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The Effect of Game-Based Conventional Training Models on Table Tennis Topspin Accuracy: A Literature Review Study

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ABSTRACT: Topspin accuracy is a core learning outcome in university table tennis courses. This narrative review (PRISMA 2020 principles) examined whether a conventional game-based training model improves topspin accuracy in physical education undergraduates. Meta-analytic evidence favours game-based approaches for decision making and skill-test performance but not for knowledge or skill in game situations, and tactical approaches did not outperform technical approaches on skill execution. The closest table tennis study (n = 56 college students) found both play practice and skill-focused instruction improved skills, with play practice superior only for forehand attack and serving. No identified study tested the target intervention with topspin accuracy as the primary outcome in this population. Certainty is rated low: the effect is plausible but unproven. A controlled trial using a validated topspin accuracy test is proposed.

KEYWORDS: Table Tennis; Topspin Accuracy; Game-Based Approach; Conventional Exercise; Physical Education Students.

I. INTRODUCTION

Table tennis is an *open-skill sport* that relies on technique, with the precision of the ball placement as the determinant of the rally outcome. *The topspin drive* is the most important attacking stroke in the modern game, and the ability to direct it accurately is the target of standard assessments in coaching and lectures (Haryanto et al., 2023). Accuracy is influenced by the execution of the technique, as well as by perceptual-motor and psychological factors such as eye-hand coordination, reaction time, cognitive processing speed, and confidence (Haryanto et al., 2024; Haryanto et al., 2026).

In the Penjaskesrek program, table tennis is taught as a skill course, typically through conventional learning: demonstrations, repetitive hitting practice with a partner, and then progression to rally. Criticism of technique-centered teaching argues that this approach separates skill from play and does not necessarily transfer to competitive situations. The game-based approach places learners on a modified form of play so that techniques are trained under perceptual demands and decision-making that resemble real play (Bunker & Thorpe, 1982). A systematic review of *the Tactical Games Model* noted the absence of studies on higher education as well as the dominance of research on team sports and invasion games (Wang et al., 2024). This gap is the reason for studies focused on students and on table tennis.

A lecturer directed training model that maintains a conventional session structure (warm-ups, demonstrations, progressive drills with reps and feedback), and inserts game-like tasks in the core part, such as topspin versus block games, goal scoring games, cooperative rally games, and modified matches with points. This model differs from (a) purely drill-based conventional learning, and (b) full tactics-based models such as *Teaching Games for Understanding* (TGfU) or *Sport Education Model* (SEM) that prioritize tactics or season structures. scores on a standard target-based topspin test, which assigns points according to the target zone where the ball landed after being hit with the correct topspin technique (Haryanto et al., 2023). undergraduate students of the Penjaskesrek program with beginner to intermediate table tennis skills.

II. METHODOLOGY

A structured narrative literature review with critical assessment, reported according to the principles of PRISMA 2020. Because research questions are narrow and direct evidence is very limited, evidence is narratively synthesized and meta-analysis is not conducted.

Table 1. Eligibility criteria (PICOS)

Elements	Criteria
Population	Physical education students, students or college students, or athletes studying table tennis; GBA review in physical education
Intervention	Game-based approaches, *play practice*, TGfU, *tactical games*, or modified game instruction
Comparator	Conventional, technique-focused, drill-based, or traditional instruction
Exterior	Topspin or *drive* forehand *accuracy* (primary); table tennis skill performance, decision-making, game performance (secondary)
Design	Experimental and quasi-experimental studies, systematic reviews and meta-analyses; correlation studies and test validation only as context

Combined search concepts: *table tennis* AND (*topspin* OR *forehand drive*) AND *accuracy*; and (*game-based approach* OR *play practice* OR TGfU OR *tactical games*) AND (*table tennis* OR *physical education*). Sources searched include publishers and open access indexes (PubMed Central, ERIC, Frontiers, MDPI, PLOS, SAGE, IOPscience) as well as Indonesian and international sports education journals. Studies were assessed qualitatively according to design, sample size, group allocation, measurement validity, and confounding risk. Overall certainty for the target question was assessed by GRADE-style reasoning (risk of bias, indirectness, imprecision, inconsistency, publication bias).

III. RESULTS

Table 2. Evidence base

Source	Design and samples	Key findings
Manninen et al. (2025)	Systematic review and multilevel meta-analysis, 28 studies before Oct 2023; PJ students/students and athletes; GBA vs traditional skills approach	Heterogeneous positive effects on decision-making in games (ES = 11.41%) and motor skills on skills tests (g = 0.36; CI 95% 0.14 to 0.57); no effect on motor knowledge and skills in game situations
Abad Robles et al. (2020)	Systematic review and meta-analysis; 7 studies (decisions), 6 studies (skill execution); tactical vs technical approach	Improved decision (ES = 0.89; 95% CI 0.12 to 1.65); skill execution did not differ significantly (ES = 0.89; CI 95%-0.45 to 2.23); large heterogeneity, low quality of evidence according to GRADE
Money et al. (2024)	Systematic review of *Tactical Games Model* in PJ	No higher education studies; dominance of team sports and invasion games; cognitive impact and decision-making are poorly researched
Zhang et al. (2012).	Quasi-experimental; 56 students, four classes intact, two instructors; unequal comparison group; *play practice* vs skill-focused instruction	Both conditions improve the accuracy of *forehand drive*, *forehand attack*, and serve; *play practice* is superior to *forehand attack* and serve
Tang et al. (2026)	Quasi-experimental; 116 1st level high school students (average 15.3 years), two whole classes, 20 sessions x 40 minutes; SEM vs traditional three-part structure	The *score of the forehand drive* (40 strokes, hit the target) post-test was 26.70 vs 24.70 (p = 0.033); the control group also improved sharply (13.20 points)
Nazari et al. (2023)	Primary school male students, 60 people randomly divided (30 vs 30), 4 weeks, 3 sessions/week, 45 minutes; TGfU vs traditional; ANOVA repeated measurement	The TGfU group obtained higher *scores of forehand* skills and cognitive flexibility
López-Lemus et al. (2023)	Quasi-experimental; 137 students, 12 lessons; hybrid model of SE/TGfU vs technical approach; handball, not table tennis	Post-test scores are higher on most variables (game engagement and performance, fun, perception of competence)
Xie et al. (2025)	Quasi-experimental; 270 students, 16 weeks; TPACK-based digital model in table tennis courses	Improved fitness and performance of table tennis; not a game-based model

Source	Design and samples	Key findings
Sirait et al. (2026)	8-week experiment on junior high school students; *footwork-based* exercises vs conventional learning; *20-point* scale backboard test	Improved *forehand drive accuracy* exceeds comparator according to the author
Baber & Babar (2023)	experiments; 24 female students; pre-tests, post-tests, retention; multi-ball exercises	Effective multiball drills for *topspin forehands* (target test)
Study of exercise methods (2017)	2x2 factorial; 8 students; 16 meetings; Mass vs Distributed Training	Distributed drills give the topspin *forehand* accuracy better; the level of eye-hand coordination also differentiates accuracy
Haryanto et al. (2026)	Correlation	Eye-hand coordination and joint reaction time explain the 50.9% variance in topspin accuracy in the total sample
Haryanto et al. (2024)	Correlatable, competitive players	Confidence (r = 0.430) and cognitive processing speed (r = 0.374) were positively correlated with topspin accuracy
Haryanto et al. (2023)	Test validation studies	Goal-based topspin accuracy tests are reported to be valid and reliable

1. The Superiority of GBA in Limited and Comparator-Dependent Motor Skills

The strongest evidence was at the review level. A multilevel meta-analysis by Manninen et al. (2025) found that GBA improved decision-making in game situations and motor skills on skills tests, with small to moderate effects for the latter (g = 0.36). GBA had no effect on knowledge or on motor skills measured in game situations. Meta-regressions showed that the experience of the intervention implementers, study quality, and comparator conditions influenced the results on the skills test. The meta-analysis of Abad Robles et al. (2020) reinforced this caution: the tactical approach improved decision-making, but did not show a significant improvement in skill execution compared to the technical approach, with large heterogeneity and low quality of evidence. Wang et al. (2024) added that the *Tactical Games Model literature* does not contain studies on higher education.

The implications for the research question: the conventional game-based model retains technique practice, so the relevant comparator is technique-focused instruction. Against such comparators, the evidence of the review does not guarantee excellence in skill execution.

2. Table tennis-specific evidence is positive but indirect, and not uniform in accuracy

The closest direct evidence is a study by Zhang et al. (2012) on 56 college students. Play practice and skill-focused instruction both improve the accuracy of forehand drive, forehand attack, and serve; play practice excellence is reported only on forehand attack and serve, not on forehand drive accuracy. This finding is important because drive accuracy is the output that comes closest to topspin accuracy, and it is precisely on that output that the game's advantage is not found. The design is quasi-experimental with a whole class and two instructors so that selection bias and instructor effects are difficult to separate.

The SEM study of high school students (Tang et al., 2026) reported a small but significant difference in forehand drive score (26.70 vs 24.70; p = 0.033), while the control group increased by 13.20 points; this suggests that structured conventional progression has resulted in significant improvements. The TGfU study in elementary school students (Nazari et al., 2023) was one-directional, but differed in population, model, and output. None of these table tennis studies used a goal-based topspin accuracy test as the primary outcome in Penjaskesrek students.

3. Responsiveness to the way exercises are structured

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primary outcome in Penjaskesrek students.

4. Determinants of accuracy are perceptual-cognitive and psychological

Eye-hand coordination and joint reaction time explained 50.9% of the topspin accuracy variance in the total sample, and the relationship was most pronounced in male participants (Haryanto et al., 2026). Confidence and cognitive processing speed were positively correlated with accuracy, with moderate coefficients (Haryanto et al., 2024). When game-based tasks overload this capacity, a mechanism for increasing accuracy makes sense. However, this mechanism is inferred from correlational data and has not been tested in game-based interventions.

5. Measurement is a weak point

Goal-based topspin accuracy tests have been validated for table tennis players (Haryanto et al., 2023). Other studies use *the Backboard Test*, a *forehand drive* test with 40 strokes and a target hit count, or a target test on a pass ball, so limited comparisons and pooling are not possible.

IV. DISCUSSION

1. Interpretation

The literature supports the general proposition that game-based practice can improve the skill performance of PJ learners, but with a small to moderate magnitude of effects on skill tests and no definite advantage in skill execution over technical approaches. The literature has not been sufficient to establish that conventional game-based models improve the topspin accuracy of Penjaskesrek undergraduate students. That conclusion requires extrapolation across three gaps: from general motor skills to topspin accuracy; from other populations (children, adolescents, mixed student classes) to PJ students in the Penjaskesrek Unisi program; and from tactics-first or hybrid models to models that maintain conventional drill structures. Nearby table tennis studies have not even found game advantages on *forehand drive* accuracy (Zhang et al., 2012). Therefore, the realistic effect magnitude of a well-designed drill-based comparator is small, and the zero effect cannot be eliminated.

2. Sensible mechanism

Three mechanisms are consistent with the evidence. First, representativeness: the topspin executed against the ball comes that varies and with consequence the score more closely resembles the demands of the match than the drill of a fixed pass. Second, perceptual-cognitive loading: the game demands anticipation and decision-making, a capacity that correlates with the accuracy of the topspin. Third, motivation and confidence: the format of the game and the season increase motivation and perception of competence (Tang et al., 2026; López-Lemus et al., 2023), and confidence is associated with accuracy.

The counter-mechanism needs to be recognized: games can reduce the number of consistent reps per learner, and the findings of distributed and multiball exercises imply that well-timed reps remain important. This is the basis of thinking for a conventional base with insert play, rather than a pure game model.

3. Critical assessment of evidence

- Sample size and design: key table tennis studies using whole classes or groups were not equivalent and rarely randomized; exercise method studies were very small in size. Selection bias and instructor effects were most likely to occur.
- Output heterogeneity: differences in accuracy and skill tests prevent quantitative merging.
- Incontinence: most of the game-based evidence concerns invasion games or other sports, as well as children and adolescents.
- Comparative ambiguity: traditional words can mean anything from unstructured teaching to well-designed drill progressions, and the magnitude of the effect depends on it (Manninen et al., 2025).
- Reporting and publication bias: positive findings dominate; many sources come from regional journals with limited methodological reporting.

Overall certainty for the target question: low (lowered due to indirectness, risk of bias, and imprecision). The effect of conventional game-based models on topspin accuracy is reasonable but has not been proven.

4. Implications for Penjaskesrek table tennis courses

There is sufficient evidence to justify trial of game-based tasks in conventional sessions, provided that validated topspin accuracy tests are used before and after the intervention, and the volume of reps is adequately maintained. There is insufficient evidence to claim a proven effect on topspin accuracy.

V. CONCLUSION

Current evidence suggests that a game-based approach may improve decision-making and skill test scores in physical education learners, but does not consistently improve skill execution compared to technical approaches. In table tennis, the closest studies support *play practice* for *forehand attack* and serve, rather than for *forehand drive* accuracy. No studies identified have directly

tested conventional game-based models of topspin accuracy in undergraduate students of physical education, so the effect is reasonable but not yet proven, with low certainty. Controlled testing with validated topspin accuracy tests is the next necessary step.

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