Changes in Basketball Shooting Performance Following Teaching Games for Understanding-Based Instruction among Junior High School Students

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Abstract

Developing basketball shooting skills is an important objective of physical education, requiring instructional approaches that connect technical execution with meaningful learning experiences. This study aimed to examine changes in basketball shooting performance among junior high school students following Teaching Games for Understanding (TGfU)-based instruction. A quantitative pre-experimental study employing a one-group pretest–posttest design was conducted with 41 eighth-grade students from SMPN 2 Karawang Barat, Indonesia. Participants completed basketball shooting assessments before and after TGfU-based instruction, with performance evaluated through movement-related indicators and shooting outcomes. Data were analyzed using descriptive statistics and a paired-samples t-test, supplemented by Cohen's dz to estimate standardized within-participant change. The mean shooting score increased from 56.34 (SD = 10.11) at pretest to 82.24 (SD = 9.71) at posttest, representing a mean improvement of 25.90 points. The paired comparison indicated a statistically significant difference, $t(40) = 15.57$, $p < .001$, with a 95% confidence interval of 22.54–29.26 points and a large standardized within-participant change (Cohen's dz = 2.43). These findings indicate substantial improvement in measured basketball shooting performance following the instructional period. However, the absence of a comparison group prevents definitive causal attribution of the observed improvement to TGfU. The study provides context-specific evidence of shooting performance changes and highlights the need for controlled investigations using validated assessment instruments and clearly documented instructional protocols.

Keywords: Teaching Games for Understanding; Basketball Shooting; Physical Education; Motor Skill Learning; Pretest-Posttest Design.

INTRODUCTION

Physical education provides an essential learning environment for developing motor competence, technical proficiency, and the ability to apply movement skills in meaningful physical activities. In team sports, effective learning requires students to coordinate technical execution with the changing demands of game situations. Basketball represents this challenge because players must integrate movement coordination, ball control, passing, and shooting while responding to dynamic spatial and tactical conditions. Consequently, basketball instruction should provide learning opportunities that develop technical proficiency and support the application of skills within relevant game contexts.

Shooting is a fundamental basketball skill because scoring success depends on coordinated movement execution, appropriate force regulation, and accurate ball projection toward the basket. Meirizal et al. (2022) demonstrated the relevance of structured technical instruction through the BEEF training method for free-throw performance. Similarly, Altavilla et al. (2022) examined ecological-dynamic and cognitive approaches to shooting accuracy, highlighting the importance of instructional organization in technical skill development. Candra et al. (2025) further emphasized movement parameters and biomechanical considerations in basketball shooting assessment. Collectively, these studies suggest that shooting proficiency requires attention to both movement

execution and the conditions under which technical skills are learned.

Developing basketball shooting proficiency remains a practical challenge in junior high school physical education, particularly when students demonstrate different levels of technical competence and movement coordination. Difficulties in body positioning, movement sequencing, and shooting execution may restrict students' ability to perform shooting tasks consistently. Instructional approaches that provide meaningful practice opportunities while accommodating students' initial abilities are therefore important considerations in basketball education. Preliminary observations reported at SMPN 2 Karawang Barat indicated difficulties in students' basketball shooting performance, particularly concerning body positioning, movement coordination, and technical execution. The observations also described limited participation during teacher-centered instructional activities. However, these observations were qualitative and were not accompanied by documented frequencies or standardized performance criteria. Consequently, they should be interpreted as contextual indications of instructional challenges rather than quantified evidence of their prevalence.

Previous studies have demonstrated that basketball learning outcomes may differ according to instructional approaches. González-Espinosa et al. (2021) reported favorable outcomes for tactical game instruction compared with direct instruction across several basketball performance indicators. Similarly, Faozi et al. (2024) found differences in basic basketball skill development between cooperative learning and direct teaching among junior high school students. These findings provide an empirical rationale for examining instructional approaches that connect technical learning with meaningful participation, although they do not establish the superiority of any model in the present research setting.

Teaching Games for Understanding (TGfU) offers a game-centered pedagogical approach that connects tactical problems, modified games, guided questioning, and technical execution within meaningful learning situations. Rather than emphasizing isolated technical repetition alone, TGfU provides opportunities for students to recognize game demands and apply relevant movement skills. Morales-Belando et al. (2022), through a systematic review, emphasized the importance of contextualized tasks, intervention structure, instructional objectives, and implementation documentation in TGfU research. Empirical investigations have examined TGfU within basketball education. Tangkudung and Mahyudi (2022) reported improvements in decision-making, technical execution, game performance, and enjoyment following TGfU-based basketball instruction. Guijarro et al. (2022) found that combining Sport Education with TGfU produced favorable outcomes in several indicators of basketball game performance and involvement compared with Sport Education alone. These findings indicate that game-centered instruction may support multiple dimensions of basketball learning, although the measured outcomes extend beyond shooting performance.

Other studies have emphasized cognitive learning. Waffak et al. (2022) developed a TGfU-based basketball learning model addressing higher-order thinking skills, whereas Nopembri et al. (2022) examined the development of higher-order thinking through TGfU-based basketball activities. These investigations demonstrate the pedagogical relevance of TGfU but also illustrate that cognitive learning outcomes should be distinguished from shooting-specific motor performance. Systematic evidence provides further clarification. González-Valero et al. (2024) reported favorable effects of TGfU on decision-making across educational settings. However, Ortiz et al. (2023) found that although TGfU demonstrated advantages in decision-making, its pooled

advantage over technical approaches for skill execution was not statistically significant. More recently, Aygun et al. (2026) reported favorable outcomes for hybrid Sport Education-TGfU interventions compared with several alternative approaches, while also demonstrating that instructional organization influences comparative learning outcomes. These findings suggest that the contribution of game-centered instruction varies according to the outcome assessed and the intervention implemented.

Shooting-specific investigations also demonstrate the relevance of alternative instructional methods. Munir et al. (2023) examined animal-name-based learning and conventional instruction for basketball free-throw performance. Munir et al. (2025) subsequently compared animal-name-based learning with a command-style approach among junior high school students. Together, these studies indicate that shooting performance can be examined through different instructional strategies, reinforcing the need to distinguish shooting-specific outcomes from broader basketball competencies.

TGfU-based instruction provides a plausible pedagogical approach for addressing shooting-related learning difficulties because modified games can connect technical practice with meaningful basketball situations. Tactical problems may create opportunities for students to recognize shooting situations, while repeated practice may support greater familiarity with movement execution. Nevertheless, these mechanisms remain theoretical explanations unless relevant instructional processes and learning constructs are measured directly. Despite the growing literature on TGfU and basketball instruction, the available evidence differs in educational level, intervention structure, research design, and outcome assessment. Previous studies have frequently examined overall game performance, tactical decision-making, higher-order thinking, or combined technical competencies. Meanwhile, shooting-specific investigations have considered alternative instructional methods, and systematic evidence has not consistently established the superiority of TGfU for technical skill execution.

Accordingly, the research gap addressed by the present study concerns the need for clearly differentiated evidence on basketball shooting performance following TGfU-based instruction within a defined junior high school context. This gap does not imply that TGfU or basketball shooting has not previously been investigated. Instead, it concerns the interpretation of shooting-specific performance changes as a distinct outcome within game-centered learning. Because the study lacks a comparison group, its contribution is limited to documenting within-student changes rather than establishing the exclusive causal effectiveness of TGfU.

The primary objective of this study was to examine changes in basketball shooting performance among eighth-grade students at SMPN 2 Karawang Barat following Teaching Games for Understanding (TGfU)-based instruction. Specifically, the study investigated whether students' shooting performance scores differed significantly between pretest and posttest assessments. The novelty of this study lies in its outcome-specific and context-focused examination of basketball shooting performance following TGfU-based instruction among junior high school students. Unlike investigations emphasizing overall game performance, tactical decision-making, or higher-order thinking, this study specifically examines shooting performance as the primary measured outcome. By distinguishing shooting scores from broader tactical, cognitive and psychosocial constructs, the investigation contributes context-specific empirical evidence concerning technical performance changes within game-centered physical education.

METHODS

Research Design

This study employed a quantitative pre-experimental approach using a one-group pretest–posttest design to examine changes in basketball shooting performance following Teaching Games for Understanding (TGfU)-based instruction. The research design was represented as O_1-X-O_2, where O_1 denotes the initial shooting assessment, X represents the instructional intervention, and O_2 indicates the final assessment. A comparable one-group design has been employed in school-based TGfU research to examine changes in educational outcomes (Usra et al., 2023). However, controlled investigations involving intact physical education classes demonstrate the methodological importance of comparison conditions when evaluating intervention-related differences (Silva et al., 2026). Accordingly, the present design was intended to assess within-participant changes rather than establish causal superiority over other instructional methods.

Research Setting and Participants

The research was conducted at SMPN 2 Karawang Barat, Indonesia, involving eighth-grade students participating in physical education lessons. The target population comprised 429 students distributed across ten eighth-grade classes. The participating sample consisted of 41 students from class VIII B, all of whom completed the reported pretest and posttest assessments. School-based intervention studies have demonstrated the importance of specifying participants' educational context, age characteristics, and instructional conditions when interpreting learning outcomes (Stojanović et al., 2023). Furthermore, Lee et al. (2026) highlighted the contextual variation associated with implementing TGfU in different school environments.

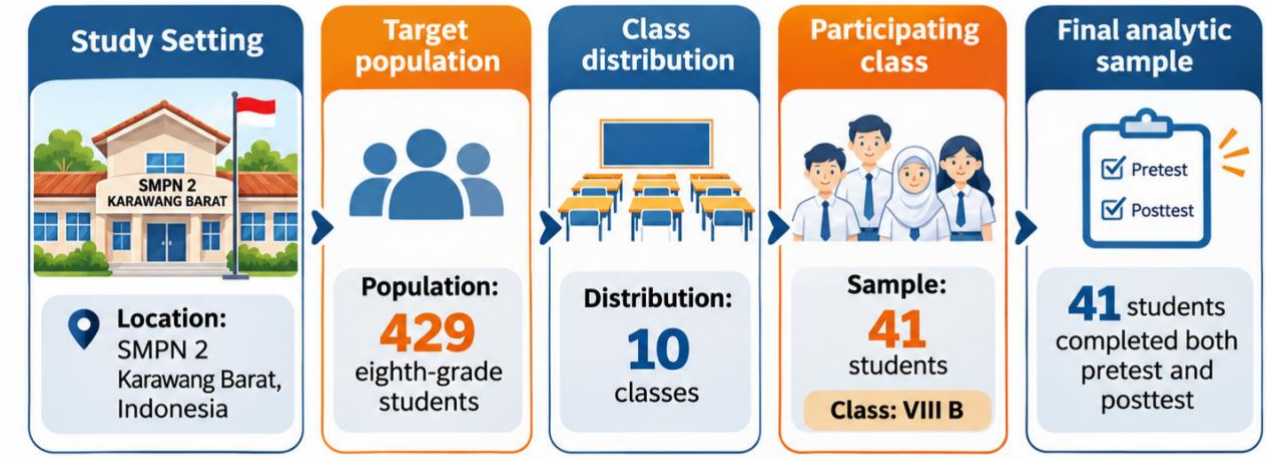


Figure 1. Research setting and participants

Sampling Procedure

The original manuscript described the sampling procedure as simple random sampling, resulting in the selection of class VIII B. However, the available information establishes only that one intact class comprising 41 students participated; it does not document whether individual students or the class itself were randomly selected. Consequently, the sampling procedure requires clarification before a specific probability-sampling classification can be confirmed. This distinction is relevant because participation conditions and teachers' experiences with TGfU may differ across educational settings (Papagiannopoulos et al., 2023). The present analysis included all 41 reported participants, with no missing pretest or posttest scores. The absence of a documented sample-size calculation and detailed selection procedure was recognized as a methodological limitation.

Teaching Games for Understanding Intervention

These interventions consist of basketball instruction organized according to the principles of TGfU. The original study described learning activities involving small-scale play, tactical understanding, decision-making, and active participation in modified game situations. These elements are consistent with the general structure of game-centered physical education interventions, although their implementation requires detailed documentation. Batez et al. (2021) demonstrated the application of TGfU in school-based volleyball instruction, while Ghorbanzadeh et al. (2024) compared TGfU to alternative pedagogical approaches to developing motor skills. From an instructional perspective, modified play provides an opportunity to connect the execution of movements with situational demands. Harvey and Cope (2025) emphasize the importance of tailoring the complexity of tasks and instructional support to learners' cognitive needs. Pritchard and Morgan (2022) highlight the question as a pedagogical strategy to support game-centered learning, while Greve et al. (2022) examine the implementation of TGfU in elementary school football instruction. In current research, the instructional focus is on shooting the basketball in game-oriented learning activities. Castro and Morgan (2025) further emphasize the importance of critically examining how the principles of TGfU translate into actual teaching and training practices.

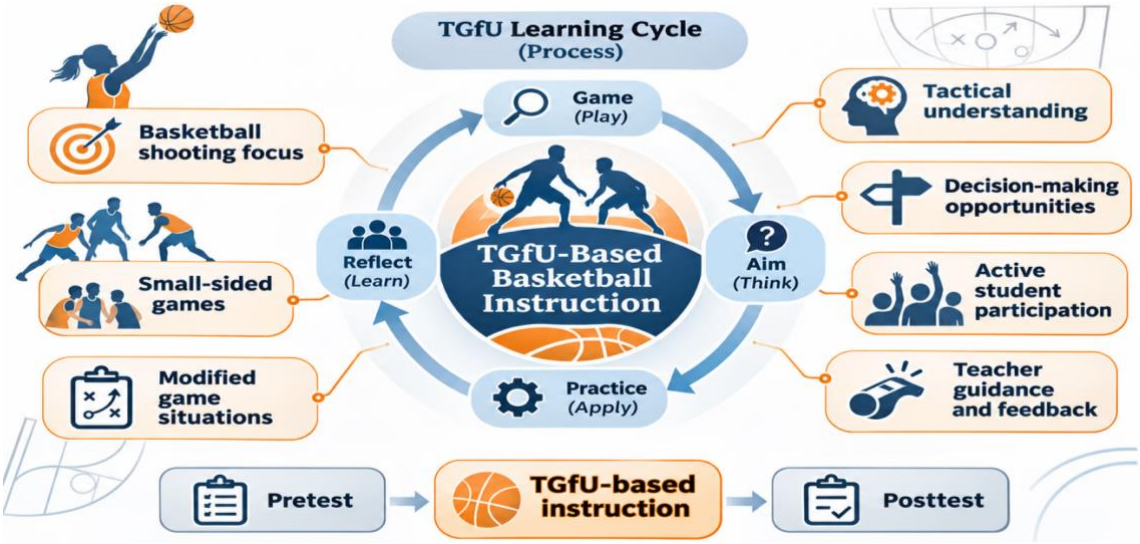


Figure 2. TGFU intervention

Research Instruments

Students' basketball shooting ability was measured before and after the implementation of the Teaching Games for Understanding (TGfU) learning model using a skill assessment instrument that includes four aspects, namely initial attitude, movement execution, movement coordination, and shooting ability. Each aspect was assessed using a scale of 1–4 based on the assessment rubric that had been set, with higher scores indicating a better level of skill mastery. The same instrument was used in the initial measurement (pretest) and final measurement (posttest) to identify changes in students' shooting ability after participating in TGfU-based learning. The assessment was carried out through observation of the implementation of students' movements by paying attention to the accuracy of the initial attitude, the quality of the implementation of techniques, the integration of movement coordination, and the ability to shoot basketball. Thus, this instrument is used to measure shooting skills based on aspects of the movement implementation process and students' technical abilities.

The importance of examining the characteristics of movement in shooting basketball is supported by Dai and Yin (2024), who examined the analysis of shooting movements through video images. Similarly, Li and He (2024) examined movement-related information in basketball free-throw instruction. Nevertheless, these studies did not independently validate the instruments used in this study. The original manuscript did not provide the exact number of shooting attempts, shooting distance, item-level descriptors, score weights, or complete score conversion procedures. The validity of the instruments, reliability, and the agreement of the assessors were also not documented. This kind of information is important for assessing the reproducibility of measurements. Paixão et al. (2026) specifically discussed the reliability of processes and outcomes in TGfU-based interventions, while Arija-Mediavilla et al. (2025) examined the coherence between pedagogical approaches and assessment practices in physical education.

Data Collection Procedure

The research procedure consisted of three consecutive stages. First, participants completed a pre-test to determine their initial performance in shooting basketball. Second, participants received basketball instruction based on the TGfU principles. Third, a posttest was conducted to measure shooting performance after the instructional period. Both assessments involved the same 41 participants. Maintaining consistency in the assessment procedure is important when interpreting changes in sports-specific skills. Wang et al. (2024) examined the performance of basketball skills under different training schedules, illustrating why instructional exposure and exercise organization should be considered when interpreting performance changes. Similarly, Wijaya et al. (2025) emphasized the need to examine the TGfU implementation process through reflective research.

Data Analysis

Data analysis was conducted using SPSS version 27 for Windows. Descriptive statistics included the number of participants, mean, standard deviation, minimum, and maximum shooting scores. The original analysis reported separate normality assessments for pretest and posttest scores and a Levene homogeneity test. A paired-samples t-test was used to examine whether the mean difference differed significantly from zero at a significance level of .05. The analysis included the mean difference, 95% confidence interval, t-statistic, degrees of freedom, and p-value. Cohen's dz was subsequently calculated from the reported mean difference and standard deviation of paired differences to quantify standardized within-participant change.

RESULTS

The study involved 41 eighth-grade students who completed basketball shooting assessments before and after the Teaching Games for Understanding (TGfU)-based instructional period. Descriptive statistical analysis was conducted to examine changes in students' shooting performance across the two assessment occasions. The results are presented in Table 1.

Table 1. Descriptive Statistics of Basketball Shooting Performance

		Pretest	Posttest
N	Valid	41	41
	Missing	0	0
Mean		56.34	82.24
Median		56.00	81.00
Mode		50[a]	81
Std. Deviation		10.106	9.713
Variance		102.130	94.339
Range		38	38
Minimum		37	62
Maximum		75	100
Sum		2310	3372

a. Multiple modes exist. The smallest value is shown

The results of the descriptive analysis showed that basketball shooting ability improved after TGfU-based learning, which can be seen from the change in average and median scores in a higher direction. The increase in minimum and maximum scores also showed a shift in score achievement in the participant group, while a decrease in standard deviation indicated a slight decrease in score variation. These findings are in line with the research of Tangkudung and Mahyudi (2022), which reported an improvement in several aspects of basketball skills and performance through TGfU. Altavilla et al. (2022) also found an increase in shooting accuracy through an ecological-dynamic approach, while Munir et al. (2023) showed that a modified learning approach can support free throw outcomes. The similarity of these findings suggests that learning organization and task characteristics are relevant aspects of shooting skill development, although the approaches used in these studies are different.

Table 2. Results of Data Normality Test

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Class	Statistic	df	Sig.	Statistic	df	Sig.
Result	Pretest	.151	41	.019	.951	41	.076
	Posttest	.136	41	.053	.953	41	.088

a. Lilliefors Significance Correction

The results of the Shapiro–Wilk test showed significance values above 0.05 on both measurements, while the Kolmogorov–Smirnov showed a distribution deviation on the pretest. The difference suggests that the two test procedures produced conclusions that are not entirely the same. However, since the study used a paired-samples t-test, the relevant normality assumption is the distribution of individual difference scores between the posttest and the pretest, rather than the distribution of the two measurements separately. Therefore, the results in this table cannot confirm the fulfillment of the assumption of the normality of paired data. Further examination via Shapiro–Wilk of the difference scores, Q–Q plots, and individual outliers is still required. The Levene test with a significance of 0.721 is not used as a primary requirement because variance homogeneity is not a necessary assumption in paired testing.

Table 4. Results of the homogeneity of variance test

		Levene Statistic	df1	df2	Sig.
Result	Based on Mean	.129	1	80	.721
	Based on Median	.227	1	80	.635
	Based on Median and with adjusted df	.227	1	79.763	.635
	Based on trimmed mean	.134	1	80	.715

Based on Table 4, the results of the homogeneity test using Levene's Test showed a significance value of 0.721 (> 0.05), so there was insufficient statistical evidence to state that the variance of the two measurement groups was different. The results of the test based on median and trimmed mean also showed significance values above 0.05. However, because this study used pretest and posttest measurements of the same student, the homogeneity of variance is not a required assumption in the paired-samples t-test. Therefore, the results of the Levene test can only be viewed as an additional analysis and are not used to determine the feasibility of testing the main hypothesis.

Table 5. Results of the paired samples t-test

	Paired Differences					t	df	Sig. (2-tailed)
				95% Confidence Interval of the Difference				
	Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1 Pretest - Posttest	-25.902	10.653	1.664	-29.265	-22.540	-15.569	40	<.001

The results of the paired-samples t-test showed a significant difference between shooting skills before and after learning, with confidence intervals all above zero and large standardized change measures. These findings are in line with the research of Faozi et al. (2024), which reported better results in developing basic basketball skills through cooperative learning than hands-on learning. Tangkudung and Mahyudi (2022) also reported improvements in technical skills and game performance after TGfU-based learning. However, different results were shown by Yang et al. (2021), who found that improvement in basketball skills was not always accompanied by a significant increase in shooting. In addition, Ortiz et al. (2023) reported that TGfU's superiority in decision-making aspects did not automatically indicate significant superiority in skill execution. Thus, the results of this study showed changes in shooting ability in the studied group but did not prove the causal superiority of TGfU over other learning approaches.

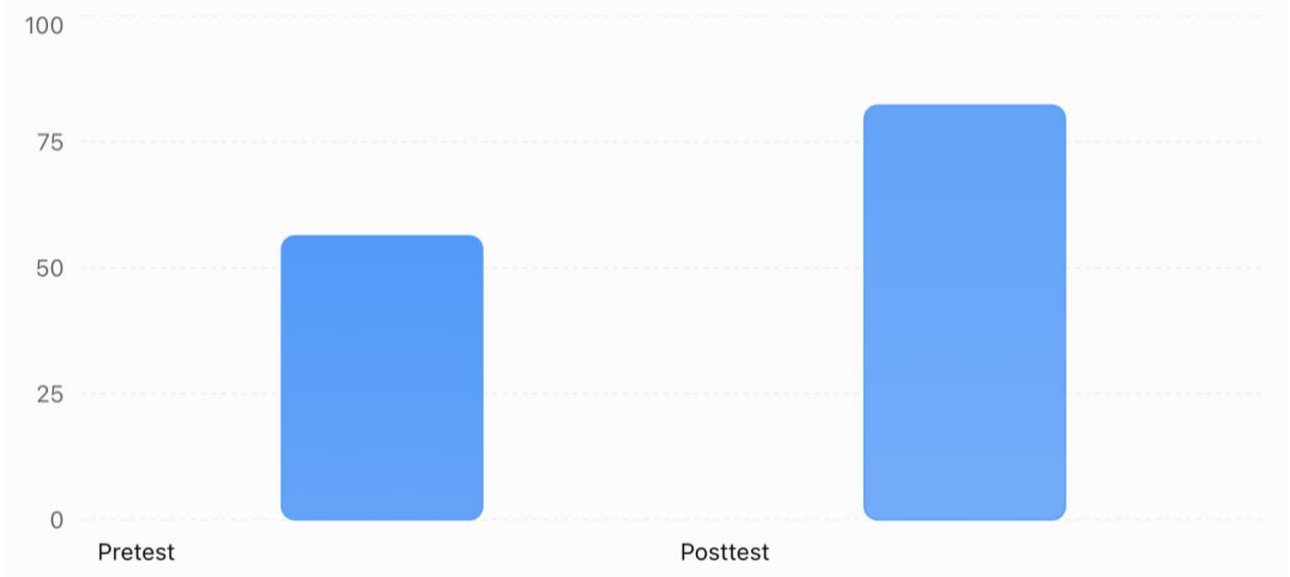


Figure 3. Comparison of Average Basketball Shooting Ability Scores between Pretest and Posttest

Figure 3 shows a shift in average shooting achievement towards a higher direction after TGfU learning. The pattern provides a visual representation of changes in group performance and is consistent with the research of Alghafary (2021), who reported improvements in shooting skills through self-questioning strategies, and Munir et al. (2023), who found better shooting outcomes

through modified learning methods. Both studies show that the organization of learning activities can support the development of shooting skills through different approaches. However, this graph only illustrates the average group comparison and does not show individual changes in each student or learning components that specifically contribute to the improvement.

Table 6. Results of the independent samples t-test effect size

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Pretest-Posttest	Equal variances assumed	0.822	0.367	-9.868	80	0.000	-24.488	2.481	-29.426	-19.550
	Equal variances not assumed			-9.868	79.106	0.000	-24.488	2.481	-29.427	-19.549

The effect size analysis yielded a Cohen's dz value of 2.43, indicating a very large standardized within-participant change in basketball shooting performance. Based on Cohen's conventional benchmarks, this value substantially exceeds the threshold for a large effect (0.80), suggesting that the observed improvement represents a substantial change relative to the variability of individual difference scores. This finding indicates that the pretest-posttest improvement was not only statistically significant but also substantial in standardized magnitude.

Overall, the results showed an improvement in basketball shooting skills after students participated in TGfU-based learning. Descriptive and inferential findings showed a consistent pattern of change, namely higher posttest achievement than pretest. These results are in line with a few previous studies that show that a structured and student-centered learning approach can support the development of basketball skills. However, differences in the results of previous studies show that shooting development does not always follow the same pattern as other engineering skills. Therefore, this study provides contextual empirical evidence regarding changes in shooting ability in game-based learning, while still considering the limitations of design without a comparison group.

DISCUSSION

The findings demonstrate an improvement in basketball shooting performance among junior high school students following TGfU-based instruction. This change indicates that students performed better on the shooting assessment after participating in the instructional activities. From a motor-performance perspective, shooting requires the coordination of body positioning, movement sequencing, force regulation, and control of ball projection toward the target. The observed improvement may therefore reflect greater familiarity with the assessed movement requirements and more effective execution of shooting-related tasks. However, because the assessment combined movement-related indicators and shooting outcomes, the specific contribution of each component cannot be determined independently.

The findings can be interpreted in relation to game-centered learning, in which technical practice is connected to meaningful playing situations. Such an approach may provide opportunities to apply shooting movements in relation to game objectives rather than treating them exclusively as isolated technical actions. Gustian and Pranata (2025) and Al Ardha et al. (2025) discuss the relevance of game-centered pedagogical experiences in physical education, while Iorga et al. (2023)

emphasize the importance of motor coordination in movement performance. These perspectives provide a plausible basis for interpreting the observed improvement, although engagement, coordination development, and tactical understanding were not directly measured in the present study.

The improvement should nevertheless be interpreted as an observed within-group change rather than direct evidence of a specific instructional mechanism. Repeated practice, familiarity with the assessment, teacher feedback, maturation, and concurrent learning experiences may also have contributed. Álvarez-Sánchez et al. (2026) emphasize the importance of evidence-informed implementation when evaluating pedagogical models. Accordingly, the present findings provide context-specific evidence of improved measured shooting performance following the instructional period, while the independent contribution of TGfU remains unresolved.

The findings are broadly consistent with evidence indicating that game-centered and model-based physical education can support learning outcomes. Tufekci et al. (2026), through a hierarchical meta-analysis, reported favorable overall learning outcomes associated with TGfU interventions. Pan et al. (2023) also examined a hybrid TGfU and Sport Education approach and reported favorable outcomes across several dimensions of physical education learning. Similarly, Ferraz et al. (2024) investigated hybrid pedagogical approaches in basketball instruction, providing further evidence of the relevance of integrating technical and tactical learning. These studies support the educational rationale for game-centered instruction, although their broader outcomes cannot be interpreted as direct evidence of shooting-specific improvement. Evidence from other invasion games also provides useful context. Ritonga et al. (2024) examined TGfU-based learning for throwing and catching skills, while Santoso et al. (2024) compared TGfU and Problem-Based Learning in football instruction. Their findings demonstrate the relevance of pedagogical approaches for developing movement skills, although differences in sports, technical demands and assessment procedures limit direct comparisons with basketball shooting.

Basketball-specific investigations further indicate that shooting performance can improve through different instructional strategies. Alghafary (2021) examined self-questioning in basketball learning and reported improvements in several technical skills, including shooting. Wang et al. (2024) investigated blended learning in physical education and basketball skill development, illustrating another instructional arrangement for supporting technical learning. These studies suggest that improvement is not exclusive to TGfU. Therefore, the present findings should not be interpreted as evidence that game-centered instruction is necessarily superior to self-questioning, blended learning, or conventional technical practice. A relevant contrasting finding was reported by Yang et al. (2021), who found improvements in overall basketball skills and selected technical components, while shooting performance did not demonstrate a statistically significant improvement. This result highlights the possibility that different basketball skills respond differently to instructional exposure. Shooting requires specific control of movement execution and ball projection, whereas passing and dribbling involve different coordination and task demands. Tian et al. (2026) and Jingxia et al. (2026) further emphasize that the relative outcomes of physical education models may differ according to learning domains and instructional conditions. These findings caution against if one pedagogical approach produces uniform improvement across all motor skills.

The findings may be interpreted through the relationship between game-centered pedagogy and motor-skill acquisition. Menezes-Fagundes et al. (2021) discussed the integration of TGfU with

Motor Praxiology, providing a perspective for understanding technical actions in relation to the internal logic of games. From this perspective, basketball shooting is not merely an isolated movement but a technical action associated with the spatial and tactical demands of gameplay. Barquero-Ruiz et al. (2024) further discuss the relationship between game-based learning environments and nonlinear pedagogical perspectives, emphasizing how instructional conditions shape opportunities for movement exploration and skill development.

The organization of practice is another relevant consideration. Zhuoxiao et al. (2026) examined activity distribution in basketball skill acquisition, while Yenes et al. (2025) investigated structured practice in jump-shot training. These studies provide a basis for considering practice organization and repetition as relevant factors in shooting development. Sha and Chiu (2025) also examined guided sensory information during basketball set-shot learning, highlighting the potential importance of instructional information during motor-skill acquisition. Nevertheless, the present study did not document individual practice repetitions, feedback frequency, or biomechanical changes. Consequently, these mechanisms remain plausible explanations rather than demonstrated mediators of the observed improvement.

The interpretation should also recognize the cognitive demands associated with game-centered instruction. Dudley (2026) proposed a neuroscientific perspective for understanding the relationship between TGfU and cognitive and psychomotor learning. Sugiarto et al. (2024) examined differences in learning outcomes associated with pedagogical approaches and student characteristics, while Zhang et al. (2024) discussed the implementation of hybrid pedagogical models. Together, these perspectives suggest that learning outcomes may depend on the interaction between instructional organization, task demands, and learner characteristics. However, the present study did not measure cognitive load, attention, motivation, or tactical decision-making; these constructs should therefore not be presented as confirmed explanations.

The findings provide preliminary implications for basketball instruction in junior high school physical education. Teachers may consider integrating modified games with shooting-specific practice, appropriate task progression, and instructional feedback. Octavianus et al. (2025) emphasize the importance of teacher facilitation and curriculum adaptation in TGfU implementation. Flores-Cidoncha et al. (2026) also discuss the relevance of supportive instructional environments, while Gaspar et al. (2021) examine TGfU-related teaching practices and students' psychological experiences. These studies suggest that the quality of implementation and learning support should be considered when applying game-centered instruction. However, motivational and psychological improvements were not assessed in the present study.

Several limitations must be acknowledged. The absence of a comparison group prevents definitive attribution of the observed improvement to TGfU rather than practice, maturation, assessment familiarity, or concurrent learning. The sample was restricted to one class at a single school, limiting generalizability. In addition, intervention dosage, session progression, and implementation fidelity were insufficiently documented, while the validity and reliability of the shooting assessment were not adequately established in the available manuscript. Normality of paired difference scores also remains unverified, and the absence of retention and transfer assessments prevents conclusions about the durability of learning.

Future investigations should use controlled or comparative designs, validated shooting assessments, and transparent documentation of intervention procedures. Galeano-Rojas et al. (2026) and Cano-Cañada et al. (2026) provide additional perspectives on contextual factors, pedagogical

implementation, and learning experiences in physical education. Future research should separately assess shooting accuracy, movement execution, tactical understanding, and game performance, while including delayed retention and transfer assessments. Overall, the present study contributes context-specific evidence of improved shooting performance following TGfU-based instruction, but stronger comparative research is required to establish its specific contribution to basketball skill acquisition.

CONCLUSION

This study demonstrated a statistically significant improvement in basketball shooting performance among eighth-grade students at SMPN 2 Karawang Barat following Teaching Games for Understanding (TGfU)-based instruction. The findings indicate that students achieved higher shooting performance scores at posttest than at pretest, with a large standardized within-participant change. These results support the research hypothesis concerning differences in shooting performance between the two assessment occasions. The study contributes context-specific empirical evidence to physical education research by examining basketball shooting as a distinct technical performance outcome within a game-centered instructional setting, rather than combining it with broader tactical, cognitive, or psychosocial learning indicators. Nevertheless, the findings should be interpreted within the limitations of the one-group pretest–posttest design. The absence of a comparison group prevents definitive attribution of the observed improvement exclusively to TGfU-based instruction. Furthermore, incomplete documentation of intervention dosage, implementation fidelity, and shooting assessment validity limits the interpretation and reproducibility of the findings. Therefore, the results provide preliminary evidence of improved basketball shooting performance following TGfU-based learning, while further controlled investigations are necessary to establish its specific instructional contribution.

RECOMMENDATION

Based on the findings, physical education teachers may consider incorporating Teaching Games for Understanding (TGfU)-based activities as an instructional alternative for developing basketball shooting skills among junior high school students. Its implementation should integrate modified games, shooting-specific practice, tactical problems, and guided feedback while considering students' initial skill levels and learning needs. Teachers are encouraged to provide sufficient opportunities for technical practice and use clearly defined assessment criteria to monitor students' shooting development. However, the adoption of TGfU should be guided by instructional objectives and classroom conditions rather than assumptions of its superiority over other teaching approaches. Future research should employ randomized or appropriately controlled quasi-experimental designs to distinguish TGfU-related changes from general practice effects, assessment familiarity, and other contextual influences. Subsequent studies should document intervention duration, instructional progression, implementation fidelity, and participant characteristics more comprehensively. The use of validated and reliable shooting assessment instruments is also recommended, with separate measurements of shooting accuracy, movement execution, tactical understanding, and decision-making. Furthermore, delayed retention tests and game-based transfer assessments would help determine whether improvements persist over time and translate into authentic basketball performance. Studies involving multiple classes or schools are needed to

strengthen the generalizability of findings and clarify the specific contribution of TGfU to basketball skill acquisition.

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