systematic classroom differences. Second, experimental and control lessons were scheduled at different times and conducted in separate activity areas to avoid students observing or informally participating in each other's sessions. Third, teachers delivering the experimental curriculum were instructed not to share teaching materials, activity designs, or assessment tools with control group teachers during the intervention period. These measures minimized information spillover and ensured that the observed learning outcomes could be attributed to the emerging sports curriculum rather than uncontrolled external influences.

3.3 Instruments and Data Collection

Multiple data collection tools were employed to ensure triangulation and enhance the reliability of the findings.

3.3.1 Physical Fitness and Motor Skills Tests

Physical fitness was assessed using standardized instruments consistent with the Chinese National Student Fitness Standards (CNFS, 2014) and international physical education benchmarks ^{[14], [15]}. The evaluation included pre- and post-tests over a 12-week intervention period, measuring key components of physical fitness and motor skills. Endurance was tested through an 800-meter run for girls and a 1000-meter run for boys; agility and coordination were evaluated using a

10×5-meter shuttle run and a one-minute rope skipping test; flexibility and balance were measured through the sit-and-reach test and one-leg stand; and explosive strength was assessed via the standing long jump. All tests were conducted by trained physical education teachers following standardized protocols to ensure consistency and inter-rater reliability.

3.3.2 Learning Motivation and Attitude Survey

A modified version of the Physical Education Learning Motivation Scale (Standage et al., 2003 ^[16]) was adapted and translated for Chinese elementary students. It measured intrinsic motivation, task engagement, and enjoyment using a 5-point Likert scale.

Internal consistency analysis showed high reliability (Cronbach's $\alpha = 0.89$), consistent across all three schools.

3.3.3 Classroom Observation and Teaching Diaries

Across 36 teaching sessions (12 per school), systematic classroom observations were conducted by independent observers using structured rubrics adapted from Dyson's cooperative learning model ^[10].

Additionally, PE teachers maintained reflective teaching diaries, documenting lesson adaptations, student engagement patterns, and classroom challenges. These qualitative insights were essential for evaluating real-time teaching dynamics.

3.3.4 Semi-Structured Interviews

Semi-structured interviews were conducted at the end of the intervention:

- 9 PE teachers (three per school);
- 27 students (nine per school, randomly selected from experimental groups).

Interview questions focused on student motivation, perceived learning progress, and the impact of emerging sports on teamwork and self-confidence. Interviews were recorded, transcribed verbatim, and coded for thematic analysis.

3.4 Implementation of the Four-Dimensional Framework

The intervention was implemented simultaneously at Schools A, B, and C and was organized into four progressive modules, each lasting three weeks. This structured approach ensured a coherent progression from foundational skills to higher levels of physical, cognitive, and social development. Each module was designed to complement the others, creating a continuous and integrative learning experience that aligned with the objectives of the four-dimensional framework.

Module 1: Progressive Skill Reconstruction: Students were introduced to the fundamental movement patterns of rope skipping, roller skating, and orienteering. Teachers adopted scaffolding strategies and peer-assisted learning to help students gradually build proficiency and confidence. Instruction emphasized exploration, reflection, and self-correction in line with constructivist principles ^[6], ^[8]. The focus on incremental mastery allowed students to internalize core motor patterns while fostering collaboration and self-directed learning.

Module 2: Spiral Physical Fitness Enhancement: In this phase, training was designed according to a spiral progression model to ensure continuous and systematic improvement in students' fitness levels. Activities were sequenced to revisit core exercises with increasing intensity and complexity, reinforcing previous learning while introducing new challenges. Individualized workloads were adjusted through heart rate monitoring and Rate of Perceived Exertion (RPE) metrics to maintain both safety and effectiveness ^[14]. This approach promoted endurance, strength, and flexibility while accommodating the varying physical capacities of students.

Module 3: Interactive and Interest-Oriented Teaching Innovation & Module 4: Multi-Dimensional Evaluation: The third module emphasized engagement through gamified and situational learning experiences such as the "Rope Skipping Adventure" and "Campus Orienteering Quest," which simulated real-world exploration to enhance motivation, teamwork, and critical thinking. The final module focused on assessing student progress through multiple perspectives—peer evaluations, teacher assessments, and self-reflection journals—guided by physical literacy indicators ^[6], ^[11]. Evaluation criteria covered three key dimensions: skill proficiency, physical fitness, and personal engagement, providing a holistic understanding of each student's growth in physical competence, confidence, and motivation.

3.5 Data Analysis

Quantitative data were analyzed using SPSS 27.0 to determine the effectiveness of the intervention. Descriptive statistics, including means and standard deviations, were calculated to summarize pre- and post-test performance across all variables. Paired-sample t-tests were employed to assess within-group improvements over the 12-week period, while independent-sample t-tests compared the outcomes between experimental and control groups. To evaluate the strength of observed effects, Cohen's d values were computed as measures of effect size, and a significance threshold of $p < 0.05$ was adopted to ensure statistical reliability. These quantitative analyses provided an empirical basis for assessing the framework's impact on students' physical fitness, skill development, and motivation.

Qualitative data—including interview transcripts, observation notes, and teaching diaries—were analyzed using Braun and Clarke's six-phase thematic analysis method ^[17]. Themes were identified inductively, collaboratively reviewed by two researchers, and validated through peer debriefing to enhance analytical accuracy. Triangulation across multiple data sources strengthened the credibility and dependability of the findings ^[13]. To ensure methodological rigor and ethical compliance, Cronbach's α values exceeded 0.85 for all scales, and inter-rater reliability among observers reached $r = 0.87$. Internal validity was supported by matching participants across groups for age, gender, and baseline fitness, while external validity was enhanced through the inclusion of three demographically diverse schools in Jinan. All research procedures conformed to the Declaration of Helsinki (2013), with voluntary participation, parental consent, and strict confidentiality maintained throughout the study.

4. Results and Discussion

4.1 Overview

The analysis evaluates improvements in physical fitness, motor skill proficiency, and learning motivation among students in the experimental and control groups. The results are interpreted in light of the Four-Dimensional Integration Framework and relevant educational theories, particularly Constructivism, Experiential Learning, and Physical Literacy Theory.

4.2 Quantitative Findings

4.2.1 Physical Fitness Improvement

Across all three schools, students in the experimental groups exhibited significant gains in overall physical fitness compared to the control groups.

Table 1 summarizes the mean pre-test and post-test scores for key indicators.

Table 1. Summary of Physical Fitness Improvements (n = 180)

Variable	Group	Pre-Test Mean \pm SD	Post-Test Mean \pm SD	t-value	p-value	Effect Size (d)
Endurance (sec)	Experimental	296.5 \pm 25.3	275.2 \pm 21.8	8.24	<0.001	0.86
	Control	295.7 \pm 26.1	289.8 \pm 23.9	1.92	0.063	0.21
Rope Skipping (reps/min)	Experimental	103.8 \pm 17.2	124.6 \pm 18.7	7.41	<0.001	0.79
	Control	104.1 \pm 18.4	108.2 \pm 19.1	1.63	0.107	0.19
Agility (10 \times 5 m, sec)	Experimental	23.5 \pm 2.1	21.2 \pm 1.8	7.93	<0.001	0.82
	Control	23.4 \pm 2.0	22.9 \pm 2.1	1.75	0.084	0.18

Students in the experimental groups improved their endurance by 7.2%, agility by 9.8%, and coordination (rope skipping) by 20%, compared to negligible improvement in control groups.

The large effect sizes ($d > 0.8$) suggest substantial benefits from emerging sports integration, consistent with findings by Liu ^[4] and Mandigo et al. ^[11], who reported similar physical literacy gains in diversified PE programs.

The use of spiral physical fitness enhancement (Module 2) contributed notably to these outcomes. By progressively increasing training intensity and incorporating playful formats (relay games, circuit challenges), students developed endurance and coordination without experiencing fatigue or disengagement.

4.2.2 Learning Motivation and Engagement

Analysis of the Physical Education Learning Motivation Scale revealed significant increases in intrinsic motivation, task orientation, and enjoyment among experimental group students (Table 2).

Table 2. Mean Scores of Learning Motivation Dimensions (1–5 Likert Scale)

Dimension	Group	Pre-Test	Post-Test	Mean	p-value
Intrinsic Motivation	Experimental	3.41	4.26	0.85	<0.001
	Control	3.38	3.47	0.09	0.118
Task Engagement	Experimental	3.62	4.21	0.59	<0.001
	Control	3.64	3.71	0.07	0.164
Enjoyment	Experimental	3.54	4.39	0.85	<0.001
	Control	3.56	3.61	0.05	0.231

The experimental groups displayed statistically significant improvements ($p < 0.001$) across all motivational dimensions. These results validate the role of gamification and situational learning (Module 3) in enhancing student engagement, echoing Standage et al.'s ^[16] argument that autonomy-supportive environments promote sustained motivation.

Observational data supported these quantitative findings. Teachers noted visibly higher enthusiasm and cooperation levels during roller skating and orienteering sessions, with students frequently requesting additional practice time. This behavioral evidence reinforces the quantitative trends and demonstrates the affective impact of emerging sports.

4.3 Qualitative Findings

Theme 1: Enhanced Enjoyment and Engagement through Novelty

Students across the three participating schools consistently expressed that the introduction of emerging sports made physical education classes more enjoyable, stimulating, and dynamic. Activities such as rope skipping combinations, roller skating, and orienteering were described as “new,” “challenging,” and “fun,” providing a refreshing contrast to the repetitive routines of traditional PE lessons. One Grade 5 student from School A remarked, “I used to find PE boring because we always played the same ball games. Now, with orienteering and skating, I feel more confident and want to move more.” Teachers also confirmed that these novel sports rekindled students’ curiosity and enthusiasm for participation, supporting Kolb’s Experiential Learning Theory, which emphasizes engagement through active exploration and real-world challenges ^[9]. These findings reinforce earlier research demonstrating that activity diversity and novelty are key motivators that enhance students’ enjoyment and attendance in PE ^[10], ^[11].

Theme 2: Development of Collaboration and Teamwork Skills

Teachers and students at Schools A, B, and C highlighted the significant social benefits of participating in emerging sports, particularly in fostering teamwork and peer cooperation. Activities like orienteering and synchronized group rope

skipping required communication, coordination, and mutual support, creating a collaborative learning environment that encouraged both leadership and empathy. A teacher from School B noted, “In roller skating relays, even less-skilled students were motivated because their classmates cheered for them. The group atmosphere was totally different from traditional drills.” Such experiences cultivated interpersonal intelligence as articulated in Gardner’s Multiple Intelligences Theory [12] and affirmed the constructivist understanding that learning is a socially mediated and context-dependent process [6], [8]. Through shared challenges and collective success, students developed essential teamwork and problem-solving skills that extended beyond physical performance.

Theme 3: Increased Teacher Adaptability and Creativity

Teachers across the three schools reported that incorporating emerging sports significantly enhanced their instructional flexibility and creativity. Shifting from traditional, teacher-directed instruction to a more facilitative role, educators designed adaptive tasks, varied assessment methods, and real-time feedback systems to suit different learning needs. This pedagogical shift reflects international trends toward student-centered approaches in physical education, emphasizing creativity, autonomy, and reflective learning [7], [8]. Moreover, teachers observed that the Four-Dimensional Integration Framework provided a clear and systematic structure for lesson planning—from the introduction of skills to the assessment of collaboration and engagement—thereby increasing their confidence and improving lesson coherence. The experience empowered teachers to view PE not merely as skill training but as a holistic process that nurtures students’ physical, cognitive, and social growth.

4.4 Discussion

The findings of this study provide strong evidence for the effectiveness of the Four-Dimensional Integration Framework in enhancing the quality of primary school physical education. Quantitative analyses demonstrated significant improvements in students’ physical fitness, motor coordination, and intrinsic motivation, while qualitative data revealed higher levels of engagement, collaboration, and creativity among both students and teachers. These complementary results validate the framework’s ability to integrate cognitive, physical, and social dimensions of learning into a unified pedagogical model. Specifically, the study confirms that the combination of constructivist pedagogy, which promotes active discovery and peer collaboration [6], [8]; experiential learning cycles, which emphasize reflection and skill transfer [9]; and physical literacy principles, which nurture lifelong motivation and engagement in physical activity [6], [11], can effectively transform traditional PE instruction into a more holistic and learner-centered process.

The results further suggest that emerging sports can act as a powerful catalyst for curriculum modernization in primary schools. The four-dimensional model implemented in Jinan demonstrates a practical and replicable approach that aligns closely with the objectives of the Chinese New Curriculum Standards (2022 revision). The framework supports both national educational priorities and global trends toward innovative, student-centered PE [7], [9]. This finding reinforces Mo’s [5] SWOT analysis, which highlighted the necessity of adaptive teaching methods and flexible curricular structures to overcome institutional rigidity and resource limitations in contemporary sports education.

Despite these encouraging outcomes, several limitations must be acknowledged. The study’s geographic scope was confined to three primary schools in Jinan, limiting the generalizability of findings to other regions. Future research should include rural and western provinces to ensure broader applicability. Additionally, the 12-week intervention period provided valuable short-term data but did not capture long-term skill retention or behavioral change. Variability in teacher training and experience also influenced the fidelity of implementation across sites. To build upon this foundation, future studies should employ longitudinal mixed-methods designs and integrate structured teacher professional development programs to assess the sustainability, scalability, and long-term educational impact of emerging sports integration.

5. Conclusion and Recommendations

5.1 Conclusion

This study examined the integration of emerging sports—including rope skipping, roller skating, and orienteering—into primary school physical education (PE) in Jinan, Shandong Province, China. Through a mixed-methods approach, combining quantitative quasi-experimental design and qualitative case analysis, the research developed and validated a Four-Dimensional Curriculum Integration Framework aimed at enhancing physical literacy, engagement, and teaching effectiveness.

The empirical findings demonstrated that emerging sports integration, guided by the four-dimensional model, significantly improved students’ physical fitness, motor coordination, and intrinsic motivation compared to traditional PE programs. Statistical analyses revealed large effect sizes in endurance, agility, and rope skipping performance ($d > 0.8$), while motivational gains were substantial across intrinsic and task-oriented dimensions ($p < 0.001$). Qualitative evidence reinforced these findings: students described the activities as “fun,” “challenging,” and “different,” while teachers reported higher classroom engagement and greater teaching flexibility.

The success of this integration is attributed to the synergistic application of Constructivist Learning Theory, Experiential Learning Theory, and the Physical Literacy Framework [6], [7], [9], [11]. These theories emphasize active participation, reflection, and holistic development—principles that are inherently embodied in emerging sports. The results confirm that physical education, when structured through a multidimensional and student-centered framework, can evolve beyond traditional performance-based models to become a vehicle for lifelong physical literacy and well-being.

In addition to the short-term improvements demonstrated in this study, the Four-Dimensional Integration Framework provides a foundation for long-term physical literacy development by cultivating motivation, confidence, and movement competence that extend beyond the 12-week intervention. By progressively expanding students’ movement vocabulary,

reinforcing fitness gains through cyclical and spiraled training, and promoting self-directed exploration in interactive learning environments, the framework nurtures the affective and cognitive dispositions necessary for lifelong engagement in physical activity. Moreover, its emphasis on reflection, autonomy, and multi-dimensional evaluation encourages students to develop a persistent sense of ownership over their physical learning, enabling sustainable growth even after the formal curriculum ends. This long-term perspective aligns with the global movement toward physical literacy as a lifelong process rather than a short-term educational outcome.

5.2 Recommendations

Based on the study's findings, several recommendations are proposed for educators, administrators, and policymakers to enhance the implementation and sustainability of emerging sports integration in primary physical education. Pedagogically, constructivist and experiential learning strategies should be embedded into PE teacher training curricula, supported by the use of formative assessment and peer evaluation to encourage reflective learning, collaboration, and social competence. Teachers should design inclusive activities that cater to diverse skill levels and physical abilities, ensuring equal participation opportunities for all students. At the curriculum level, regional pilot programs should be established in Shandong and other provinces to expand the application of the four-dimensional model, while emerging sports modules should be incorporated into PE textbooks and digital platforms to promote accessibility and standardization. Interdisciplinary projects connecting PE with geography, art, and science are encouraged to enrich student learning experiences. From a policy and research perspective, a national teacher certification system for emerging sports instruction should be developed, supported by research-practice partnerships between universities and primary schools to monitor innovation outcomes. Finally, international collaboration and academic dissemination should be strengthened to align Chinese PE reform with global educational trends in physical literacy, health promotion, and lifelong learning.

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