Jurnal Penelitian dan Pengkajian Ilmu Pendidikan: e-Saintika
https://journal-center.litpam.com/index.php/e-Saintika/index

November 2025 Vol. 9, No. 3
e-ISSN: 2615-6881
pp. 685-703

Integration of Teaching Games for Understanding in Physical Education Learning: Improving Students' Motor Competence through Volleyball Game Modification

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Received: July 2025; Revised: October 2025; Published: November 2025

Abstract

Motor competence is a crucial aspect of the development of elementary school-aged children. The Teaching Games for Understanding (TGfU) model is considered capable of improving motor skills through a contextual and participatory approach to play. However, empirical evidence in local contexts, particularly regarding the effectiveness of TGfU on locomotor and object control skills separately, as well as gender differences, remains limited. This study used a quantitative approach with a one-group pretest-posttest quasi-experimental design. A total of 54 fifth-grade students of SD Negeri 190 Pekanbaru participated in TGfU-based volleyball learning for 6 weeks (12 sessions). The Test of Gross Motor Development, Second Edition (TGMD-2) assessed locomotor and object control skills. Because the data were not normally distributed (Shapiro–Wilk $p < 0.05$), analysis was performed using the Wilcoxon test. Results showed that TGfU was associated with improvements in overall motor competence ($W = 3.5$; $z = -6.06$; $p < .001$; Median = 4.0, 95% CI [3.5, 4.5], Effect Size = .99), locomotor skills (V1: $W = 14$; $z = -5.47$; $p < .001$; Median = 3.0, 95% CI [2.5, 3.5], Effect Size = .97), and object control skills (V2: $W = 16$; $z = -5.80$; $p < .001$; Median = 2.5, 95% CI [2.0, 3.0], Effect Size = .97). Female students showed greater improvement in locomotor aspects than males. Further research, employing a randomized controlled design and long-term retention testing, is recommended to strengthen the generalizability of these findings.

Keywords: Teaching Games for Understanding; Volleyball Game; Motor Competence; Physical Education

How to Cite: Apriani, L., Bausad, A. A., Alpen, J., Amran, Z., & Setiawan, B. A. (2025). Integration of Teaching Games for Understanding in Physical Education Learning: Improving Students' Motor Competence through Volleyball Game Modification. *Jurnal Penelitian Dan Pengkajian Ilmu Pendidikan: E-Saintika*, *9*(3), 685-703. https://doi.org/10.36312/zckjpy50

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INTRODUCTION

Physical education is an integral part of the elementary school curriculum which plays an important role in developing students' physical, social, and cognitive abilities. Physical education activities are designed not solely to improve fitness, but also to stimulate basic motor skills that are essential for a child's development. Gross motor skills, such as running, jumping, throwing, and catching, have a major contribution to students' readiness to carry out academic and non-academic activities in a balanced manner (Yonda et al., 2024). Various learning approaches have been

developed to support this achievement, one of which is the Teaching Games for Understanding (TGFU) model, which is increasingly popular in physical education because it is able to integrate cognitive, affective, and psychomotor aspects through modified games (Purnomo et al., 2024).

Research consistently demonstrates that the TGfU model significantly enhances elementary students' coordination, balance, and fundamental motor skills by promoting active engagement through ability-appropriate modified games (Gouveia et al., 2022; Herwina, 2021; Prayoga & Kustiawan, 2020). Beyond physical development, TGfU fosters collaboration, communication, and mutual respect, thereby supporting character formation (Greve et al., 2022; Jundia et al., 2025). From a pedagogical standpoint, TGfU enables teachers to adopt reflective, process-oriented practices that integrate character values within play activities (Sumarno et al., 2022). International evidence further confirms its effectiveness in improving motivation, engagement, and motor competence across various sports contexts including volleyball, soccer, and adapted programs for students with special needs (Dimmick, 2022; Ortiz et al., 2023).

The TGfU model was designed to address the weaknesses of traditional sports learning approaches, which tend to emphasize repetition of techniques without considering the game context. Instead, TGfU emphasizes tactical understanding before technical mastery, so students learn to understand the reasons and situations for using a movement, not just how to perform it (Abdul Ghani et al., 2024; Cocca et al., 2020; Lee et al., 2024; Octavianus et al., 2025a). This model has been shown to increase student motivation, responsibility, and engagement (Gargallo-García et al., 2024; Ortiz-Jimenez et al., 2022; Pan et al., 2025). In practice, TGfU encourages exploration of game strategies in a fun and challenging environment, thus providing a more meaningful learning experience (Wibowo, 2024; Wibowo et al., 2021; Yudatama et al., 2024). When implemented through a modified volleyball game, TGfU provides opportunities for students to develop two key motor skill domains in the Test of Gross Motor Development (TGMD-2): locomotor and object control skills, in an authentic and enjoyable learning context.

In the context of basic education, the TGfU model has been recognized as an effective pedagogical approach that enhances physical literacy and critical thinking through game-based learning (Aryanti et al., 2022; López-Lemus et al., 2023). Its application in volleyball instruction not only improves students' technical skills, such as passing and serving, but also strengthens decision-making and tactical awareness during play (Pan et al., 2023; Wibowo et al., 2024), making TGfU a holistic, adaptive, and relevant approach for developing motor and cognitive competencies from an early age (González-Valero et al., 2024; Greve et al., 2022). However, in the Indonesian context, effective TGfU implementation in elementary schools remains constrained by limited facilities, insufficient instructional time, and varying teacher readiness, which reduce opportunities for students to engage in structured and meaningful game-based learning particularly in volleyball, a technically demanding yet widely taught sport. Therefore, adaptive learning designs are needed to preserve TGfU's pedagogical integrity while aligning it with local school conditions.

Although numerous international studies have demonstrated the effectiveness of TGfU, empirical studies in Indonesia are still limited, particularly regarding the extent to which this model produces differential effects on the two TGMD-2 skill

domains, locomotor (running, hopping, horizontal jumping) and object control (catching, throwing), and how these effects vary based on student gender. Previous local research has primarily highlighted improvements in general motor skills, without examining differences in specific skill domains or gender-based responses (Hasmara, 2022, Prayoga, & Kustiawan, 2020). Based on this, this study proposes three main hypotheses: (H1) TGfU-based volleyball learning is associated with significant improvements in overall motor competence; (H2) the magnitude of improvement differs between locomotor and object control skills; and (H3) female students show more pronounced improvements in locomotor skills than male students. These hypotheses extend TGfU theory by examining the interaction between the school learning context, differences in skill domains, and gender factors. Therefore, a more comprehensive empirical study focused on the application of TGFU in the local environment, such as at SD Negeri 190 Pekanbaru, is needed to find out the extent of its impact on students' motor skills.

This research presents a novelty in the context of the empirical application of the TGFU model in volleyball learning at the elementary school level, especially in the Indonesian education environment where there is still a lack of similar local studies. Although the effectiveness of TGFU has been widely proven in the international literature, this study specifically examined its impact on improving students' motor skills using a quantitative approach and one-group pretest-posttest design in grade V students of SD Negeri 190 Pekanbaru. The uniqueness of this study lies in the use of the standardized instrument Test of Gross Motor Development (TGMD), which provides strong validity in measuring changes in gross motor skills such as running, jumping, throwing, and catching.

This study aims to evaluate the influence of the TGFU learning model in volleyball learning on the motor skills of elementary school students. The research was carried out with a quantitative approach through a one-group pretest-posttest design in grade V students at SD 190 Pekanbaru. The TGFU model was chosen because it has been shown to be effective in developing students' physical, cognitive, and social aspects through a fun and meaningful approach to play (Syamsuar & Zen, 2021). In the context of volleyball, this approach allows students to learn through game situations that demand tactical thinking skills, team coordination, and adaptive movement responses in real time (Aryanti et al., 2022; Wibowo et al., 2024).

METHOD

Research Design

This study employed a quantitative approach with a quasi-experimental one-group pretest–posttest design, aiming to measure the effect of the Teaching Games for Understanding (TGfU) model on the improvement of elementary students' motor competence. The same group of participants was assessed both before and after the intervention to identify performance changes attributable to the implementation of TGfU. This design was selected because it allows researchers to observe within-subject improvements without manipulating independent variables across groups, thereby maintaining ecological validity in the natural school setting at SD Negeri 190 Pekanbaru.

The intervention spanned six weeks, comprising 12 sessions (two sessions per week), each lasting 35 minutes. The learning process was integrated into the students' regular physical education schedule to ensure continuity and minimize external influences. To clarify the intervention timeline, Figure 1 presents the experimental flow, showing the pretest, 12-session TGfU intervention, and posttest stages, including the learning dose and sequence of sessions.

Learning Procedure and Instrument

The learning procedures in this study were designed based on the six-phase TGfU model: Gameplay, Game Appreciation, Tactical Awareness, Decision-Making, Skill Execution, and Performance. Each phase was structured to gradually develop students' locomotor and object control skills through contextual volleyball activities. The intervention began with simplified gameplay to build engagement, then introduced basic rules and tactical awareness through guided instruction. Decision-making activities were emphasized through teacher-led direction and rapid student reactions, ensuring learners could connect tactical choices with technical execution. Technical drills followed to reinforce proficiency, and finally, a complete game setting was used to integrate all acquired skills. The phases, activities, and success indicators are summarized in Table 1.

Table 1. Integration of TGFU in Volleyball Learning

Phase	Main Objective	Core Activity	Example Task	Engine Focus	Success Indicator	Duration & Session
Game	Establish engagement & context	Play a small-sided volleyball game (3v3 on half court)	"King of the Court": each team keeps the rally alive for 2 hits before rotating positions	Locomotor: free movement around court Object control: basic tosses & catches	High enthusiasm & clear grasp of "keep the ball in play"	Session 1–2 (2 x 35 minutes)
Game Appreciation	Understand basic rules & court layout	Explore service zones, boundaries, rally flow	Teacher demo of underhand serve Students mark service line and observe landing areas	Locomotor: walking/jogging to follow demo Object control: catching/tossing into zones	Students accurately describe service rules and court lines	Session 3–4 (2x35 minutes)
Tactical Awareness	Recognize simple tactical decisions	Discuss when to use soft vs. firm tosses and ideal positioning for serve/receive	Teacher-led prompts (e.g., "serve deep," "opponent close to net") or quick reaction responses from students	Locomotor: moving to optimal ready position Object control: adjusting toss strength	Students choose appropriate serve type for each scenario	Sessions 5–6 (2x35 minutes)

Phase	Main Objective	Core Activity	Example Task	Engine Focus	Success Indicator	Duration & Session
Decision Making	Practice "what" and "how" of decision-making	Simulate situational drills: select bump vs. set based on context	"Quick Reaction" drill moves to designated corner, and executes the correct pass	Locomotor: quick shuffle steps, side-steps Object control: accurate pass direction	≥ 80% of passes chosen and directed correctly	Sessions 7–8 (2x35 minutes)
Skill Execution	Build technical proficiency & consistency	Structured drills for footwork and passing techniques	1. Zig-zag cone run 2. Partner underhand passing (10 reps) 3. Wall-set practice (15 reps)	Locomotive: sprint, controlled jumps Object control: precise underhand/overhand passes	Average TGMD score improves by ≥ 3 points from pre-test	Sessions 9–10 (2x35 minutes)
Performance	Integrate skills into full game play	4v4 full-court volleyball with simplified scoring	Mini tournament: best of two sets to 7 points	Locomotor & object control: combined application in rallies	Improved rally length, more consistent passing and serving	Sessions 11–12 (2x35 minutes)

Each phase of the TGfU intervention was deliberately designed to scaffold motor competence development. The Game phase provided initial engagement, activating locomotor patterns through free movement while fostering enjoyment and motivation. In the Game Appreciation phase, students built a foundational understanding of court layout and rules, linking motor actions (serving, positioning) with contextual awareness. The Tactical Awareness phase emphasized situational understanding through guided prompts and quick reactions, which trained adaptive movement and object control under variable conditions. Decision-making required students to connect tactical choices with motor execution, strengthening the integration of cognitive and physical responses. The Skill Execution phase reinforced technical proficiency, ensuring consistency and accuracy in locomotor and object control skills, as measured by TGMD indicators. Finally, the Performance phase consolidated learning by integrating tactical, cognitive, and motor elements in a competitive but simplified game environment, ensuring transferability to authentic play.

The instrument used in this study was the Test of Gross Motor Development, Second Edition (TGMD-2), developed by Ulrich (2020), which has been widely validated to assess fundamental motor skills in children. In Indonesia, the TGMD-2 has been tested for validity and reliability by (Ismaryati et al., 2023), This study found the test to be valid, as the average Keyser-Meyer-Olkin (KMO) score was above 0.60, namely 0.837. TGMD -2 evaluates two major domains: locomotor skills (e.g., running, galloping, leaping) and object control/object control skills (e.g., throwing, catching, striking). Each skill consists of 3 to 5 performance criteria, scored on a binary scale (1 = correct execution; 0 = incorrect), with each skill performed twice. Scores are aggregated into raw scores for each subdomain.

To ensure the validity and reliability of measurements, two physical education teachers were trained as raters prior to data collection. The training included detailed instruction on the TGMD-2 rubric, practice scoring using video examples, discussion to resolve ambiguities, and calibration exercises. During the pretest and posttest phases, all student performances were recorded on video and independently scored by the two trained raters. The final score for each student was determined by averaging the two raters' assessments. Periodic intra-rater and inter-rater checks were conducted using 10% of the video samples to ensure consistency across and within raters. All assessments followed the standard TGMD-2 protocol and used the original scoring rubric without modification.

The intervention was carried out over six weeks**,** consisting of 12 sessions (2 sessions per week), each lasting 2x35 minutes, integrated into the school's physical education schedule. Fidelity of implementation was monitored through structured observation forms to ensure adherence to the TGfU model across all sessions. Prior to implementation, teachers received a one-day workshop on TGfU principles, instructional strategies, and session execution to maintain consistency and treatment integrity throughout the study.

Study Participant

A total of 54 fifth-grade students were assessed for eligibility, and all met the inclusion criteria. None were excluded, as all participants satisfied health, attendance, and consent requirements. The final sample consisted of 29 male and 25 female students, all of whom completed the TGfU intervention comprising 12 sessions over six weeks. Pretest and posttest data were successfully collected from all participants, with no attrition or missing data. Before inclusion, students were screened to ensure they had no prior structured volleyball experience, confirming comparable baseline conditions across the sample.

Statistical Analysis

The statistical analysis in this study began with a test of the normality of the data using two methods, namely Kolmogorov-Smirnov and Shapiro-Wilk. This test aims to find out whether the pretest and posttest results are distributed normally. If the significance value of the two tests is greater than 0.05, then the data is considered normally distributed and the analysis is continued with a paired sample t-test. The t-test was used to measure the significance of the mean difference between the score before and after treatment. However, if the results of the normality test show that the data is not normally distributed (significance value < 0.05), then the Wilcoxon signed-rank non-parametric test is used as an alternative. This test was chosen because it does not require normal data distribution and is able to identify significant differences between two paired data groups. All analyses were performed with the help of statistical software with a significance level set at $\alpha = 0.05$.

RESULTS AND DISCUSSION

Improvement in Motor Competence

TGFU learning model, integrated into Physical Education learning materials for volleyball, has led to a comprehensive and statistically significant increase in students' motor competence. This improvement is evident in both overall scores and in locomotor and object control indicators, as measured by the 2nd edition of the Gross

Motor Development Test (TGMD-2). The comparison of total Motor Competence scores after 6 weeks of intervention demonstrates this positive impact.

Table 2. Data Normality Test Result

	PreTest		PostTest		PreTest	PostTest
Motor Competence	**Boy**	**Girl**	**Boy**	**Girl**	**Overall Score**	**Overall Score**
Valid	29	25	29	25	54	54
Missing	0	0	0	0	0	0
Median	12.00	10.00	15.00	13.00	10.00	14.00
Mean	11.28	9.720	14.45	13.32	10.56	13.93
Std. Deviation	2.852	2.132	1.723	1.701	2.640	1.789
Variance	8.135	4.543	2.970	2.893	6.969	3.202
Shapiro-Wilk	0.945	0.923	0.923	0.895	0.943	0.925
P-value of Shapiro-Wilk	.133	.062	.036	.014	.013	.002
Range	10.00	8.000	6.000	5.000	10.00	6.000
Minimum	7.000	7.000	11.00	11.00	7.000	11.00
Maximum	17.00	15.00	17.00	16.00	17.00	17.00
Sum	327.0	243.0	419.0	333.0	570.0	752.0

The normality test results indicate that most of the pretest and posttest data are not normally distributed. This is evident from the Shapiro-Wilk significance value, which is less than 0.05, for example, in the overall pretest score ($p = 0.013$) and posttest ($p = 0.002$). Similar conditions also appear in most motor skill indicators, both in the locomotor and object control aspects. Thus, the assumption of normality is unmet, making parametric tests inappropriate. Therefore, the analysis continued with a non-parametric Wilcoxon signed rank test to compare the differences in pretest and posttest scores.

Table 3. Wilcoxon Signed Rank Test Result

					Correlation		95% CI for Rank-Biserial Correlation	
PreTest	**PostTest**	**W**	**z**	**p**	**Rank-Biserial**	**SE Rank-Biserial**	**Lower**	**Upper**
MC	MC	3.5	-6.06	< .001	-0.994	0.163	-0.997	-0.989
Boy	Boy	0	-4.37	< .001	-1	0.225	-1	-1
Girls	Girl	2.5	-4.21	< .001	-0.983	0.229	-0.993	-0.959
V1	V1	14	-5.47	< .001	-0.969	0.175	-0.984	-0.939
V1 B	V1 B	10	-3.55	< .001	-0.905	0.25	-0.964	-0.761
V1 G	V1 G	0	-4.02	< .001	-1	0.244	-1	-1
V1.1	V1.1	8.5	-3.22	< .001	-0.889	0.269	-0.961	-0.704
V1.1 B	V1.1 B	0	-1.83	0.072	-1	0.499	-1	-1
V1.1 G	V1.1 G	6.5	-2.73	0.003	-0.857	0.305	-0.956	-0.582
V1.2	V1.2	80.5	-3.28	< .001	-0.675	0.203	-0.841	-0.395
V1.2 B	V1.2 B	13	-3.16	0.001	-0.848	0.262	-0.944	-0.618
V1.2 G	V1.2 G	27.5	-1.26	0.197	-0.396	0.305	-0.776	0.195
V1.3	V1.3	23	-4.87	< .001	-0.931	0.189	-0.967	-0.859
V1.3 B	V1.3 B	10	-2.48	0.011	-0.78	0.305	-0.931	-0.405

					Correlation		95% CI for Rank-Biserial Correlation	
PreTest	PostTest	W	z	p	Rank-Biserial	SE Rank-Biserial	Lower	Upper
V1.3 G	V1.3 G	0	-4.2	< .001	-1	0.234	-1	-1
V2	V2	16	-5.8	< .001	-0.972	0.166	-0.985	-0.946
V2 B	V2 B	0	-4.37	< .001	-1	0.225	-1	-1
V2 G	V2 G	8	-3.74	< .001	-0.931	0.244	-0.973	-0.826
V2.1	V2.1	27	-4.81	< .001	-0.919	0.189	-0.961	-0.836
V2.1 B	V2.1 B	6.5	-3.56	< .001	-0.932	0.256	-0.975	-0.82
V2.1 G	V2.1 G	7.5	-3.27	< .001	-0.902	0.269	-0.966	-0.736
V2.2	V2.2	32	-5.33	< .001	-0.932	0.173	-0.965	-0.87
V2.2 B	V2.2 B	9	-4.13	< .001	-0.945	0.225	-0.977	-0.869
V2.2 G	V2.2 G	7.5	-3.4	< .001	-0.912	0.262	-0.968	-0.768

Note. Wilcoxon signed-rank test, OS (Overall Score Motor Compotence), V1 (Locomotor Skills), V1.1 (Locomotor Skills: Run), V1.2 (Locomotor Skills: Hop), V1.3 (Locomotor Skills: Horizontal Jump), V2 (Object Control Skills), V2.1 (Object Control Skills: Catch), V2.2 (Object Control Skills: Throw), B (Boy), G (Girl)

The Wilcoxon signed-rank test results (Table 3) provide a comprehensive statistical assessment of students' motor competence improvements before and after the intervention following implementing the Teaching Games for Understanding (TGfU) model. The analysis revealed statistically significant improvements in almost all measured variables. The overall motor competence (MC) score showed a highly significant improvement, with a Wilcoxon test statistic (W) of 3.5, $z = -6.06$, and $p < 0.001$, indicating a huge effect (Rank-Biserial Correlation = -0.994, 95% CI [-0.997, -0.989]). This strong negative correlation reflects a significant positive shift in post-test performance. When disaggregated by gender, both male and female students showed significant improvements, with male students achieving a perfect rank-biserial correlation (-1.000) and female students showing a near-perfect improvement (-0.983), both with $p < 0.001$, indicating that TGfU had a substantial impact on improving motor competence across genders.

Similarly, significant improvements were found in locomotor skills (V1: $W = 14$, $z = -5.47$, $p < 0.001$, $r = -0.969$), with high effect sizes in running, rope jumping, and horizontal jumping, although the jumping component in female students (V1,1 G) showed a slightly lower effect ($r = -0.857$, $p = 0.003$). In object control skills (V2), including catching (V2.1) and throwing (V2.2), the results were also significant (e.g., V2: $z = -5.80$, $p < 0.001$, $r = -0.972$), indicating the model's impact in improving object control abilities. Although some gender-specific subgroups, such as V1.1 B and V1.2 G, did not reach statistical significance ($p = 0.072$ and $p = 0.197$, respectively), the majority showed strong and consistent improvements with rank-biserial correlations approaching -1.000 and narrow confidence intervals. Overall, these results confirm the substantial impact of the TGfU model in improving primary school students' motor competence through meaningful, context-based play, with effect sizes ranging from large to very large, strengthening its pedagogical validity in the context of physical education.

The raincloud plot results show that almost all individual scores shifted from pretest to posttest toward higher scores in the TGfU intervention. The boxplot confirms a higher posttest median with a more even distribution, and the distribution

curve shifts to the right, indicating overall motor skill improvement. The descriptive plot displays a significant increase in the mean from 11 (pretest) to 14 (posttest), indicating a statistically significant difference and the impact of the TGfU model in improving students' motor skills. These findings are consistent with previous research reporting TGfU improves playing ability and motor skills, including in volleyball (Moa et al., 2024; Wibowo et al., 2024). Through contextualized play experiences, TGfU promotes mastery of techniques (passing, serving) and understanding of game strategy (Aryanti et al., 2022). Engagement in modified games also strengthens decision-making, motor adaptation, and team coordination (Ortiz et al., 2023; Pan et al., 2023). Thus, TGfU is worthy of being recommended as a PJOK learning model that emphasizes tactics and strategies before basic techniques (Aryanti et al., 2022; Octavianus et al., 2025b).

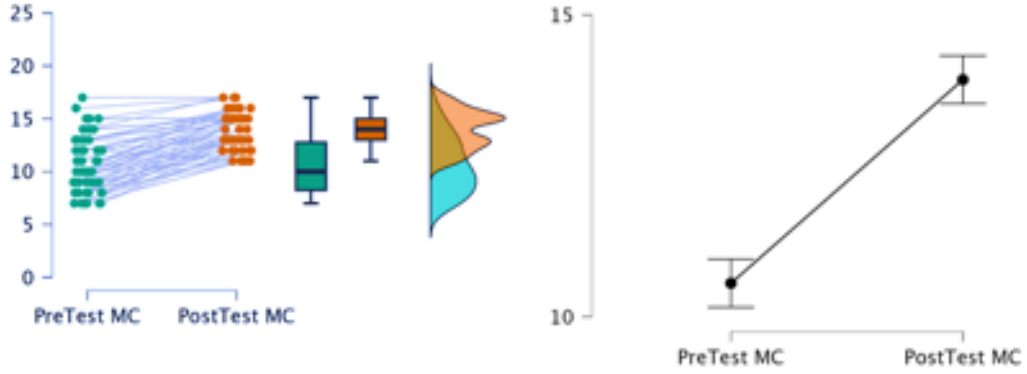

Figure 1. Comparative Analisys of Overall Score

Locomotor Skills

The analysis focuses on the locomotor skills indicators in TGMD-2, which include run, hop, and horizontal jump, to examine how far the six-week TGfU intervention changed the quality of motor compotence of fifth-grade students. In summary, the locomotor domain showed a statistically significant increase at both the construct and subconstruct levels ($p < .001$) and a tendency for relatively greater increases in female students.

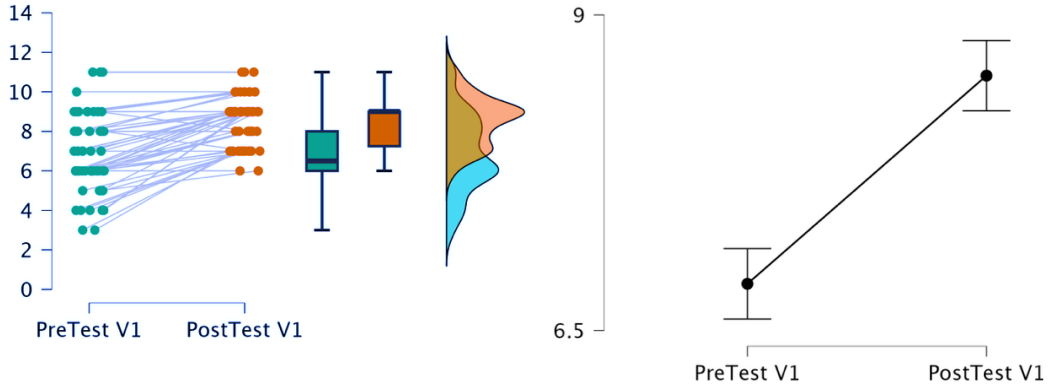

Figure 3. Comparative Analisys of Locomotor Skills (V1) Score Result

The spaghetti and box/violin graphs show that most individual lines increased, indicating that most participants experienced improvement in their scores, while only a few stagnated or slightly decreased. The distribution of scores shifted to the right,

from a range of ±5–8 at pre-test to predominantly ±8–10 at post-test, with some participants approaching the maximum score, suggesting a potential mild "ceiling" effect. The box plot's median, quartiles, and lower bound shifted upward, indicating a decrease in the proportion of low-scoring participants. The panel averages (mean ± interval) confirmed these findings with a mean increase of approximately 2 points (±7 to ±9) and a relatively narrow inter-individual spread, indicating reasonably accurate estimates. These findings align with the literature documenting the effectiveness of the TGfU approach in improving motor skills in elementary school-aged students through contextualized and enjoyable play activities (Guijarro et al., 2022; Moon et al., 2024; Ortiz et al., 2023; Pan et al., 2023). The study's results showed substantial and widespread improvements in locomotor skills, especially in running and horizontal jumping (Table 3).

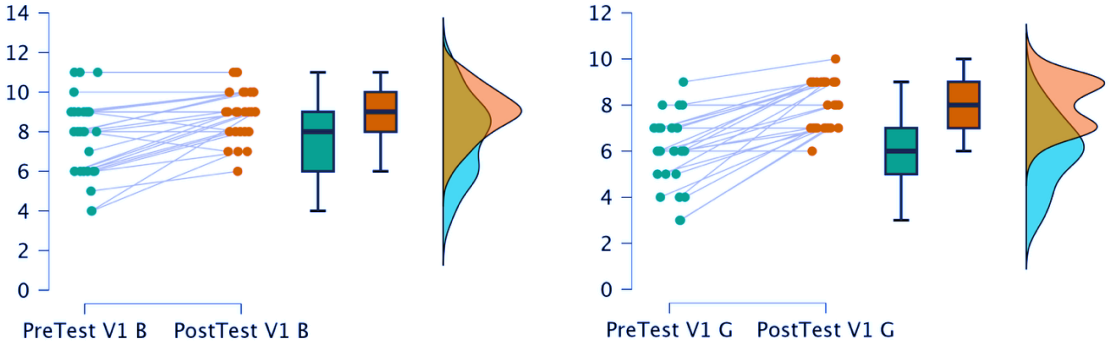

Figure 4. Comparative Analisys of Locomotor Skills (V1) Score by Gender

The study results showed that the TGfU model was able to improve locomotor skills in both male and female students, albeit with different patterns of improvement. The comparison graph shows that both groups experienced significant improvement in scores from the pre-test to the post-test, marked by a shift in individual scores toward higher values. In male students, the improvement appeared consistent with a more homogeneous distribution, particularly in the hop and horizontal jump aspects, which reflect explosive strength and dynamic balance. In contrast, female students showed a larger median jump in scores, particularly in the running aspect, indicating more significant improvements in agility and movement coordination. This finding aligns with previous studies (Fitrianto, 2023; Mazzardo et al., 2022; Y. A. Wibowo et al., 2024) that found that TGfU improves basic motor skills through realistic play situations, and supports the findings of (Chai et al., 2023) and (Drenowatz et al., 2021), who emphasized the role of context-based play in strengthening students' motor competence, self-confidence, and physical readiness for ongoing sports activities.

Object control Skills

This analysis examined how a six-week TGfU intervention impacted the motor competence of fifth-grade students, particularly focusing on object control skill (V2) indicators measured using the TGMD-2, such as catching and throwing. The results revealed statistically significant improvements in the object control domain at both the construct and subconstruct levels ($p < 0.001$), indicating a consistent trend of improvement across the two object control components, throwing and catching (Table 3).

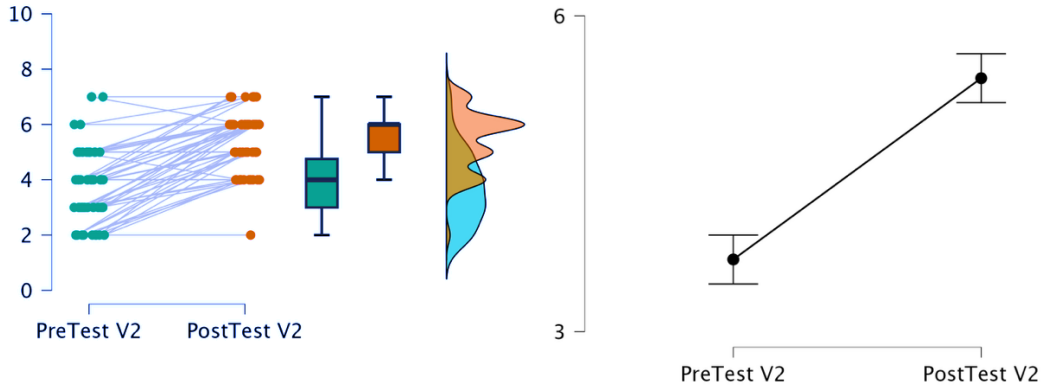

Figure 5. Comparative Analisys of Manipulatif Skills (V2) Score Result

The individual boxplot graphs illustrate that almost all students experienced increased scores, with the posttest distribution shifting toward higher scores and a more stable median. The mean graph with error bars also confirms an apparent increase, from approximately 3 in the pretest to nearly 6 in the posttest, with confidence intervals that do not overlap, indicating a statistically significant difference. This improvement reflects the success of TGfU in developing object control skills such as throwing and catching, acquired through playing experiences in real-world contexts. This finding aligns with the research findings of Wibowo, (2024), which demonstrated the effectiveness of TGfU in improving elementary school students' volleyball skills, and is supported by (Ritonga et al., 2024a), who emphasized that game-based learning can optimize basic object control skills through strategy adaptation and teamwork.

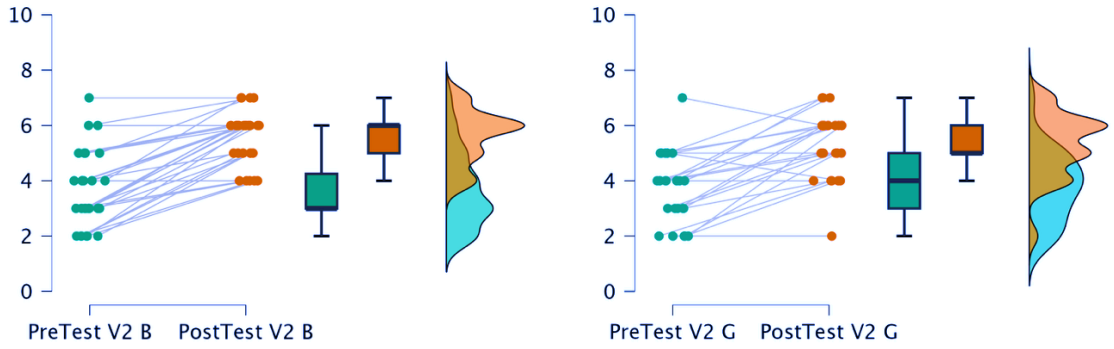

Figure 4. Comparative Analisys of Object Control Skills (V2) Score by Gender

The results showed that the object control skills of both male and female students improved after the implementation of the TGfU model, but with different patterns of development. Male students showed a greater improvement in catching skills than female students. Still, female students' final performance remained slightly better, indicating that TGfU helped males catch up while maintaining females' advantage in this aspect. Meanwhile, in throwing skills, males made greater gains than females, thus demonstrating that TGfU could facilitate the development of their strength and motor coordination more optimally. These findings reinforce the view that TGfU not only improves object control skills in general but also provides space for gender differences to develop according to their respective dominant potentials. These results are in line with (Santoso et al., 2024), who emphasized the effectiveness of TGfU in

training adaptive responses through a game context, and are supported by (Chai et al., 2023) and (Drenowatz, 2021) who emphasized that increasing object control motor competence plays a vital role in building students' self-confidence, active involvement, and readiness in long-term sports activities.

The empirical findings in this study indicate that applying the TGfU model in volleyball learning resulted in substantial improvements in students' motor competence, both in the locomotor and object control domains. This improvement confirms that TGfU is not simply a pedagogical alternative, but a rational-instructional approach based on constructivist learning principles, in which children actively construct motor knowledge through authentic and contextualized play experiences. TGfU is an inclusive, student-centered pedagogy emphasizing play and inquiry to build contextual understanding in physical education (Victoria, 2025).

Furthermore, the observed gender differences, with female students showing relatively greater improvements in locomotor competence, highlight the inclusive capacity of TGfU to provide equitable learning benefits, consistent with evidence that play-centered cooperative pedagogy increases confidence and participation, particularly for female students. Further support comes from research (Ritonga et al., 2024b) and (Octavianus et al., 2025b) which suggests that the TGfU model is effective in developing the gross motor skills of elementary school students. In the study, a contextual and fun approach to play was able to improve locomotor abilities such as running, jumping, and balance, as well as object control such as throwing and catching.

At the elementary level, the TGfU approach has advanced motor skills through a playful context (Gustian et al., 2024). TGfU also improves basic object control movements compared to other methods (Sandy, 2023). Similar findings were also revealed by (Chai et al., 2023a) and (Drenowatz et al., 2021), which states that game-based learning has a positive impact on students' social and cognitive development, including critical thinking skills and emotion regulation. Interestingly, the findings of this study also show a difference in the level of improvement between locomotor and object control skills. Higher score increases occurred in the locomotor aspect compared to object control, a tendency that was also documented by (Ha et al., 2024). This indicates the need for more attention to learning design that explicitly targets the development of object control skills so as not to lag the development of students' locomotor skills. In accordance with the findings that a safe learning environment and teacher learning competence influence motivation and participation (Li & Singh, 2022; Szucs et al., 2021).

In addition, the aspect of gender differences also emerged as an important variable. Female students show a comparatively greater improvement in locomotor skills than males. These findings support the study (Uria-Valle & Gil-Arias, 2022)) which states that an inclusive learning environment such as TGfU provides a safe space for female students to participate actively and confidently. Gouveia (2024) notes that although male students tend to have higher initial competencies in motor skills, the improvement in female students' skills is more significant in learning contexts that focus on collaboration and tactical decision-making. However, the literature also indicates differences in improvement between locomotor and object control skills; learning designs must explicitly target object control skills to mitigate delays in object control skills (Fitrianto, 2023; Tangkudung & Mahyudi, 2022). In the Indonesian

context, challenges such as teacher preparedness, school facilities, and the number of students per class can hinder optimal TGfU implementation, highlighting the need for further local research on its effectiveness and feasibility (Aryanti et al., 2022; Gustian et al., 2024).

Theoretically, TGfU is a learning model that is in line with the principles of social constructivism, where knowledge is built through experience and interaction in a social context. This model allows students to learn through hands-on experience, tactical reflection, and collaborative problem-solving. As explained by (González-Valero et al., 2024), TGfU encourages the development of strategic thinking, game understanding, and emotional engagement that are all intertwined in strengthening students' motor skills. This approach also supports the integration of cognitive and psychomotor skills, which are foundational in the development of students' physical literacy (Greve et al., 2022; Pan et al., 2023). Physical literacy is defined as the ability to move confidently and competently in a variety of physical activities, involving understanding, motivation, and skills (Octavianus et al., 2025b). Thus, TGfU plays an important role in creating a holistic learning process that is relevant to the developmental needs of elementary school-age children.

Furthermore, TGfU is also in line with the theory of basic psychological needs according to the Self-Determination Theory (SDT) approach, namely the need for competence, autonomy, and social connectedness (Gaspar et al., 2021; Ortiz et al., 2023). In this context, TGfU provides space for students to feel competent through success in the game, independent in making decisions, and connect with friends through teamwork. This condition creates a healthy learning climate and supports the emotional well-being of students in physical education. Another theoretical implication is that the TGfU approach encourages the use of various student learning modalities, both visual, kinesthetic, and verbal. This expands the scope of engagement and allows students with different learning styles to derive maximum benefits from the learning process. TGfU is also considered effective in encouraging reflective learning as students are invited to think about the decisions they make in the game and their impact on outcomes (Santoso et al., 2024; Simpson et al., 2025).

Limitations of this study must be acknowledged. First, the use of a one-group pretest–posttest design introduces potential threats to internal validity, including history, maturation, and testing effects. Without a comparison group, it is difficult to rule out alternative explanations for the observed improvements. Second, the research was conducted at a single site with one teacher delivering the intervention, which limits generalizability and raises the possibility of teacher effects influencing outcomes. Third, although the TGMD-2 instrument was employed, no volleyball-specific performance rubric was used, which may limit the alignment between instructional content and assessment. Fourth, several students approached maximum scores in the posttest, suggesting potential ceiling effects that could mask further improvement. Fifth, interclass correlation coefficients (ICC) were not reported, limiting the reliability analysis across raters. Finally, although fidelity was monitored through teacher training and observation, no formal fidelity index was calculated, which may affect the internal consistency of the intervention delivery.

CONCLUSION

This study found that the application of the Teaching Games for Understanding (TGfU) model was associated with improvements in elementary students' motor competence, as measured by the Test of Gross Motor Development, Second Edition (TGMD-2). Statistically significant gains were observed in overall motor competence, encompassing both locomotor skills (running, hopping, and horizontal jumping) and object control skills (throwing and catching), following six weeks of TGfU-based volleyball instruction. These findings suggest that TGfU may provide a practical pedagogical approach for enhancing motor competence within authentic physical education contexts. However, given the one-group pretest–posttest design, the findings should not be interpreted as evidence of direct causality. The absence of a control group limits the ability to attribute observed improvements solely to the intervention. Future research employing randomized or controlled designs is recommended to verify these associations and to explore long-term effects across different skill domains and student populations. Overall, TGfU appears to be a contextually relevant and inclusive strategy for promoting fundamental motor skill development in elementary physical education while supporting engagement and meaningful participation among students.

RECOMMENDATION

The findings of this study provide several important recommendations for developing physical education practices in elementary schools. First, physical education teachers are advised to systematically integrate the Teaching Games for Understanding (TGfU) model into lesson plans, particularly for team games such as volleyball. Implementing TGfU has improved students' motor skills while encouraging active and collaborative participation in the learning process. Second, schools are expected to provide support through ongoing training for teachers to develop a deep understanding of the principles and application of TGfU. This is crucial to ensure consistent implementation of the model and its suitability to student characteristics across various learning contexts. Adequate facilities and infrastructure are also needed to support the successful implementation of TGfU in the classroom. Third, Practically, physical education teachers are encouraged to integrate TGfU strategies into lesson plans to create a more engaging, inclusive, and tactical learning environment. Schools should support this process through teacher training and adequate facilities to ensure fidelity of implementation. From a research perspective, future studies should use controlled designs, such as randomized comparisons of TGfU with technique-focused models, to establish clearer causal effects. Longitudinal research is also needed to test the durability of TGfU's impact at follow-up (e.g., three months post-intervention) and to evaluate targeted modules that specifically strengthen object control skills, which tended to underperform locomotor skills in this study.

Acknowledgments

During the preparation of this work, the authors used ChatGPT to enhance the clarity of the writing. After using the ChatGPT, the authors reviewed and edited the content as needed and take full responsibility for the publication's content.

Funding Information

This research received no external funding

Author Contributions Statement

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Budi Arif Setiawan					✓	✓	✓			✓		✓		✓

Conflict Of Interest Statement
Authors state no conflict of interest.

Informed Consent
We have obtained informed consent from all individuals included in this study.

Data Availability
The data that support the findings of this study are available from the corresponding author, upon reasonable request.

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