

Integrating Physical, Cognitive, and Social Development in High Schools: A Conceptual Framework for Square Dancing under the Healthy China 2030 Agenda

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Abstract

Under the Healthy China 2030 agenda, high schools face the dual challenge of improving student physical fitness while fostering whole-person development amidst heavy academic loads. While square dancing represents a feasible school-based intervention, its potential to simultaneously address physical, cognitive, and social domains remains under-theorized in current literature. This paper addresses this gap by proposing a multi-dimensional conceptual framework that redefines square dancing as a sophisticated pedagogical tool integrating rhythmic action, choreographed memory, and synchronized formation. Drawing on Diamond's executive control theory and Johnson and Johnson's cooperative learning theory, the framework posits that the cognitive load of rhythmic synchronization directly engages executive functions, thereby enhancing classroom attention, while the structural interdependence of group formations fosters pro-social behaviors such as cooperation and responsibility. Furthermore, the model identifies implementation fidelity—specifically instructional time and teacher modeling—as a critical moderating variable, suggesting that the magnitude of these developmental benefits is contingent upon the quality of delivery rather than mere attendance. This study provides school administrators with a theoretically grounded roadmap for resource allocation and program adoption, positioning arts-integrated physical education as a strategic asset for holistic adolescent development.

Keywords

School-based square dancing; Healthy China 2030; Conceptual framework; Executive control; Cooperative learning; Implementation fidelity

1. Introduction

The release of the Healthy China 2030 agenda marks a decisive pivot in national ed-

educational strategy, transitioning the objective of school physical education from basic fitness metrics to a broader mandate of "whole-person development." This policy evolution requires high schools to integrate physical health with mental well-being and social adaptability, positioning the school environment as a critical setting for fostering lifelong healthy lifestyles (State Council of China, 2016, 2019). However, operationalizing this comprehensive mandate within the rigid constraints of the current educational system presents a complex managerial challenge. School administrators must reconcile the demand for holistic growth with the practical limitations of time and resources. Addressing this tension, this paper proposes a unified conceptual framework for integrating square dancing—a resource-efficient, rhythmic activity—into high school curricula. By synthesizing theories of executive control, cooperative learning, and social cognition (Bandura, 1986; Diamond, 2013; Johnson and Johnson, 1989), we argue that square dancing offers a unique, multi-dimensional intervention capable of addressing the fragmented developmental needs of adolescents within the specific context of the Chinese education system.

1.1. The Developmental Dilemma in High School Settings

Despite the Ministry of Education's clear guidance on strengthening physical education and integrating artistic literacy (Ministry of Education of China, 2020), the practical reality in high schools is characterized by intense competition for instructional time. Students face heavy academic loads that frequently encroach upon the time allocated for physical maintenance and mental restoration. In this high-pressure environment, administrators encounter a "developmental dilemma": they are tasked with delivering the outcomes of the Healthy China agenda—which include physical fitness, cognitive engagement, and social adjustment—yet they operate with limited scheduling flexibility and spatial resources.

Traditional sports programs often prioritize physical skill acquisition in isolation, which may underutilize the limited class time available for simultaneous cognitive engagement and social interaction. Consequently, there is an urgent need for interventions that yield a high "educational return" by addressing multiple developmental domains concurrently rather than sequentially. The challenge lies in identifying programs that can deliver physical adjustment, attention regulation, and social growth without requiring extensive new infrastructure or disrupting existing campus safety and management routines.

1.2. Square Dancing: A Multidimensional Rhythmic Intervention

Within this context, square dancing emerges as a strategically viable pedagogical tool, distinct from its common stereotype as merely a leisure activity for the elderly. For the purposes of high school education, this study re-defines square dancing as a structured, rhythm-based, and formation-based group activity delivered during scheduled lessons or organized clubs under teacher supervision. This definition

moves beyond casual recreation to highlight two structural characteristics relevant to student development.

First, the activity is inherently rhythmic, requiring students to synchronize movement sequences with musical beats, a process that demands sustained auditory-motor coordination and executive attention. Second, it is formation-dependent, necessitating collective choreography where individual movements are constrained by and must contribute to the group's spatial integrity. Unlike individual exercises, square dancing integrates the "self" with the "group" through shared rhythm and space. Evidence emerging from school settings suggests that when these elements are combined, they create a plausible pathway not just to physical performance, but also to improvements in health knowledge via safety rules and social behavior via peer interaction (Xiao and Hilton, 2019; Zhang et al., 2023).

1.3. Fragmented Evidence and the Need for a Unified Framework

While the potential of dance-based interventions is recognized, the existing evidence base remains disjointed, limiting its utility for systematic adoption. Research has documented isolated benefits, such as improvements in flexibility and coordination (Liu and Guo, 2023; Vilchez et al., 2020), gains in cognitive function and mental well-being (Chang et al., 2021; O'Connor et al., 2024), or enhanced social cohesion (Li et al., 2022). However, these findings often operate in silos—viewing square dancing either solely as physiological exercise or solely as a social activity—without a unifying theoretical mechanism that explains how these domains interact within a school setting.

Moreover, a critical gap persists regarding the conditions of delivery. Many studies report outcomes without rigorously documenting implementation fidelity, focusing on "whether" the intervention works rather than "how" it is effectively delivered (Damschroder et al., 2009; McKenzie et al., 1991). Without accounting for process indicators such as instructional time per session and teacher implementation fidelity, it is difficult for administrators to determine if successful outcomes are replicable. To bridge these gaps, this paper constructs a multi-dimensional conceptual framework. Anchored in Diamond's (2013) executive control theory and Johnson and Johnson's (1989) cooperative learning theory, the proposed model maps the specific mechanics of square dancing to physical, cognitive, and social outcomes, while explicitly incorporating implementation fidelity as a moderating condition for sustainable practice.

2. Theoretical Underpinnings of Rhythmic Physical Activity

This framework is anchored in well-established theories that explain how specific movement characteristics translate into developmental outcomes. Unlike general aerobic exercises such as jogging, which may allow for cognitive drifting, square dancing imposes unique and simultaneous cognitive and social demands on partici-

pants. To explicate these mechanisms, this paper integrates social cognitive theory, executive control theory, and cooperative learning theory (Bandura, 1986; Diamond, 2013; Johnson and Johnson, 1989). Within this broad learning context, observational learning serves as a foundational process where students model teacher demonstrations and correct movements based on peer feedback. Beyond this general learning mechanism, two specific theoretical pathways—cognitive engagement and social interdependence—drive the developmental benefits relevant to the Healthy China 2030 agenda.

2.1. Cognitive Engagement through Rhythmic Synchronization

The cognitive potential of square dancing extends beyond the physiological benefits of increased blood flow to the brain; it is rooted in the structural demands of the activity itself. Higher-level cognitive processes—specifically working memory, inhibitory control, and cognitive flexibility—are essential for goal-directed behavior and are actively recruited during rhythmic motor tasks (Diamond, 2013). In the context of square dancing, the fundamental requirement to "keep the beat" and synchronize movement with music necessitates continuous auditory-motor coordination. Structured dance choreography, as opposed to free movement, places a higher load on working memory because students must hold complex movement sequences in mind and update them in real-time (Rudd et al., 2021).

Furthermore, the instructional environment requires students to filter sensory input selectively. Following teacher cues while suppressing irrelevant actions or correcting missteps engages inhibitory control. Research on rhythmic exercise indicates that this sustained attention to external cues mediates improvements in cognitive status, which is conceptually linked to the classroom attention required in high school settings (Chang et al., 2021). Therefore, the rhythmic complexity of square dancing acts as a cognitive training ground, converting physical practice into gains in focus and information retention through the repeated application of executive functions.

2.2. Social Interdependence in Group Formations

While the cognitive dimension focuses on individual processing, the social dimension is governed by the collective nature of the activity. Cooperative learning theory posits that positive interdependence—where individuals perceive that they can reach their goals if and only if the other students reach theirs—is a primary driver of prosocial behavior (Johnson and Johnson, 1989). Square dancing inherently creates this interdependence through its reliance on formations. Unlike individual track events where performance is isolated, a square dance routine requires spatial coordination among all participants to maintain the integrity of the geometric shape.

This "formation-dependence" transforms the physical space into a social contract. Synchronized group movement has been shown to foster interpersonal skills and

team spirit, as students must communicate non-verbally and adjust their spacing relative to peers to avoid disrupting the collective flow (Zhang et al., 2023). Consequently, the group structure necessitates responsibility and rule observance; a failure in individual compliance is immediately visible and affects the group outcome. Supporting this view, cooperative structures in physical education have been found to significantly enhance academic self-efficacy and self-regulation (Fernández-Río et al., 2017). Thus, the formation is not merely an aesthetic arrangement but a functional mechanism that compels peer support and cooperation.

3. The Proposed Conceptual Framework

Building upon the theoretical foundations of executive control and cooperative learning, this study proposes a multi-dimensional conceptual framework designed to guide the integration of square dancing into high school physical education. The framework articulates the specific mechanics of the intervention, maps these mechanics to distinct developmental pathways, and identifies the implementation conditions necessary to realize these benefits.

3.1. Mechanics of the Intervention

Within this framework, school-based square dancing is operationalized not merely as physical exertion but as a composite of three structural elements: Rhythmic Action, Choreographed Memory, and Synchronized Formation. Rhythmic Action refers to the requirement for continuous auditory-motor synchronization, serving as the physiological driver. Choreographed Memory involves the cognitive load of retaining and updating complex movement sequences (Diamond, 2013). Synchronized Formation constitutes the social structure, where individual positioning is interdependent with the group's spatial integrity (Johnson and Johnson, 1989). These three elements function as the "active ingredients" of the intervention, distinguishing it from unstructured physical activities.

3.2. Pathways to Student Development

The framework posits that these structural elements trigger specific developmental mechanisms, leading to outcomes across three domains:

Proposition 1: The Rhythmic-Cognitive Link. The cognitive load imposed by maintaining rhythm and recalling choreography is proposed to directly engage executive functions. Sustained practice in "keeping the beat" and following cues is expected to transfer into improved Health Knowledge and Attention, specifically manifesting as better retention of safety rules and enhanced focus during instruction (Rudd et al., 2021).

Proposition 2: The Formation-Social Link. The interdependence required by synchronized formations is proposed to function as a social catalyst. The necessity of maintaining group geometry forces students to engage in non-verbal communica-

tion and peer monitoring, which translates into observable Social Behavior, defined here as cooperation, responsibility, and rule observance (Zhang et al., 2023).

Proposition 3: The Repetition-Physical Link. The cumulative effect of rhythmic action, driven by motivated practice and perceived competence, is expected to result in measurable gains in Physical Performance, covering standard high school metrics such as coordination, flexibility, and endurance (Fox and Corbin, 1989).

3.3. The Critical Role of Implementation Fidelity

A distinguishing feature of this framework is the inclusion of implementation fidelity as a critical moderator. Existing literature often assumes that "doing" the activity is sufficient, neglecting the quality of delivery. We argue that the magnitude of the developmental benefits described above is contingent upon three process indicators: Attendance (exposure dose), Instructional Time per Session (intensity dose), and Teacher Implementation Fidelity (quality of delivery).

Mere presence in a class is insufficient; the framework posits that significant improvements in cognitive and social domains occur only when the instructional dosage is adequate and when teachers faithfully execute the pedagogical components—such as correcting movements, managing intensity, and enforcing cooperative roles (Damschroder et al., 2009; McKenzie et al., 1991). Consequently, this model treats these process indicators not as peripheral details, but as essential conditions that determine whether the theoretical potential of square dancing is realized in practice.

4. Discussion and Implications

The conceptual framework proposing square dancing as a driver of multi-dimensional development offers a theoretical corrective to the prevailing, often fragmented approach to high school physical education. By explicitly linking rhythmic action to executive control and formation dependence to social interdependence, this study moves beyond the simplistic view of square dancing as mere geriatric recreation. Instead, it positions the activity as a sophisticated pedagogical tool aligned with the holistic objectives of the Healthy China 2030 agenda. This theoretical shift holds significant implications for assessment paradigms and administrative practice.

4.1. Moving Beyond Physical Metrics

The primary implication of this framework is the necessity to expand the criteria for evaluating school physical education. Traditionally, the success of a PE program—and by extension, the effectiveness of school management—has been measured almost exclusively by physiological outputs such as cardiovascular endurance or BMI reduction (State Council of China, 2016). However, our proposed propositions suggest that limiting assessment to these metrics ignores the substantial cog-

nitive and social "value-added" components of arts-integrated activities. If, as Diamond (2013) suggests, the executive functions engaged during rhythmic synchronization are foundational for academic learning, then physical education should be re-conceptualized as a partner in cognitive development rather than a competitor for instructional time. Furthermore, the social interdependence inherent in formation changes addresses the critical need for cooperative skills in high-pressure academic environments (Johnson and Johnson, 1989). Consequently, school administrators should advocate for a balanced scorecard of student development, where indicators of attention regulation (e.g., ability to follow complex cues) and social behavior (e.g., peer cooperation) are weighted alongside traditional fitness tests. This aligns with international standards which emphasize that physical literacy encompasses knowledge and behavior, not just physical competence (SHAPE America, 2014; UNESCO, 2015).

4.2. Strategies for Sustainable Implementation

From a management perspective, the most critical insight from this framework is the role of implementation fidelity. The model posits that the developmental benefits of square dancing are not automatic; they are moderated by the quality of delivery. This challenges the "plug-and-play" adoption strategy where schools simply broadcast music during breaks without structured instruction.

For the theoretical pathways to function—for rhythm to train attention and for formations to train cooperation—teachers must actively model movements, correct errors, and enforce group roles. As noted in implementation science frameworks, the failure of many school-based interventions is often a failure of implementation rather than the intervention itself (Damschroder et al., 2009). Therefore, sustainable implementation requires administrators to move beyond monitoring mere attendance. Resource allocation must prioritize instructional time per session to ensure sufficient dosage for cognitive adaptation, and professional development must focus on teacher fidelity, training instructors to see themselves as facilitators of cognitive and social growth rather than just fitness coaches. Without these managerial commitments, the theoretical potential of square dancing to serve the Healthy China agenda will remain unrealized.

5. Conclusion

This paper has argued that in the context of the Healthy China 2030 agenda, high school physical education requires a paradigm shift from a singular focus on physiological fitness to a multi-dimensional approach that embraces whole-person development. By constructing a conceptual framework anchored in executive control and cooperative learning theories, we have demonstrated that school-based square dancing possesses the structural complexity necessary to serve as a comprehensive educational intervention. Far from being a simple recreational pastime, the activity's

dual requirements of rhythmic synchronization and collective formation create a unique pedagogical environment where physical exertion is intrinsically linked to cognitive engagement and social interdependence.

The proposed framework posits that when implemented with fidelity, square dancing functions as a high-efficiency tool for school management. It addresses the developmental dilemma of limited instructional time by targeting physical performance, health knowledge, attention, and social behavior simultaneously. However, the theoretical benefits outlined in this model are contingent upon rigorous delivery. We conclude that for these multi-dimensional outcomes to materialize, school administrators must prioritize implementation conditions—specifically ensuring adequate instructional time and high-quality teacher modeling—rather than treating the activity as a passive exercise routine. Ultimately, this framework provides a theoretical roadmap for transforming arts-integrated physical education into a strategic asset for adolescent development, offering a scalable solution that aligns institutional resources with the national mandate for holistic health. Future empirical research is now needed to test these propositions in diverse school settings and to quantify the specific dose-response relationships proposed herein.

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