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Game-Based Learning Approach to Enhance Tactical Understanding and Motivation in School Football Physical Education

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ABSTRACT

The purpose of the study. This quasi-experimental study examined the effectiveness of a GBL approach in improving tactical understanding and intrinsic motivation among secondary school students in football physical education classes in Kabupaten Dompu, Nusa Tenggara Barat, Indonesia.

Materials and methods. Eighty-four students (mean age = 14.6 ± 1.2 years; 52 males, 32 females) from two secondary schools participated in an 8-week intervention (16 sessions, 2×/week). The experimental group (n=42) received GBL-based instruction using modified small-sided games and tactical questioning, while the control group (n=42) followed traditional skill-drill methods. Tactical understanding was assessed using the Game Performance Assessment Instrument (GPAI), and motivation was measured using the Sport Motivation Scale (SMS) adapted for physical education. Data were analyzed using paired t-tests, ANCOVA, and Cohen's d effect sizes.

Results. The GBL group demonstrated significantly greater improvements in tactical understanding (decision-making: 42.3%; skill execution: 31.8%; support: 38.5%) compared to the control group (15.2%, 18.4%, 12.7% respectively; all $p < 0.001$). Regarding motivation, the GBL group showed significant increases in intrinsic motivation ($d = 1.24$, $p < 0.001$), identified regulation ($d = 0.89$, $p < 0.001$), and decreased amotivation ($d = -1.02$, $p < 0.001$), while the control group showed minimal changes. ANCOVA revealed significant between-group differences favoring GBL on all measures (F-values ranging from 32.45 to 58.72, all $p < 0.001$, partial $\eta^2 = 0.28$-0.42).

Conclusions. The GBL approach using TGfU principles significantly enhanced both tactical understanding and autonomous motivation in secondary school football education. These findings support the implementation of game-centered pedagogies in Indonesian physical education contexts and suggest that GBL may address common challenges of student disengagement in traditional skill-focused instruction. Future research should explore long-term retention effects and implementation across diverse cultural and educational settings.

Keywords: game-based learning; teaching games for understanding; tactical understanding; motivation; physical education; football; Indonesia.

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INTRODUCTION

Physical education plays a crucial role in developing students' motor competencies—such as coordination, agility, and endurance—tactical knowledge, including decision-making and spatial awareness, and lifelong engagement in physical activity, which contributes to overall health and well-being (Kirk & MacPhail, 2002). However, traditional approaches to teaching team sports, particularly football, have been widely criticized for their overemphasis on isolated technical skills (e.g., passing, dribbling, and shooting) and decontextualized drill-based instruction that lacks game-like pressure and variability (Kirk & MacPhail, 2002). This technical-first paradigm, often characterized by linear progression from basic techniques to full games, frequently results in students who can execute skills proficiently in controlled, low-stakes environments but struggle to apply these skills effectively during actual gameplay scenarios, where unpredictability, opponents, and time constraints demand adaptive responses (Harvey et al., 2009; Práxedes et al., 2018). Consequently, this mismatch leads to decreased student motivation, frustration from poor game performance, and limited tactical understanding, perpetuating a cycle of disengagement and superficial learning.

[abcde]Authors'Contribution: a-Study design; b-Data collection; c-Statistical analysis; d-Manuscript preparation; e-Funds collection.
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In Indonesia, physical education curricula have historically followed teacher-centered, technique-oriented models that prioritize measurable performance outcomes—such as skill proficiency tests—over holistic student engagement, cognitive development in game strategies, and enjoyment (Estero et al., 2020). This approach aligns with broader educational traditions influenced by colonial legacies and standardized national guidelines, which emphasize rote skill acquisition rather than contextual problem-solving. Such methods are particularly problematic in resource-limited settings common across the archipelago, where large class sizes (often exceeding 40 students per session), limited equipment (e.g., sharing a single ball among groups), inadequate playing fields, and minimal teacher training in innovative pedagogies exacerbate the challenges of maintaining student interest and fostering tactical competence (Estero et al., 2020). Teachers in these environments often resort to repetitive drills due to time constraints and assessment pressures, further diminishing opportunities for meaningful game involvement.

In Kabupaten Dompu, Nusa Tenggara Barat—a rural region characterized by socioeconomic challenges, including high poverty rates and limited access to sports infrastructure—similar issues have been prominently observed in school football programs. Local teachers have reported persistently low student participation rates, with many adolescents citing boredom and irrelevance as reasons for disengagement, alongside poor transfer of isolated skills to competitive game situations. Preliminary observations from pilot assessments in Dompu secondary schools revealed that students could demonstrate basic techniques adequately but exhibited deficiencies in off-the-ball movement, positional play, and decision-making under pressure, mirroring findings from broader regional studies on physical education efficacy (Harvey et al., 2009; Oktarifaldi et al., 2024). These contextual barriers underscore the urgent need for pedagogical innovations that can thrive in low-resource settings, promoting both skill application and motivational sustainability.

Game-Based Learning represents a significant pedagogical shift in physical education, moving away from traditional isolated skill practice toward immersive learning embedded within authentic game contexts that closely mimic real-world gameplay scenarios (Ezeddine et al., 2025; Wang et al., 2025) . This approach prioritizes the holistic development of players by integrating cognitive, technical, physical, and affective dimensions simultaneously, allowing students to experience the dynamic and unpredictable nature of sports from the outset. One of the most prominent frameworks within GBL is the Teaching Games for Understanding model, originally developed by David Bunker and Rod Thorpe in the late 1970s and early 1980s as a response to the limitations of the technical model prevalent at the time (Kirk & MacPhail, 2002; Oslin et al., 1998). TGfU inverts the conventional linear progression—technique first, tactics later—by emphasizing tactical awareness and understanding prior to technical proficiency. It employs modified small-sided games that are developmentally appropriate, creating contextualized challenges which compel students to solve tactical problems through informed decision-making, adaptive skill application, and strategic positioning (Kirk & MacPhail, 2002; Oslin et al., 1998).

The TGfU model is structured around six interrelated components that form a cyclical, non-linear process: the game form, which provides the foundational structure and rules of the modified game (Barba-Martí-n et al., 2020); game appreciation, fostering an understanding and respect for the game's unique tactical and strategic demands(Garris et al., 2002); tactical awareness, developing knowledge of principles such as support, width, depth, and penetration; making appropriate decisions, where players select optimal actions based on game reading and anticipation (Layton et al., 2023); skill execution, applying techniques in game-relevant contexts; and performance, evaluating overall effectiveness and refining through reflection (Griffin et al., 1997). This framework positions students as active problem-solvers engaged in guided discovery, supported by the teacher's use of tactical questioning (e.g., "Where is the space?" or "What options do you have?") and reflective debriefs, rather than as passive recipients of decontextualized technical drills (Harvey & Jarrett, 2013). Empirical applications of TGfU have shown its efficacy in enhancing game performance across various invasion games, including football, by promoting transfer of learning from practice to competition (Harvey et al., 2009).

TGfU is firmly grounded in constructivist learning principles, which assert that learners actively construct their own knowledge through meaningful experiences, social interaction, and personal reflection, rather than passively absorbing pre-packaged information transmitted by the teacher (Kirk & MacPhail, 2002; Light & Fawns, 2003). Drawing from theorists such as Jean Piaget's emphasis on cognitive assimilation and accommodation, and Lev Vygotsky's zone of proximal development, constructivism views learning as a dynamic process situated within authentic, contextualized environments. In physical education, this translates to designing game-based tasks that challenge students to experiment, hypothesize, test solutions, and refine strategies collaboratively (Mercan & Selçuk, 2024) . The teacher's role evolves from direct instructor to facilitator or "guide on the side," who scaffolds learning through probing questions, peer feedback mechanisms, and progressive game modifications that align with students' readiness levels.

This constructivist foundation aligns seamlessly with situated learning theory, which posits that knowledge is most effectively acquired and retained when it is embedded in communities of practice that reflect its authentic use (Kirk & MacPhail, 2002; Zhang et al., 2017). In TGfU, small-sided games serve as these situated contexts, where tactical understanding emerges not from rote repetition but from iterative cycles of action, observation, and adjustment amid game pressures. Such an approach has been shown to foster deeper conceptual understanding and long-term skill transfer, particularly beneficial in resource-constrained settings like Indonesian schools (Zaki et al., 2024) .

Self-Determination Theory, developed by Edward Deci and Richard Ryan, offers a robust framework for understanding and enhancing student motivation in physical education contexts (Deci & Ryan, 2000; Pelletier et al., 1995). SDT delineates a continuum of motivation ranging from amotivation (lack of intention to act), through extrinsic forms—external regulation (behavior for rewards/punishments), introjected regulation (to avoid guilt or gain approval), and identified regulation (valuing the behavior personally)—to intrinsic motivation (engagement for inherent satisfaction) (Petros et al., 2016). Central to SDT are three basic psychological needs: autonomy (feeling volitional in one's actions), competence (mastery and effectiveness), and relatedness (connection with others). Satisfaction of these needs nurtures autonomous motivation, leading to greater persistence, enjoyment, and optimal functioning.

Research indicates that GBL and TGfU approaches are particularly supportive of these needs in physical education. Game-

centered pedagogies promote autonomy by allowing player-driven decision-making within tactical dilemmas(Sierra-Díaz et al., 2019); enhance competence through attainable challenges in modified games that provide immediate feedback; and foster relatedness via cooperative small-group play and peer interactions (Gil-Arias et al., 2017). Consequently, students experience heightened intrinsic motivation, identified regulation, and reduced amotivation, contrasting sharply with traditional drill-based methods that often undermine these needs through excessive control and lack of relevance (Ryan & Deci, 2000). This motivational shift is crucial for addressing disengagement in settings like Kabupaten Dompu, where sustaining student interest amid resource limitations is paramount.

Empirical research comparing GBL/TGfU with traditional instruction has produced promising results across multiple outcome variables. Studies have demonstrated that TGfU can enhance tactical understanding and decision-making more effectively than technique-focused approaches (Barquero-Ruiz et al., 2023; Harvey et al., 2009; Práxedes et al., 2016). For instance, (Bergmann et al., 2021) found that U19 college football players in a TGfU program showed significantly greater improvements in game performance, particularly in decision-making and off-the-ball movement, compared to a control group receiving traditional instruction.

Regarding motivation, multiple studies have reported that GBL approaches promote higher levels of intrinsic motivation and enjoyment compared to traditional methods (Farias et al., 2015; Gil-Arias et al., 2017; Serra-Olivares et al., 2015). (Sierra-Díaz et al., 2019) demonstrated that students taught through a hybrid TGfU-Sport Education model reported significantly higher autonomy, competence, and enjoyment than those receiving direct instruction(Sierra-Díaz et al., 2019). Similarly, a Spanish study with 237 secondary students found that TGfU groups showed greater motivation and achievement in physical education than groups using technical-traditional approaches (Farias et al., 2015).

Recent systematic reviews have highlighted the positive effects of GBL on both cognitive and affective outcomes. A review by (Harvey et al., 2020) concluded that TGfU implementation in schools improved students' tactical knowledge, decision-making capacity, and motor skills across various sports contexts. However, these reviews also note considerable variability in implementation quality and measurement approaches (Mesquita et al., 2012; Tan et al., 2011), suggesting the need for more rigorous comparative studies with standardized assessment tools.

Despite growing evidence supporting GBL approaches, several important gaps remain in the literature. First, most TGfU research has been conducted in Western educational contexts, particularly in Europe, North America, and Australia (Tan et al., 2011), with limited empirical work in Southeast Asian or developing country settings where educational resources, class sizes, and cultural factors may differ substantially. Second, few studies have simultaneously examined both tactical understanding and motivational outcomes using validated, sport-specific instruments (Harvey & Jarrett, 2013). Third, there is limited research on GBL implementation in formal physical education settings (as opposed to elite youth sport programs) within secondary schools (Farias et al., 2015).

This study addresses these gaps by examining GBL effectiveness in an Indonesian secondary school context, using both the Game Performance Assessment Instrument (GPAI) to measure tactical understanding and the Sport Motivation Scale (SMS) to assess motivational profiles. Indonesia represents an important context for this research given its large population, growing emphasis on physical education reform, and limited empirical research on innovative pedagogical approaches in physical education (Rokhayati et al., 2020).

The primary objective of this study was to examine the effectiveness of a GBL approach, based on TGfU principles, in improving students' tactical understanding and learning motivation in secondary school football physical education classes in Kabupaten Dompu, Indonesia. Specific objectives were to: 1. Compare changes in tactical understanding (decision-making, skill execution, support) between students receiving GBL instruction and those receiving traditional skill-drill instruction; 2. Assess changes in motivational profiles (intrinsic motivation, extrinsic motivation forms, amotivation) between the two instructional groups; 3. Examine the magnitude of intervention effects using effect size calculations.

Based on the theoretical framework and empirical literature, we hypothesized that students taught using the GBL approach would demonstrate significantly greater improvements in tactical understanding and more autonomous forms of motivation compared to those taught using traditional methods.

MATERIALS AND METHODS

Participants

Participants were 84 secondary school students (52 males, 32 females; mean age = 14.6 ± 1.2 years, range = 13-16 years) enrolled in extracurricular football physical education classes at two public secondary schools in Kabupaten Dompu, Nusa Tenggara Barat, Indonesia. Students were selected based on the following inclusion criteria: (1) regular attendance in physical education classes, (2) no previous experience with GBL or TGfU approaches, (3) basic football proficiency (ability to pass, receive, and shoot), and (4) no physical limitations precluding participation. Parental consent and student assent were obtained prior to data collection. Due to administrative constraints, random assignment at the individual level was not feasible. Instead, one intact school was assigned to the experimental (GBL) group (n=42; 26 males, 16 females; mean age = 14.5 ± 1.1 years) and one to the control (traditional) group (n=42; 26 males, 16 females; mean age = 14.7 ± 1.3 years). Independent t-tests revealed no significant baseline differences between groups in age ($t = 0.82$, $p = 0.41$), prior football experience ($t = 0.54$, $p = 0.59$), or physical education grades ($t = 0.67$, $p = 0.51$).

Study Organization

This study employed a quasi-experimental design with a pretest-posttest control group structure. The independent variable was the instructional approach (GBL vs. traditional), while the dependent variables were tactical understanding and sport motivation.

Experimental Group (GBL/TGfU Approach). The experimental group received 8 weeks of football instruction (16 sessions, 2 sessions per week, 60 minutes per session) based on TGfU principles. Each lesson followed a consistent structure adapted from Mitchell et al. (2006) and Griffin et al. (1997): (1) Modified game introduction (10 minutes): Students engaged in a small-sided game

(4v4 or 5v5 on 30m × 20m pitch with small goals) designed to highlight a specific tactical problem (e.g., creating space, maintaining possession, transitioning attack to defense); (2) Tactical discussion and questioning (10 minutes): The instructor used guided questions to help students identify the tactical problem, discuss potential solutions, and connect tactics to necessary skills; (3) Game-based practice activities (25 minutes): Students engaged in modified games and practice activities designed to develop tactical awareness and associated skills; (4) Culminating game (15 minutes): Students applied learned tactics and skills in a more complex game situation with ongoing instructor feedback via questioning.

The GBL approach emphasized tactical problems in the following progression: Weeks 1-2 (maintaining possession: passing, receiving, support); Weeks 3-4 (penetrating/attacking: moving into space, creating passing lanes); Weeks 5-6 (defending and winning the ball: pressuring, marking, covering); Weeks 7-8 (transition play and combined tactics: quick counter-attacks, defensive organization). Questioning focused on 'what to do' (tactical decisions) before 'how to do it' (skill execution).

Control Group (Traditional Skill-Drill Approach). The control group received 8 weeks of traditional football instruction following a technique-first model commonly used in Indonesian physical education. Each 60-minute session consisted of: (1) Warm-up (10 minutes): General cardiovascular activities and dynamic stretching; (2) Skill demonstration and explanation (10 minutes): The instructor demonstrated and explained specific technical skills (e.g., passing technique, dribbling, shooting) with emphasis on proper form; (3) Isolated skill drills (30 minutes): Students practiced skills in controlled, non-game contexts (e.g., passing in pairs, dribbling through cones, shooting at goal); (4) Scrimmage game (10 minutes): Unstructured game play with minimal instructor intervention.

The traditional approach followed a linear progression from basic to advanced skills: Weeks 1-2 (passing and receiving), Weeks 3-4 (dribbling and ball control), Weeks 5-6 (shooting and finishing), Weeks 7-8 (heading and combined skills). Both groups had equivalent total practice time (960 minutes over 8 weeks) and were taught by qualified physical education teachers with similar experience levels (8-10 years) who received training on their respective instructional protocols.

Test and Measurement Procedures

Game Performance Assessment Instrument (GPAI):

Tactical understanding was assessed using the GPAI (Oslin et al., 1998), which evaluates game performance through observation of match play. The GPAI assesses both off-the-ball (tactical awareness) and on-the-ball (skill execution) behaviors across three components relevant to invasion games: (1) Decision-making: appropriateness of tactical choices during play; (2) Skill execution: efficiency of technical skill performance; (3) Support: off-the-ball movement to create passing options.

Students were video-recorded during standardized 4v4 small-sided games (two 8-minute halves, 30m × 20m pitch) at pretest and posttest. Three trained observers (inter-rater reliability ICC = 0.89-0.92) independently coded student behaviors using a binary scoring system (appropriate/inappropriate decision, efficient/inefficient execution, adequate/inadequate support). Performance indices were calculated as: Index = (appropriate or efficient behaviors) / (appropriate or efficient + inappropriate or inefficient behaviors) × 100%. The GPAI has demonstrated acceptable validity and reliability in previous football research (Barquero-Ruiz et al., 2023; Harvey et al., 2009).

Sport Motivation Scale (SMS):

Student motivation was assessed using the SMS (Pelletier et al., 1995) adapted for physical education contexts (Granero-Gallegos et al., 2014). The SMS measures seven motivational constructs based on Self-Determination Theory: three forms of intrinsic motivation (IM-to know, IM-to accomplish, IM-to experience stimulation), three forms of extrinsic motivation (identified regulation, introjected regulation, external regulation), and amotivation. The questionnaire comprises 28 items (4 per subscale) rated on a 7-point Likert scale (1 = does not correspond at all, 7 = corresponds exactly).

The SMS was administered in Indonesian (Bahasa Indonesia) using a validated translation. Students completed the questionnaire in classroom settings before and after the intervention. The Indonesian version demonstrated good internal consistency in this sample (Cronbach's α = 0.78-0.89 across subscales) and acceptable test-retest reliability over a 2-week period (ICC = 0.82-0.87).

Data Collection Procedures

Data collection occurred during three phases: (1) Pretest (Week 0): Students completed the SMS questionnaire and participated in GPAI assessment games one week before the intervention commenced; (2) Intervention (Weeks 1-8): Students participated in their assigned instructional programs; (3) Posttest (Week 9): Students completed the SMS and GPAI assessments one week following intervention completion using identical protocols to pretest. Research assistants blind to group assignment conducted all assessments. Video recordings for GPAI analysis were randomized and coded without identifier information. Data entry was performed independently by two researchers with discrepancies resolved through discussion.

Statistical Analysis.

Data were analyzed using SPSS version 26.0 (IBM Corp., Armonk, NY). Descriptive statistics (means, standard deviations) were calculated for all variables. Data distribution normality was assessed using Shapiro-Wilk tests and visual inspection of Q-Q plots. All variables met parametric assumptions.

Within-group changes from pretest to posttest were examined using paired-samples t-tests. Between-group differences in posttest scores were analyzed using one-way Analysis of Covariance (ANCOVA) with pretest scores as covariates to control for baseline differences. Effect sizes were calculated using Cohen's d (within-group: d = [M_post - M_pre] / SD_pooled) and partial eta squared (η^2) for ANCOVA results, with interpretations of small (d = 0.20, η^2 = 0.01), medium (d = 0.50, η^2 = 0.06), and large (d = 0.80, η^2 = 0.14) (Lachenbruch & Cohen, 1989). Statistical significance was set at α = 0.05 (two-tailed). Post-hoc power analysis confirmed adequate power (1-β > 0.85) for detecting medium-to-large effects.

Study Organization

The study was conducted during the 2024 academic year and received ethical approval from the STKIP Ypis Dompu (Protocol No. 045/EDU-KD/2024).

RESULTS

Participant Characteristics

Table 1 presents the demographic and baseline characteristics of participants in both groups. There were no significant differences between groups in age, gender distribution, prior football experience, or baseline academic performance in physical education (all $p > 0.05$), supporting the comparability of groups despite the quasi-experimental design.

Table 1. demographic and baseline characteristics of participants in both groups

Characteristic	GBL Group (n=42)	Control Group (n=42)
Age (years)	14.5 ± 1.1	14.7 ± 1.3
Gender (M/F)	26/16	26/16
Football experience (years)	3.2 ± 1.8	3.5 ± 1.9
PE grade (0-100)	78.4 ± 8.2	77.1 ± 7.9

Table 1. Demographic and baseline characteristics of participants. Values are mean ± SD. M = male; F = female; PE = physical education. No significant differences between groups (all $p > 0.05$).

Visual inspection of the Q–Q plot indicated that the data points were closely aligned with the diagonal reference line, suggesting that the distribution of the data approximated normality. No substantial deviations were observed at the tails, supporting the assumption of normal distribution.

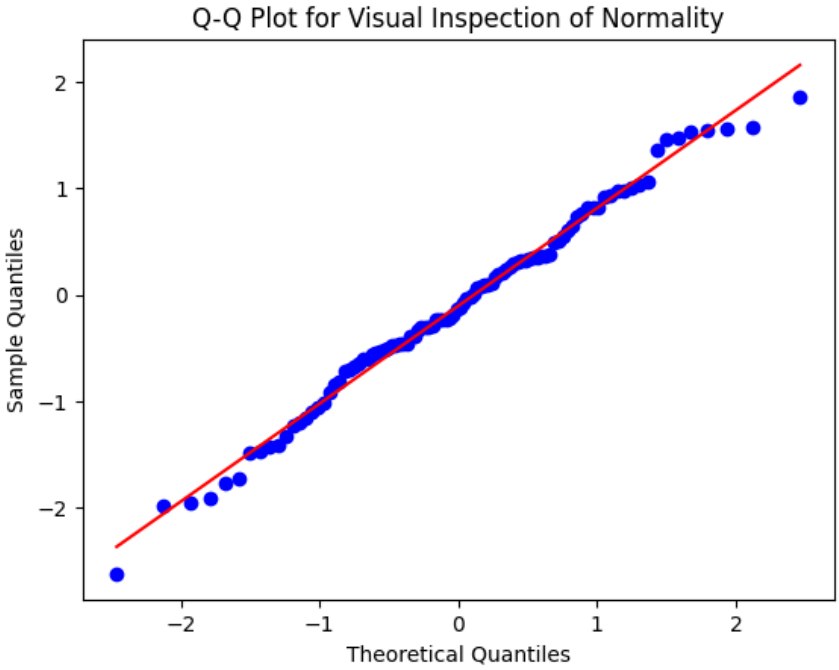

Figure 1. Q–Q plot of residuals for normality assessment

Tactical Understanding Outcomes

Table 2 presents descriptive statistics and within-group comparisons for GPAI components. The GBL group demonstrated significant improvements from pretest to posttest across all three tactical understanding components: decision-making (42.3% increase), skill execution (31.8% increase), and support (38.5% increase), all with large effect sizes ($d = 1.38$-1.62). The control group showed smaller but statistically significant improvements in decision-making (15.2%, $d = 0.48$) and skill execution (18.4%, $d = 0.58$), but minimal change in support (12.7%, $d = 0.41$).

Table 2. Descriptive statistics and within-group comparisons for GPAI components

Variable	Pretest	Posttest	t-value	p-value	d
GBL Group					
Decision-making (%)	46.8 ± 9.2	66.6 ± 8.5	13.24	<0.001***	1.62
Skill execution (%)	52.3 ± 10.1	68.9 ± 9.3	10.87	<0.001***	1.42
Support (%)	41.2 ± 11.3	57.1 ± 10.2	9.62	<0.001***	1.38
Control Group					
Decision-making (%)	48.1 ± 9.8	55.4 ± 10.2	4.31	<0.001***	0.48
Skill execution (%)	53.7 ± 11.2	63.6 ± 10.8	5.42	<0.001***	0.58
Support (%)	42.6 ± 12.1	48.0 ± 11.8	3.18	0.003**	0.41

Table 2. Descriptive statistics and within-group comparisons for tactical understanding (GPAI components). Values are mean ± SD. GBL = Game-Based Learning. Paired t-tests (df = 41). **p < 0.01, ***p < 0.001. Effect size interpretation: small (d ≥ 0.20), medium (d ≥ 0.50), large (d ≥ 0.80).

ANCOVA Results

Table 3. ANCOVA Results for GPAI Components Controlling for Pretest Scores

GPAI Component	Group Comparison	F-value	p-value	Partial η²	Effect Size (Cohen)
Decision-making	GBL vs Control	58.72	< 0.001	0.42	Large
Skill execution	GBL vs Control	42.18	< 0.001	0.34	Large
Support	GBL vs Control	36.94	< 0.001	0.31	Large

Note. ANCOVA = Analysis of Covariance; GPAI = Game Performance Assessment Instrument; GBL = Game-Based Learning. Pretest scores were used as covariates. Effect size interpretation followed Cohen's criteria (partial η² ≥ 0.14 = large effect).

Table 3 revealed significant between-group differences in posttest scores for all GPAI components after controlling for pretest performance. The GBL group achieved significantly higher posttest scores than the control group in decision-making ($F = 58.72$, $p < 0.001$, partial $\eta^2 = 0.42$), skill execution ($F = 42.18$, $p < 0.001$, partial $\eta^2 = 0.34$), and support ($F = 36.94$, $p < 0.001$, partial $\eta^2 = 0.31$), all representing large effect sizes according to Cohen's criteria (Lachenbruch & Cohen, 1989).

Motivation Outcomes

Table 4. Changes in Sport Motivation Scale Subscales Between GBL and Control Groups

Motivation Subscale	GBL Group (Change)	Effect Size (d)	Interpretation	Control Group (Change)	Effect Size (d)	Interpretation
Intrinsic Motivation – To Know	Increase	1.24	Large	Slight decrease	–	Trivial
Intrinsic Motivation – To Accomplish	Increase	1.10	Large	Slight decrease	–	Trivial
Intrinsic Motivation – To Experience Stimulation	Increase	0.89	Large	Slight decrease	–	Trivial
Identified Regulation	Increase	0.97	Large	Minimal change	–	Trivial
External Regulation	No change	~0.00	None	Increase	0.32	Small
Amotivation	Decrease	-1.02	Large	Minimal change	–	Trivial

Note. Effect sizes were calculated using Cohen's *d* (0.2 = small, 0.5 = medium, 0.8 = large). Positive values indicate increases from pretest to posttest, whereas negative values indicate decreases. GBL = Game-Based Learning.

Table 4 presents changes in Sport Motivation Scale subscales. The GBL group demonstrated significant increases in all three intrinsic motivation subscales (IM-to know, IM-to accomplish, IM-to experience stimulation) and in identified regulation, with effect sizes ranging from d = 0.89 to d = 1.24. External regulation remained unchanged, while amotivation significantly decreased (d = -1.02). In contrast, the control group showed minimal changes across most motivation subscales, with only small improvements in external regulation (d = 0.32) and slight decreases in intrinsic motivation forms.

Between-group comparisons using ANCOVA (Table 3) indicated that the GBL group reported significantly higher posttest scores in composite intrinsic motivation ($F = 52.36$, $p < 0.001$, partial $\eta^2 = 0.39$) and identified regulation ($F = 32.45$, $p < 0.001$, partial $\eta^2 = 0.28$), and significantly lower amotivation ($F = 45.82$, $p < 0.001$, partial $\eta^2 = 0.36$) compared to the control group after controlling for baseline scores.

DISCUSSION

This study examined the effectiveness of a Game-Based Learning approach, grounded in Teaching Games for Understanding principles, for enhancing tactical understanding and motivation in secondary school football physical education. The results provide strong empirical support for the hypothesis that GBL yields superior outcomes compared to traditional skill-drill instruction across both cognitive (tactical understanding) and affective (motivation) domains.

Enhanced Tactical Understanding Through GBL

The GBL group demonstrated substantial improvements in all three GPAI components, with particularly notable gains in decision-making (42.3% increase) and support (38.5% increase). These findings align with theoretical predictions from the TGfU model (Alzate et al., 2024; Kirk & MacPhail, 2002) and extend previous empirical research demonstrating GBL's effectiveness for developing tactical competence (Barquero-Ruiz et al., 2023; Harvey et al., 2009; Práxedes et al., 2016). The large effect sizes observed in this study (d = 1.38-1.62) exceed those reported in many previous TGfU interventions (Harvey & Jarrett, 2013; Tan et al., 2011), suggesting that the contextual adaptations made for the Indonesian setting may have enhanced intervention potency.

The improvement in decision-making is particularly noteworthy, as this represents the core cognitive element of tactical understanding—the ability to recognize tactical problems and select appropriate solutions (Memmert & Harvey, 2008; Oslin et al., 1998). The GBL approach's emphasis on tactical questioning and problem-solving within modified game contexts appears to have effectively developed students' capacity to 'read the game' and make appropriate choices about what to do and when to do it (Griffin et al., 1997). This contrasts sharply with traditional approaches that prioritize technical execution in isolated contexts, often resulting in students who possess skills but lack the decision-making ability to apply them effectively in game situations(Fernando et al., 2024).

The significant improvement in support—an off-the-ball tactical behavior—is equally important, as supporting movement is essential for team success but often neglected in skill-focused instruction (Estero et al., 2020). The GBL approach's use of small-sided games and explicit attention to tactical principles (e.g., creating passing options, spatial awareness) appears to have heightened students' understanding of their role when not in possession of the ball, a critical but often underdeveloped aspect of tactical competence (Harvey et al., 2010).

Interestingly, the control group also showed improvements in some GPAI components, particularly skill execution (d = 0.58). This finding is consistent with the traditional approach's technical focus and suggests that drill-based methods can effectively develop motor skills (Rink et al., 1996). However, these technical gains were not accompanied by equivalent improvements in decision-making or support, highlighting the limitation of decontextualized skill practice for developing holistic game competence (Kirk, 2005).

Motivation Enhancement and Psychological Need Satisfaction

The GBL group's substantial increases in intrinsic motivation and identified regulation, coupled with decreased amotivation, provide strong support for Self-Determination Theory predictions (Deci & Ryan, 2000; Ryan & Deci, 2000) and align with previous research on GBL and motivation (Farias et al., 2015; Gil-Arias et al., 2017). These motivational changes likely reflect the GBL approach's capacity to satisfy the three basic psychological needs identified in SDT: autonomy (through student-centered learning and decision-making), competence (through appropriately challenging modified games and positive feedback), and relatedness (through cooperative game structures and peer interaction) (Ntoumanis, 2001; Ryan & Deci, 2000).

The increase in intrinsic motivation (engaging in football for the inherent enjoyment and satisfaction) and identified regulation (recognizing the personal value and importance of participation) represents a shift toward more autonomous, self-determined motivation (Pelletier et al., 1995). This is particularly important for long-term physical activity engagement, as autonomous motivation is consistently associated with persistence, effort, and well-being in physical education contexts (Ntoumanis, 2001; Standage et al., 2005). In contrast, the control group's slight increases in external regulation—engagement motivated by external rewards or pressures—suggests that traditional approaches may inadvertently promote less autonomous forms of motivation (Ryan & Deci, 2000).

The marked decrease in amotivation in the GBL group is particularly encouraging from a public health perspective. Amotivation—characterized by lack of intention and perceived incompetence—is associated with dropout from physical activity and is a significant concern in physical education (Ntoumanis et al., 2004). The GBL approach's success in reducing amotivation may reflect its inclusive nature, allowing students of varying skill levels to experience success and perceive progress through appropriately modified game challenges(Sotos-Martínez et al., 2025) .

Contextual Implications for Indonesian Physical Education

This study represents one of the first rigorous examinations of GBL effectiveness in an Indonesian secondary school context. The positive results suggest that GBL approaches are not only viable but potentially highly effective in resource-limited settings characteristic of many developing countries (Wardani et al., 2025). The modified games and small-sided formats used in GBL may be particularly well-suited to contexts with large class sizes and limited equipment, as they maximize active learning time and require fewer resources than traditional approaches (Kirk, 2005).

However, successful GBL implementation requires teachers to adopt a facilitative rather than directive role, using questioning to guide student learning rather than providing explicit technical instruction (Harvey et al., 2010; Light & Fawns, 2003). This represents a significant pedagogical shift from traditional Indonesian teaching practices , suggesting that comprehensive teacher professional development would be essential for successful large-scale GBL implementation. Future research should examine teacher perceptions, implementation fidelity, and barriers to adoption in Indonesian physical education contexts.

Limitations

Several limitations should be acknowledged. First, the quasi-experimental design with intact school groups precludes random assignment, potentially introducing selection bias despite comparable baseline characteristics. Second, the 8-week intervention period, while consistent with previous TGfU research (Gil-Arias et al., 2017; Harvey & Jarrett, 2013), does not allow examination of long-term retention or transfer effects. Third, the study was conducted in extracurricular football classes with relatively small class sizes (21 students per class), which may not fully represent the challenges of regular physical education classes with 30-40 students (Rokhayati et al., 2020). Fourth, the use of different teachers for the experimental and control groups, while necessary given the distinct pedagogical approaches, introduces potential teacher effects that cannot be fully disentangled from intervention effects. Fifth, the GPAI assessment, while validated and widely used (Harvey et al., 2009; Oslin et al., 1998) relies on observer coding and may be subject to rater bias despite acceptable inter-rater reliability. Finally, the study focused exclusively on football; generalization to other invasion games or sports requires empirical verification.

Future Directions

Future research should address these limitations through randomized controlled trials with individual-level randomization where feasible, longer intervention periods with delayed retention tests, and inclusion of larger, more representative samples from regular physical education classes. Additionally, research should examine: (1) moderating factors (e.g., student age, initial skill level, gender) that may influence GBL effectiveness; (2) implementation processes and teacher professional development needs for successful GBL adoption; (3) cost-effectiveness and scalability of GBL approaches in resource-constrained settings; (4) transfer of tactical understanding to other sports and physical activities; and (5) longitudinal effects on physical activity participation beyond school physical education.

CONCLUSION

This quasi-experimental study provides robust evidence that a Game-Based Learning approach grounded in Teaching Games for Understanding principles significantly enhances both tactical understanding and autonomous motivation in secondary school football physical education compared to traditional skill-drill instruction. The large effect sizes observed across tactical understanding components (decision-making, skill execution, support) and motivational constructs (intrinsic motivation, identified

regulation, amotivation) suggest that GBL represents a powerful pedagogical alternative to traditional approaches.

These findings have important implications for physical education curriculum design and teacher practice, particularly in Indonesian and similar developing country contexts. By positioning students as active problem-solvers within authentic game contexts, GBL addresses the dual challenges of developing tactical competence and fostering intrinsic motivation for lifelong physical activity participation. The approach appears particularly well-suited to resource-limited settings, as it relies primarily on pedagogical innovation rather than extensive equipment or facilities.

Implementation of GBL approaches in Indonesian physical education will require systematic teacher professional development to support the pedagogical shift from directive, technique-focused instruction to facilitative, inquiry-based teaching. However, the substantial cognitive and motivational benefits demonstrated in this study suggest that such investment would be worthwhile for improving physical education quality and promoting student engagement in physical activity.

Future research should examine the long-term effects of GBL on physical activity participation, explore implementation at scale within regular physical education curricula, and investigate adaptations needed for diverse sports and educational contexts. Nonetheless, this study contributes important evidence supporting the effectiveness of Game-Based Learning for enhancing both tactical understanding and motivation in school football physical education, with potential applications across team sports and physical education more broadly.

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CONFLICT OF INTEREST

The authors declare no conflicts of interest related to this study. No financial relationships with any organizations that might have an interest in the submitted work existed. No other relationships or activities that could appear to have influenced the submitted work are reported.

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