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Enhancing Motivation through Structured Music Activity: A Quasi-Experimental Study

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This quasi-experimental study investigated the effects of a 16-week structured music-based physical activity intervention on the exercise motivation of rural high school students in China. Ninety-eight Grade 10 students were assigned to either an experimental group, which participated in culturally relevant and emotionally engaging physical activities including functional music gymnastics, fun snake run, figure skipping rope, and yoga-based relaxation or a control group, which engaged in conventional group running. The intervention was grounded in the ADDIE instructional model, cooperative learning theory, and scaffolding. Motivation was measured before and after the intervention using a validated questionnaire. Results revealed significantly greater improvements in the experimental group across all motivation subdomains, with the largest effects observed in emotional experience and value embodiment. Overall motivation also increased substantially compared to the control group, which showed minimal change. These findings highlight the effectiveness of structured, emotionally resonant, and socially collaborative physical activity in enhancing student motivation. The study contributes to the literature by demonstrating the applicability of a multi-theoretical instructional design in rural educational settings and offers actionable implications for school administrators and physical education teachers seeking low-cost, scalable strategies to improve student engagement and well-being through rhythmically structured, music-enhanced recess programs.

Keywords: exercise motivation, structured physical activity, rural education, music-based intervention, secondary school students, instructional design, education

INTRODUCTION

Adolescence is a critical period for developing lifelong physical activity habits, with motivation playing a central role in promoting sustained engagement and psychological well-being (MacNamara et al., 2011; Sánchez-Miguel et al., 2020). However, in rural regions of China, high school students often face substantial motivational challenges due to limited educational resources and outdated physical education (PE) practices (Primo et al., 2023). Conventional PE in these settings is typically characterized by rigid

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instruction, low autonomy, and minimal emotional engagement, resulting in decreased intrinsic and extrinsic motivation (Li et al., 2024; Qin et al., 2025). Furthermore, the lack of diverse, engaging physical activity options contributes to declining participation and weakens the role of PE in supporting student health and development (An et al., 2022; Miao et al., 2024).

To address this issue, contemporary pedagogical models have increasingly investigated the incorporation of music-integrated movement strategies to foster students' affective and cognitive engagement in physical education (Laukka & Quick, 2013). One such approach is Functional Structured Music-Integrated Physical Activity (FSMPA), a pedagogical framework that synchronizes rhythmic movement patterns, task-oriented physical challenges, and purposefully selected musical accompaniment to cultivate multisensory and emotionally resonant learning environments (Liu, 2024; Ying et al., 2022). In contrast to rigid, drill-oriented instruction, FSMPA prioritizes intrinsic enjoyment, activity diversity, and cooperative interaction through modalities such as music-supported gymnastics, rhythm-based rope skipping, and structured mindfulness exercises (Rigon et al., 2024; Zhu et al., 2023). These pedagogical characteristics reflect key principles of Self-Determination Theory—specifically the facilitation of autonomy, perceived competence, and social relatedness—which are recognized as fundamental to promoting sustained motivation and behavioral engagement in educational contexts (Lobo, 2025).

To ensure pedagogical integrity and contextual flexibility, FSMPA in this study was informed by three interrelated theoretical and design frameworks. First, the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation) provides a systematic, iterative approach to instructional design, enabling educators to align activities with learner characteristics and institutional affordances (Abuhassna & Alnawajha, 2023). Second, cooperative learning theory underscores the importance of positive interdependence, collective goal attainment, and structured peer engagement—elements that have been empirically linked to increased motivational engagement and a sense of social inclusion in physical education settings (Casey & Quennerstedt, 2020; Dyson et al., 2021). Third, the principle of instructional scaffolding facilitates the progressive development of learner self-regulation by modulating teacher support in response to evolving skill mastery (Behzadnia et al., 2019; Wibowo & Dyson, 2021). Collectively, these foundations strengthen the conceptual coherence and practical applicability of FSMPA as a responsive, equity-oriented pedagogical model.

This study sought to investigate the impact of a 16-week FSMPA intervention on exercise motivation among high school students in rural China (Manninen et al., 2022). A quasi-experimental design was utilized to examine shifts in motivational orientation between participants engaged in FSMPA and those receiving conventional group running instruction. Motivation was evaluated across five distinct subdomains: physical and psychological enjoyment, extrinsic regulation, cognitive engagement, affective responses, and internalized value (Albuquerque et al., 2017; Ryan & Deci, 1997). It was hypothesized that the FSMPA group would show significantly greater improvements across all dimensions. By validating a theory-informed, culturally responsive model in a

resource-constrained setting, the study contributes empirical insights to the design of scalable, motivation-enhancing physical education practices.

Literature Review

Adolescents' motivation for physical activity arises from an interplay of psychological, emotional, social, and cognitive factors (Alderman et al., 2006; Bryan& Solmon, 2012; Laukka & Quick, 2013; Sevil-Serrano et al., 2022). Grounded in Self-Determination Theory (Nogg et al., 2021; Teixeira et al., 2012), motivation is conceptualized as a continuum shaped by varying degrees of internalization, reflecting the needs for autonomy, competence, and relatedness (Ryan & Deci, 2020). This study is guided by a multidimensional model of motivation encompassing five subdimensions: physical and psychological enjoyment, external regulation, cognitive engagement, affective responses, and internalized value. These constructs provide a theoretically grounded and analytically differentiated framework for examining the development and transformation of motivational states in response to structured physical education interventions. Furthermore, cooperative learning theory underscores the role of social interdependence and purposefully structured peer interaction in supporting both intrinsic and extrinsic motivational pathways within educational settings (Boke et al., 2025; Chen & Solmon, 2024). By synthesizing these theoretical lenses, the study elucidates the multifaceted nature of adolescent exercise motivation and explores how school-based programs can be designed to resonate with students' autonomous motivations and sociocultural contexts (Rosenkranz et al., 2023).

The intentional integration of music in physical education has been shown to hold significant pedagogical potential in fostering student motivation, affective involvement, and long-term exercise adherence (Sierra-Díaz et al., 2019; Terry et al., 2020). Evidence indicates that rhythmic auditory cues can activate dopaminergic pathways, attenuate perceived effort, and enhance positive affective responses during physical exertion (Hove et al., 2022; Park et al., 2023). These effects are especially pronounced among adolescents, a developmental group characterized by heightened neurobiological sensitivity to emotionally charged and socially mediated experiences (Armstrong, 2016; Corbett et al., 2023; Haegele et al., 2020). Nevertheless, much of the current literature centers on transient enjoyment, neglecting music's capacity to shape deeper motivational dimensions such as cognitive engagement, social connectedness, and internalized value (Park et al., 2023). Moreover, the majority of interventions have been implemented in urban or well-resourced settings, leaving rural populations underrepresented despite their disproportionate lack of access to stimulating and systematically designed physical education programs (Love, 2019). To address these limitations, this study positions music as a central pedagogical component rather than a background element, with the aim of cultivating both immediate emotional engagement and enduring motivational growth within a rural educational context (Yesil & Aras, 2024).

The effectiveness of physical activity interventions is closely linked to instructional design, which shapes how students engage, process, and sustain motivation (Ennis, 2017). This study adopts a tripartite framework comprising the ADDIE model,

cooperative learning, and scaffolding. The ADDIE model facilitates systematic intervention planning tailored to the contextual realities of under-resourced schools (Ebrahimi et al., 2025; Li et al., 2022). Cooperative learning, rooted in social interdependence theory, promotes peer interaction, shared responsibility, and supportive group dynamics, all of which enhance intrinsic and extrinsic motivation (García-González et al., 2023; Ruos et al., 2025). Complementing these, instructional scaffolding strategies—such as modeling, guided practice, and differentiated tasks—gradually build learner autonomy and perceived competence, fostering self-regulated motivation (Chen & Solmon, 2024; Moura et al., 2023). By integrating these frameworks, the intervention is both pedagogically grounded and context-sensitive, aiming to enhance motivation in rural adolescents through structured and responsive physical education.

While structured, music-based physical activity programs have demonstrated promise in enhancing student motivation (Jeong et al., 2020), their application in rural educational settings remains limited. Rural adolescents often encounter infrastructural and pedagogical constraints that restrict access to engaging, theory-informed physical education (Deng et al., 2024; Greeven et al., 2023). Moreover, few interventions address the full range of motivational dimensions—particularly knowledge-seeking and value embodiment—within an integrated, longitudinal framework (Zhang, 2021). This study responds to these gaps by implementing a 16-week FSMPA program grounded in motivational theory and instructional design. By evaluating both global and subscale motivation shifts, the study offers a detailed understanding of how structured, socially supportive, and affectively engaging physical activity can enhance motivation among underserved populations. The findings aim to inform inclusive pedagogical strategies and contribute a replicable model for physical education programs seeking to foster equitable student engagement in under-resourced contexts (UNESCO, 2021).

METHOD

Quasi-Experimental Design

This study adopted a quasi-experimental pretest–posttest control group design to evaluate the effects of a 16-week FSMPA intervention on exercise motivation among rural high school students. Given the ethical and logistical constraints of school-based research, random assignment at the individual level was not feasible; Therefore, two intact Grade 10 classes were assigned to serve as the experimental and control groups (Ahmed et al., 2020; Cook & Campbell, 1986; Pham & Do, 2021). The experimental group participated in structured FSMPA sessions during afternoon recess, incorporating music-enhanced activities such as functional gymnastics, snake-run games, rope-skipping, and yoga-based relaxation. The control group continued with the school's standard collective running program. The intervention was embedded within the regular school schedule to preserve ecological validity and minimize academic disruption. Exercise motivation, the primary outcome, was measured using a culturally adapted and validated questionnaire encompassing five dimensions: physical and mental pleasure, external regulation, knowledge acquisition, emotional experience, and value realization. While participants were blinded to group assignment to reduce expectancy bias,

instructors remained unblinded to ensure fidelity. This design offers a pragmatic balance between internal validity and contextual applicability, contributing evidence-based insights into motivation-enhancing strategies for under-resourced rural education settings (Wafubwa & Csíkos, 2022).

Participants

Participants were recruited from Xiayi County Senior High School, a public rural school in Henan Province, China, using a purposive and cluster sampling strategy. The school was selected for administrative feasibility, and two intact Grade 10 classes were assigned to experimental (n = 50) and control (n = 48) groups based on timetable availability to preserve classroom integrity and minimize disruption. Inclusion criteria required students to be aged 16–17, enrolled full-time, medically cleared for moderate physical activity, and to provide informed assent with parental consent. Students with activity-limiting conditions were excluded. The final sample included 98 students (M_age = 16.4 ± 0.5 in the experimental group; M_age = 16.3 ± 0.5 in the control group). Baseline equivalence was confirmed through independent-samples t-tests and chi-square tests, showing no significant differences in age, gender, or residence ($p > 0.05$), thus supporting group comparability. This approach ensured both contextual relevance and internal validity within the constraints of a rural school setting.

Intervention Program

The intervention was developed using the ADDIE instructional design model (Branch & Varank, 2009) —to ensure theoretical alignment, contextual relevance, and measurable outcomes. Initial analyses revealed that the school's existing recess activities, dominated by militarized collective running, lacked engagement and pedagogical structure. In response, the FSMPA program was designed to enhance fitness, motivation, and attitude by integrating music-based, curriculum-aligned activities. The program comprised four modules: Functional Music Gymnastics, Fun Snake Run, Figure Skipping Rope, and Yoga-Based Relaxation, each targeting motivational constructs such as autonomy, enjoyment, and competence. Instructional materials were pilot-tested and refined, and teachers received standardized training to ensure fidelity. Implemented over 16 weeks during daily recess (15:30–16:30), the FSMPA sessions were conducted on the East Playground and included a rhythmic warm-up, aerobic games, skill conditioning, and a cool-down, with tempo-specific instrumental music supporting physical and emotional engagement. Trained instructors made real-time adjustments to match students' fitness levels. The control group (n = 48), whose activities took place on the West Playground, continued routine 30-minute collective running sessions with limited variation, feedback, or instructional input. Grounded in cooperative learning (Slavin, 1996) and scaffolding theory (Vygotsky, 1978), the FSMPA promoted peer-supported, progressively challenging activities.

The four modules were seamlessly integrated into a single, continuous 60-minute activity sequence, with specially edited instrumental music tracks synchronized to each phase to ensure rhythmic continuity and ecological flow. Music selection was guided by three criteria: (1) tempo alignment with physical intensity (e.g., 110–130 BPM for warm-up, 120–140 BPM for aerobic games, 100–120 BPM for skill conditioning, and

60–80 BPM for cool-down), (2) rhythmic consistency to support movement timing, and (3) affective suitability to energize or relax. All tracks were instrumental, culturally neutral, and pre-reviewed by physical education specialists to minimize distraction.

During the Fun Snake Run, students formed a line and maintained consistent spacing and pace while navigating a winding path in time with musical cues, requiring collective coordination and rhythm synchronization. In skill conditioning, synchronized rope-skipping required teams of 4–5 students to maintain rhythm and alignment, promoting mutual accountability and peer encouragement. These structured collaborative activities were designed to foster social relatedness and teamwork, aligning with cooperative learning principles and supporting the relatedness dimension of Self-Determination Theory (Ryan & Deci, 2000).

Instrument

Students' exercise motivation was measured using a revised version of the College Students' Tennis Exercise Motivation Scale (Li, 2015), which was adapted from the Échelle de Motivation dans les Sports (EMDS; Brière et al., 1995), a widely used questionnaire in sport psychology designed to assess motivational orientations based on Self-Determination Theory (Deci & Ryan, 1985). To align with the school-based context, references to "tennis" were replaced with "recess-time physical activity," while the original seven-factor structure—comprising intrinsic motivation (knowledge, stimulation, accomplishment), extrinsic motivation (identified, introjected, external regulation), and amotivation—was preserved. Five higher-order dimensions were further identified: physical and mental pleasure, external influence, knowledge-seeking motivation, emotional experience, and value embodiment. A pilot study with a demographically similar rural student sample confirmed high reliability (α = 0.709–0.952 for subscales; α = 0.928–0.982 for total scale), supporting the instrument's psychometric soundness and contextual fit. This multidimensional tool enables a comprehensive assessment of motivational constructs, consistent with Self-Determination Theory and the study's aim to evaluate the intervention's impact on student motivation.

Data Collection

Data were collected at two key time points to evaluate the intervention's effectiveness: a pretest in early September 2024, prior to implementation, and a posttest in late December 2024, following the 16-week program. Both assessments were administered during regular school hours in classroom settings by trained research assistants unaffiliated with the intervention to ensure procedural consistency and reduce bias. Standardized protocols were used across both time points. Participants completed paper-based questionnaires after receiving a uniform explanation emphasizing the study's voluntary and anonymous nature. To minimize social desirability bias and expectancy effects, the intervention was introduced as a general school initiative to enhance physical education, fostering a naturalistic, non-evaluative testing environment that supported response authenticity (Setiawati et al., 2024).

Data Analysis

Data were analyzed using IBM SPSS Statistics 27.0, following a pre-registered analytic strategy. To enhance methodological transparency and reporting rigor, the analysis and reporting align with the CONSORT extension for non-randomized controlled trials (Treasure et al., 2023). Baseline equivalence between groups was confirmed via chi-square tests for demographic variables and independent samples t-tests for motivation scores ($p > 0.05$). Normality and homogeneity assumptions were met, as verified by Shapiro-Wilk and Levene's tests ($p > 0.05$, $p > 0.10$). Missing data (< 2%) were addressed using full information maximum likelihood (FIML) (Djudin, 2023). Within-group changes were examined using paired samples t-tests, with Cohen's d used to estimate effect sizes (Cohen, 2013). Between-group differences were analyzed using ANCOVA, controlling for pretest scores, and results included F-values, adjusted mean differences, partial eta-squared, and 95% confidence intervals from 1,000 bootstrap samples. Cohen's d was also reported for between-group effect sizes. A Bonferroni-adjusted alpha ($\alpha = 0.008$) addressed multiple comparisons across five motivation subscales. The high correlation between baseline and post-test scores ($r > 0.60$) supported ANCOVA's use. A priori power analysis (G*Power) confirmed the sample size ($N = 98$) had 80% power to detect medium effects ($d = 0.50$) at $\alpha = 0.05$. Data collection followed ethical standards of confidentiality, informed consent, and procedural neutrality.

FINDINGS

Baseline Equivalence Between Groups

Baseline analyses confirmed the comparability of the experimental and control groups prior to the intervention. Chi-square tests indicated no significant differences in age ($\chi^2 = 0.11$, $p = 0.741$), gender ($\chi^2 = 0.04$, $p = 0.843$), or residence ($\chi^2 = 0.37$, $p = 0.544$), supporting demographic equivalence (Table 1). Independent samples *t*-tests further revealed no significant between-group differences in pretest motivation scores across all five subdimensions or in overall motivation (all $p > 0.05$). Effect sizes were small (Cohen's $d < 0.30$), suggesting motivational homogeneity at baseline (Table 2). These findings confirm the effectiveness of the sampling and group assignment procedures in ensuring baseline equivalence and enhancing the internal validity of the study.

Table 1
Baseline demographic characteristics by study group

Characteristic	Category	Experimental (n = 50)	Control (n = 48)	χ^2	p
Age (years)	16	25 (50.0%)	25 (52.1%)		
	17	25 (50.0%)	23 (47.9%)	0.11	0.741
Gender	Male	26 (52.0%)	25 (52.1%)		
	Female	24 (48.0%)	23 (47.9%)	0.04	0.843
Residence	Rural	24 (48.0%)	28 (58.3%)		
	Urban	26 (52.0%)	20 (41.7%)	0.37	0.544

Note. All p-values derived from chi-square tests (χ^2) for categorical variables. Age was dichotomized (16 vs. 17 years). No significant between-group differences were found ($p > 0.05$), confirming baseline equivalence. Percentages reflect within-group proportions.

Table 2
Baseline motivation comparisons between experimental and control groups

Motivation Domain	Control Group	Experimental Group	p	d	T
Physical and mental pleasure	3.35 ± 0.73	3.46 ± 0.70	0.45	0.15	0.76
External influence	3.20 ± 0.60	3.38 ± 0.74	0.19	0.27	1.31
Knowledge-seeking	3.29 ± 0.69	3.47 ± 0.66	0.19	0.27	1.31
Emotional experience	3.33 ± 0.71	3.16 ± 0.67	0.23	0.25	1.21
Value embodiment	3.26 ± 0.69	3.43 ± 0.65	0.21	0.25	1.25
Total Score	3.30 ± 0.54	3.42 ± 0.56	0.24	0.24	1.18

Notes: Data presented as mean ± standard deviation. Cohen's d interpreted as small effect size (0. $2 \leq d < 0.5$). Degrees of freedom (df) = 96 (adjusted for equal variances assumed).

Within-Group Differences in Motivation Domains

Within-group analyses revealed that the experimental group (EG) demonstrated statistically significant improvements across all five motivation domains and in the total motivation score following the 16-week intervention. Specifically, the EG showed a significant increase in physical and mental pleasure ($\Delta = 0.30$, $p = 0.003$, $d = 0.45$), external influence ($\Delta = 0.23$, $p = 0.014$, $d = 0.34$), knowledge-seeking ($\Delta = 0.22$, $p = 0.006$, $d = 0.33$), emotional experience ($\Delta = 0.61$, $p < 0.001$, $d = 0.91$), and value embodiment ($\Delta = 0.45$, $p < 0.001$, $d = 0.69$). The overall motivation score also increased significantly in the EG ($\Delta = 0.34$, $p < 0.001$, $d = 0.60$). In contrast, the control group (CG) did not exhibit statistically significant changes in any motivation domain or in the total motivation score. All within-group comparisons for the CG yielded small, non-significant changes with negligible effect sizes (all $p > 0.05$, $d < 0.20$). These results suggest that the structured physical activity intervention had a meaningful impact on enhancing various aspects of student motivation in the experimental group only (see Table 3).

Table 3
Within-group effects on motivation dimensions: Experimental vs. control

Domain	Group	Pre-Test (Mean±SD)	Post-Test (Mean±SD)	Δ [95% CI]	p	d
Physical and mental pleasure	CG	3.35 ± 0.73	3.40 ± 0.69	0.05 [-0.07, 0.17]	0.382	0.07
	EG	3.46 ± 0.70	3.76 ± 0.64	0.30 [0.12, 0.48]	0.003	0.45
External influence	CG	3.20 ± 0.60	3.32 ± 0.65	0.12 [-0.03, 0.27]	0.112	0.19
	EG	3.38 ± 0.74	3.61 ± 0.62	0.23 [0.05, 0.41]	0.014	0.34
Knowledge-seeking	CG	3.29 ± 0.69	3.33 ± 0.70	0.04 [-0.09, 0.17]	0.538	0.06
	EG	3.47 ± 0.66	3.69 ± 0.67	0.22 [0.07, 0.37]	0.006	0.33
Emotional experience	CG	3.33 ± 0.71	3.42 ± 0.65	0.09 [-0.05, 0.23]	0.214	0.13
	EG	3.16 ± 0.67	3.77 ± 0.69	0.61 [0.42, 0.80]	<0.001	0.91
Value embodiment	CG	3.26 ± 0.69	3.39 ± 0.66	0.13 [-0.02, 0.28]	0.087	0.19
	EG	3.43 ± 0.65	3.88 ± 0.64	0.45 [0.28, 0.62]	<0.001	0.69
Total Motivation Score	CG	3.30 ± 0.54	3.39 ± 0.77	0.09 [-0.11, 0.29]	0.352	0.13
	EG	3.42 ± 0.56	3.76 ± 0.57	0.34 [0.20, 0.48]	<0.001	0.60

Note. EG = Experimental Group (n = 50); CG = Control Group (n = 48). Between-group Δ represents the difference in change scores (EGΔ - CGΔ). Effect sizes for between-group differences calculated using pooled standard deviations.

Between-Group Differences in Motivation Domains

An ANCOVA was conducted to examine between-group differences in post-test motivation scores, controlling for pre-test scores. The results indicated significant intervention effects in all five motivation dimensions and the overall motivation score (see Table 4). In terms of physical and mental pleasure, the experimental group (EG) demonstrated a significantly greater improvement than the control group (CG), $F(1,95) = 6.27$, $p = 0.014$, $\eta^2 = 0.06$, with a medium effect size ($d = 0.54$). For external influence, the intervention effect was also significant, $F(1,95) = 4.91$, $p = 0.029$, $\eta^2 = 0.05$, $d = 0.46$. Significant group differences emerged in knowledge-seeking motivation, $F(1,95) = 7.38$, $p = 0.008$, $\eta^2 = 0.07$, $d = 0.53$, favoring the experimental group. A robust effect was found in emotional experience, $F(1,95) = 25.14$, $p < 0.001$, $\eta^2 = 0.21$, with a medium effect size ($d = 0.52$). Similarly, a substantial intervention effect was observed for value embodiment, $F(1,95) = 18.92$, $p < 0.001$, $\eta^2 = 0.17$, $d = 0.76$. Lastly, a significant improvement was found in the total motivation score, $F(1,95) = 12.64$, $p < 0.001$, $\eta^2 = 0.12$, with a medium effect size ($d = 0.55$).

Table 4
Between-group intervention effects on motivation dimensions

Domain	F(1,95)	ΔΔ [95% CI]	ANCOVA p	η^2	Between d
Physical and mental pleasure	6.27	0.36 [0.08, 0.64]	0.014	0.06	0.54
External influence	4.91	0.29 [0.02, 0.56]	0.029	0.05	0.46
Knowledge-seeking	7.38	0.36 [0.12, 0.60]	0.008	0.07	0.53
Emotional experience	25.14	0.35 [0.22, 0.48]	<0.001	0.21	0.52
Value embodiment	18.92	0.49 [0.30, 0.68]	<0.001	0.17	0.76
Total Motivation Score	12.64	0.37 [0.18, 0.56]	<0.001	0.12	0.55

Note. EG = Experimental Group (n = 50); CG = Control Group (n = 48). All analyses conducted using ANCOVA controlling for baseline scores. Effect size benchmarks: η^2 (0.01 = small, 0.06 = medium, 0.14 = large); Cohen's d (0.20 = small, 0.50 = medium, 0.80 = large). MCID thresholds: 0.20 (small), 0.50 (medium), 0.80 (large) for respective dimensions. All assumptions met (homogeneity of variance $p > 0.05$, normality $p > 0.05$). Bonferroni-adjusted $\alpha = 0.008$ for multiple comparisons.

Collectively, the post-test analyses using paired t-tests and ANCOVA demonstrated significant improvements in motivation among students in the experimental group, indicating that the structured physical activity program offers a promising, engaging alternative to traditional recess routines.

DISCUSSION

This quasi-experimental study explored the effects of a 16-week FSMPA intervention on rural high school students' exercise motivation. The intervention targeted five motivational subscales: physical and mental pleasure, external influence, knowledge-seeking motivation, emotional experience, and value embodiment. As hypothesized, the experimental group showed statistically and practically significant improvements across all subscales when compared to the control group, which followed a traditional running-based routine. These findings underscore the pedagogical potential of integrating music-based structured activities with cooperative learning in physical education (PE), particularly within under-resourced rural settings (Blasco-Lafarga et al., 2022; Leite et

al., 2024). The following discussion interprets the results through theoretical lenses, aligns them with existing literature, and explores implications for practice and future research.

The FSMPA intervention produced the most substantial improvements in emotional experience (d = 0.52) and value embodiment (d = 0.76), suggesting enhanced affective engagement and deeper internalization of physical activity values. Moderate to large effects were also observed in knowledge-seeking motivation, external influence, and physical and mental pleasure. The overall increase in total motivation (Δ = 0.37, d = 0.55) suggests a comprehensive impact. These motivational gains can be attributed to several features of the program. First, the integration of rhythmic gymnastics and structured skipping enhanced sensorimotor coordination and self-expression, supporting intrinsic motivation via satisfaction of autonomy, competence, and relatedness (Lourenço et al., 2025; Pushkina, 2024). Second, cooperative task structures reduced pressure and encouraged peer bonding (Cothran & Ennis, 1999; Lafont et al., 2017). Third, reflective and guided relaxation practices may have enhanced emotional literacy, thereby supporting deeper cognitive and affective involvement (Hastie et al., 2022). Together, these elements cultivated a motivational climate that fostered experiential enjoyment, perceived relevance, and autonomously regulated participation (Kokkonen et al., 2020)

The FSMPA program was informed by the ADDIE instructional design framework. During the analysis phase, student needs were systematically assessed, with particular attention to the structural and pedagogical constraints inherent in rural physical education contexts. The design and development stages emphasized culturally resonant, engaging, and accessible movement experiences aligned with local resources and student interests. In the implementation phase, inclusive and participatory pedagogical strategies were integrated, incorporating structured peer collaboration to strengthen interpersonal support and collective engagement. The intervention also incorporated principles of cooperative learning, including group-based tasks designed to cultivate mutual accountability and shared goal attainment (Tran & Duong, 2025). Furthermore, instructional scaffolding was applied in accordance with Vygotsky's Zone of Proximal Development (ZPD). Initial sessions featured teacher-guided modeling, whereas later phases progressively transferred responsibility to students through peer-led activities, thereby fostering self-regulation, enhancing self-efficacy, and reinforcing intrinsic motivation (Son, 2025). In contrast, the control group's militarized routine lacked novelty, social interaction, and instructional adaptability, which may explain their limited motivational changes.

These findings align with international literature on student-centered physical activity interventions. For example, Bechter et al. (2019) reported average effect sizes of d = 0.11, whereas this study observed stronger effects (d = 0.46 – 0.76), particularly in emotional and value-related domains. Results also complement findings by Jeong et al. (2020), who demonstrated motivational benefits of music-integrated physical activity in urban contexts. The current study contributes to this literature by demonstrating the applicability of such approaches in rural schools. Notably, the FSMPA program's integrative framework—combining the ADDIE model, cooperative learning, and scaffolding—addressed cognitive, behavioral, and affective aspects of motivation. This

multi-theoretical foundation may explain the broader and more robust motivational outcomes compared to traditional or single-model PE interventions.

Theoretically, this study offers empirical validation for applying instructional design models and social-constructivist frameworks in physical education. The results highlight the potential of structured, interactive, and student-centered approaches in promoting emotional engagement and internal motivation. Practically, the FSMPA model presents a feasible strategy for improving PE in rural schools. Its low-cost, adaptable format supports inclusive, socially engaging physical activities that address both motivational and psychosocial needs. This makes the model particularly relevant for educational systems seeking sustainable approaches to health promotion and student engagement.

While this study offers valuable insights, it is not without limitations. The quasi-experimental design, although appropriate for authentic educational settings, constrains the strength of causal conclusions due to the absence of random group allocation. The sample was drawn from a single rural school in Henan Province, which may limit the transferability of findings across different regional or socioeconomic contexts. Although the 16-week duration allowed for meaningful short-term evaluation, longitudinal effects remain unexamined. Furthermore, the dependence on self-reported data introduces the potential for response bias and socially desirable responding. Future research should adopt randomized controlled trials with heterogeneous samples, incorporate follow-up assessments to evaluate the persistence of outcomes, and integrate qualitative approaches—such as in-depth interviews or systematic classroom observations—to illuminate the underlying mechanisms, experiential dimensions, and contextual factors shaping motivational development.

The findings indicate that the FSMPA intervention yielded meaningful enhancements in exercise motivation among rural students across multiple motivational domains. Grounded in systematic instructional design and collaborative pedagogical principles, FSMPA presents a theoretically coherent and contextually adaptable model for improving physical education practices in resource-constrained and geographically isolated settings.

CONCLUSION

This quasi-experimental study investigated the impact of a 16-week FSMPA intervention on exercise motivation among high school students in rural China. Findings revealed statistically meaningful gains across all motivational subdomains in the experimental group, with moderate to large effect sizes observed in affective responses ($d = 0.52$), internalized value ($d = 0.76$), and overall motivational orientation ($d = 0.55$). FSMPA—a pedagogical model integrating structured movement, music-supported tasks, and socially interactive learning experiences—demonstrated superior efficacy compared to traditional running protocols in promoting autonomously regulated motivation and deeper emotional involvement.

Grounded in the ADDIE model, cooperative learning, and scaffolding theory, the intervention demonstrated that motivation can be intentionally cultivated through well-designed pedagogical strategies. The findings support motivation as a multidimensional

construct responsive to environmental inputs and offer a scalable, low-cost solution for promoting physical activity in under-resourced rural schools. Future studies should consider randomized trials and longitudinal designs to assess sustainability and underlying mechanisms, while policymakers are encouraged to embed structured, emotionally supportive activities into school curricula to enhance adolescent well-being and lifelong engagement in physical activity.

DECLARATION OF COMPETING INTEREST

The authors declare that there are no known competing financial interests or other interests that could compromise the work reported in this article.

ETHICAL CONSIDERATIONS

The study was conducted in accordance with the relevant guidelines and regulations of the Ethics Committee of Henan Normal University, and informed consent was obtained from all participants prior to data collection.

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