Journal of Contemporary Educational Research, 2026, Volume 10, Issue 4
http://ojs.bbwpublisher.com/index.php/JCER
Online ISSN: 2208-8474
Print ISSN: 2208-8466

Construction of a Formative Assessment and Stratified Practice Support Framework for Basic Table Tennis Movements in Public Physical Education Courses

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Abstract: Addressing the practical challenges of "difficulty in diagnosis, feedback, and personalized intervention" in teaching basic table tennis movements in large-class public physical education settings, this study, guided by the concept of lightweight intelligent teaching, constructs a framework for formative assessment and stratified practice prescriptions for basic table tennis movements, using forms as its medium. The framework designs a three-dimensional evaluation structure of "general movement quality–movement stability–technique-specific indicators," establishes a structured closed-loop mechanism of "diagnosis–prescription–retesting," and achieves the operationalization of transitioning from classroom observation to personalized intervention. This paper demonstrates the design rationality of the framework from three dimensions: content validity, operational feasibility, and decision-making effectiveness. It provides a standardized and replicable paradigm for skill teaching in large-class public physical education under low-resource constraints, and also offers a complete framework foundation and theoretical basis for subsequent empirical research.

Keywords: Public physical education courses; Table tennis; Formative assessment; Rubric; Stratified practice prescription; Framework construction

Online publication: May 12, 2026

1. Introduction

Public physical education courses in China face structural constraints including large class sizes, limited class hours, and significant student stratification in athletic foundations [1]. These challenges are particularly

pronounced in table tennis instruction [2], where fundamental techniques such as forehand attack and backhand push involve numerous details and demand precise technical patterning [3]. With class sizes of 30–50 students, instructors struggle to observe and correct movement details for all students under the traditional "demonstration–practice–verbal correction" model, leaving many students uncertain about movement correctness, improvement pathways, and targeted practice content [2]. Incorrect movement patterns easily become ingrained, hindering teaching quality and diminishing learning engagement.

Formative assessment offers a solution by providing standardized, continuous observation and feedback to optimize learning [4]. For table tennis beginners, proper movement patterning relies on timely, precise, and actionable feedback rather than end-of-term summative assessments [5]. Traditional feedback lacks uniform standards and is often vague, preventing students from translating it into concrete practice. Structured formative assessment translates abstract movement standards into observable, uniformly judgeable behavioral indicators, enabling clear performance requirements and improvement directions.

This paper is a framework construction study in physical education pedagogy. Targeting the constraints of large-class table tennis instruction, it constructs a low-tech, implementable, replicable framework combining formative assessment and stratified practice prescriptions. The framework clarifies design principles, core dimensions, a structured connection between assessment and practice, and closed-loop learning adjustment rules, arguing its contextual suitability and application feasibility.

2. Literature review

2.1. The role of formative assessment in motor skill learning

Formative assessment enables continuous monitoring of the learning process to provide timely evidence for the bidirectional optimization of teaching and learning. Its central value lies in "assessment for learning," distinguishing it from summative assessment, which focuses on outcome judgment [4]. In motor skill learning, formative assessment can promptly capture learner movement errors, preventing solidification of incorrect patterns, while reinforcing learning motivation through positive, clear feedback. However, existing technology-enabled formative assessment solutions often rely on specialized equipment such as AI motion recognition, wearable sensors, and high-speed cameras. Although they enable precise motion capture and analysis, their requirements for facilities, funding, and technical maintenance are high, making them unsuitable for the low-resource, large-class scenarios common in most university public physical education courses [6].

2.2. Rubric-guided feedback and representation of basic movement quality

The Rubric is an evaluation tool that decomposes abstract learning objectives into observable, gradable behavioral standards, enabling standardization and transparency in assessment [7]. The external, observable nature of physical skills makes them inherently well-suited for rubrics. Rubrics can decompose complex actions and unify evaluation criteria, addressing issues of vague feedback and inconsistent standards in traditional physical education teaching. They are also adaptable to large-class settings and can support peer assessment without significantly increasing the instructor's workload. However, existing research often focuses on constructing the evaluation system itself and fails to address the core issue of "how to intervene after assessment," leading to a disconnect between assessment and instruction and preventing the formation of a complete teaching closed loop.

2.3. Significance of movement stability in beginner skill acquisition

Movement stability is a core indicator of motor skill acquisition and a crucial prerequisite for technical patterning in table tennis beginners. Existing research confirms that a primary pain point for beginners is achieving a single correct movement that cannot be consistently replicated; this lack of stability directly affects technical solidification and confidence for progression, making it a core issue in the initial stage [8]. However, existing research often defines stability in general, qualitative terms, lacking an operational definition usable in the classroom, preventing its integration into daily assessment and training routines.

2.4. Stratified practice and learning support

Stratified practice is a teaching model that designs differentiated tasks based on individual learner differences, representing a core pathway for addressing the issue of diverse foundational levels in large-class teaching [9]. In physical education skill instruction, it can accommodate varying student ability levels, avoid the teaching dilemma of polarization, and cater to the needs of all students. Although existing research confirms its effectiveness in enhancing physical education instruction, most approaches rely on the instructor's subjective experience, lack standardized diagnostic bases, and suffer from issues like vague criteria, insufficient task matching, and no closed-loop adjustment mechanism, making it difficult to form a continuously optimized teaching closed loop.

2.5. Research gaps and rationale for framework construction

Synthesizing existing research, significant gaps remain: a lightweight formative assessment system for table tennis adapted to low-resource, large-class public physical education settings has yet to be constructed [6]; an operational, classroom-usable evaluation indicator for beginner movement stability has not been clearly defined [10]; and a structured connection between assessment and practice to form a complete instructional closed loop is lacking. Based on this, this study constructs a framework integrating assessment, diagnosis, intervention, and retesting for basic table tennis movements, aiming to fill these research gaps.

3. Construction of the formative assessment and stratified practice prescription framework for basic table tennis movements in public physical education courses

3.1. Framework design principles

This framework is built on a foundational logic centered on four core principles, all aimed at adapting to the public physical education teaching context. First, the principle of importance: all designs are closely aligned with the core learning objectives of the introductory table tennis stage, focusing on key elements that influence proper movement patterning and long-term learning effectiveness. Second, the principle of observability: all evaluation indicators employ behavioral descriptions, ensuring they can be uniformly and quickly observed and judged in the classroom setting, thus avoiding subjective bias. Third, the principle of operability: framework implementation requires no specialized equipment or high investment; the entire process can be completed using only paper forms, making it deeply suitable for low-resource teaching scenarios. Fourth, the principle of decisional capability: all evaluation results can directly trigger corresponding teaching interventions, accompanied by clear rules for validating effectiveness, ensuring that assessment directly serves instructional improvement rather than merely assigning grades.

3.2. Core dimensions of the framework

Based on the skill formation patterns of basic table tennis movements, this framework constructs a three-dimensional evaluation index system comprising "General Movement Quality–Movement Stability–Technique-Specific Indicators." This forms a complete evaluation structure covering movement specifications, consistency capability, and technique-specific characteristics, providing a standardized basis for subsequent diagnosis and intervention. The General Movement Quality dimension covers the entire process of movement preparation, execution, and outcome, utilizing a graded rubric to achieve a generalized and standardized representation of basic forehand and backhand techniques. The Movement Stability dimension decomposes the abstract concept of stability into two types of sub-indicators: quantifiable statistics and observable classroom behaviors, balancing objectivity and classroom convenience, thereby solving the core problem of vague and non-operational stability evaluation. The Technique-Specific Indicators dimension designs specialized evaluation modules for the technical differences between forehand attack and backhand push. It employs a sampling evaluation method to balance the framework's general applicability with targeted specificity without increasing the daily teaching burden.

3.3. Connection logic between formative assessment and stratified practice prescriptions

Based on the core logic of "problem diagnosis–cause categorization–precise intervention," this framework establishes a structured mapping mechanism linking evaluation results to stratified practice prescriptions. This bridges the gap between "assessment" and "instruction." The mechanism uses abnormal evaluation results from single or multiple dimensions as trigger conditions, mapping them to specific movement problem causes and matching them with targeted practice prescriptions, forming standardized "condition–action" decision rules. This enables precise prescription matching without requiring complex subjective judgment from the instructor. All practice prescriptions adhere to the principle of progressive difficulty design, adapting to the learning pace of students at different levels and ensuring the executability and progression of practice tasks.

3.4. Retesting and learning adjustment mechanism

Based on the closed-loop optimization principle of formative assessment, this framework constructs a complete closed-loop mechanism of "diagnosis–prescription–retesting–adjustment," achieving continuous iterative optimization of the learning process. The mechanism focuses on the core evaluation indicators corresponding to the prescription as the objects for retesting. After completing the prescribed intervention practice, students verify its effectiveness through retesting. The retest results then bifurcate into two standardized learning pathways: those who meet the standard can proceed to the next stage of learning or increase practice difficulty; those who do not meet the standard can either repeat the current prescription or adjust to a more suitable intervention plan. Each retest result serves as both the endpoint of the current instructional loop and the starting point for the next diagnosis, thus forming a continuously upward-spiraling learning trajectory and ensuring the realization of the core value of formative assessment.

4. Explanation of the framework's teaching application

4.1. Typological adaptation for common beginner problems

The core principle underlying the design of this framework is to create an internally unified logic linking

"problem type–evaluation dimension–intervention pathway," based on the stage-specific patterns of skill acquisition for table tennis beginners, with the three-dimensional evaluation structure at its core. The framework categorizes beginner movement errors into three levels: basic specification issues, consistency and stability issues, and specialized technique issues. These correspond logically to the three dimensions of general movement quality, movement stability, and technique-specific indicators, respectively. Through this precise matching of problem types with evaluation dimensions, targeted localization of learning pain points is achieved, fundamentally avoiding instructional blindness from the design stage and ensuring that teaching interventions are highly adapted to student needs.

4.2. Supportive role for instructional decision-making in large classes

This framework provides a standardized, highly efficient support system for instructional decision-making in large-class settings. Instructors can quickly complete student movement evaluation and problem identification through brief, standardized diagnostics. They can then group students by prescription for differentiated practice, focusing their guidance primarily on students with issues. This significantly enhances classroom efficiency and the reach of personalized instruction. The entire process relies on standardized rules, eliminating the need for complex subjective judgment and thus addressing the core challenge of implementing personalized instruction in large-class teaching.

4.3. Implementability in low-resource teaching contexts

This framework is deeply suitable for the low-resource, highly constrained teaching scenarios of public physical education, offering strong potential for generalization. It requires no specialized equipment or additional investment; the entire process can be completed using simple forms. It flexibly adapts to the regular class schedules of university public physical education courses. Furthermore, it supports peer assessment, which reduces the instructor's teaching burden while deepening students' understanding of movement standards and enhancing classroom participation.

5. Conclusion

5.1. Significance of the framework for supporting initial skill teaching in public physical education

The framework constructed in this study enriches the theoretical and practical system of formative assessment in motor skills, filling existing gaps in the research. It clarifies an operational evaluation logic for beginner movement stability in table tennis, refining the theoretical basis for evaluating basic table tennis skills. It also establishes a structured mapping mechanism between assessment and practice, overcoming the research limitation of "emphasizing assessment while neglecting intervention" and perfecting the closed-loop application logic of formative assessment in physical education skill teaching. Its lightweight design concept also offers a new approach for the intelligent transformation of physical education teaching in low-resource contexts.

5.2. Pedagogical value from assessment to practice prescription

This framework provides an implementable solution to the core challenges of large-class teaching in public physical education. Relying on standardized assessment and structured intervention mechanisms, it

enables personalized instruction in large-class settings without increasing burden or investment, breaking the traditional "one-size-fits-all" model and effectively enhancing the quality of table tennis instruction. Simultaneously, it provides students with clear self-assessment standards and autonomous practice pathways, fostering self-regulated learning abilities and contributing to the formation of lifelong exercise habits. Moreover, its design logic is transferable, offering a reference for teaching other similar skill-based activities in large-class contexts.

6. Limitations and future research directions

As a framework construction study, this research has certain limitations: the indicator system of the framework has not yet undergone expert consensus validation; the inter-rater reliability of the evaluation indicators has not been empirically tested; and the actual teaching effectiveness of the framework requires verification through controlled teaching experiments. Subsequent research will employ the Delphi method to solicit opinions from domain experts and frontline instructors to optimize the indicator system; test inter-rater reliability through standardized video scoring; conduct controlled teaching experiments to validate the framework's teaching effectiveness; and collect user feedback from both instructors and students for continuous framework iteration and improvement.

Disclosure statement

The authors declare no conflict of interest.

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