



Integrating Teaching Games for Understanding and Team Quest Gamification to Enhance Decision-Making Skills in Basketball among Junior High School Students

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ABSTRACT

Decision-making is a crucial cognitive-tactical component in basketball, as it determines student ability to select appropriate actions during the game. This study aimed to analyze the effects of Teaching Games for Understanding (TGfU), Team Quest Gamification, and their interaction on the decision-making skills of junior high school students in basketball. A quantitative approach was employed using a 2x2 factorial pretest-posttest quasi-experimental design. The 32 participants were divided into four treatment groups, namely TGfU with Team Quest Gamification, TGfU without gamification, Direct Instruction with Team Quest Gamification, and Direct Instruction without gamification. Data were analyzed using descriptive statistics, gain scores, N-Gain, prerequisite tests, and Two-Way ANCOVA, with pretest scores serving as the covariate. The results revealed that the TGfU plus Team Quest Gamification group achieved the highest performance, with a post-test mean of 88.79, a gain of 40.54, and an N-Gain of 0.784 (classified as high). The TGfU without gamification and Direct Instruction plus Team Quest Gamification groups fell into the medium category, while the Direct Instruction without gamification group fell into the low category. Two-Way ANCOVA results indicated significant effects of the instructional model, gamification, and their interaction on decision-making. These findings suggest that integrating TGfU and Team Quest Gamification holds potential as an effective, contextual, and collaborative basketball teaching strategy focused on enhancing student tactical thinking skills. However, the results should be interpreted with caution due to the relatively limited number of participants.

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INTRODUCTION

Current literature syntheses in physical education increasingly reflect a paradigm shift toward game-centered models that position learners as active participants in diagnosing and solving gameplay dilemmas (Barba-Martín et al., 2020; Wang et al., 2024). Specifically, Teaching Games for Understanding (TGfU) has gained prominence by redirecting instructional focus from decontextualized, isolated drill practices toward tactical awareness, game appreciation, and contextualized decision-making within authentic play scenarios. A meta-analysis by González-Valero et al. (2024) demonstrated that TGfU yields moderate-to-large enhancements in decision-making ($g = 0.82$, 95% CI [0.55, 1.09]), with robust consistency across primary ($g = 0.61$), secondary ($g = 0.75$), and higher education levels ($g = 0.88$). This empirical evidence confirms that decision-making is not merely an incidental byproduct of technical mastery, but rather a higher-order competence that can be systematically fostered through deliberate, game-centered pedagogical design.

On the other hand, several studies continue to utilize technical approaches or Direct Instruction as comparisons to tactical models because such approaches represent teacher-centered instruction, demonstrations, movement repetitions, technical corrections, and skill practices that tend to be separated from game contexts (Gil-Arias et al., 2021). In teaching invasion games such as basketball, practicing technical skills in isolation risks limiting students' opportunities to link technique with tactical choices, such as when to pass, dribble, shoot, or adjust positioning under defensive pressure and temporal constraints. Robles et al. (2020) reported that tactical interventions demonstrated clearer advantages in decision-making over technical approaches, yielding an effect size of 0.89 with a 95% confidence interval of 0.12 to 1.65, although evidence quality and intervention heterogeneity remain recognized limitations.

The primary issue addressed in this study is how to enhance junior high school students' basketball decision-making through instructional models that are more contextual, participatory, motivating, and responsive to gameplay problems. Research on TGfU and the Tactical Games Model demonstrates that decision-making quality develops when students gain representative playing experiences, encounter tactical dilemmas, and reflect on their choices during play (Barba-Martín et al., 2020; González-Valero et al., 2024; Wang et al., 2024). Conversely, technical approaches that isolate skills from the game context are deemed inadequate for developing an understanding of when, why, and how skills should be applied in dynamic environments (Robles et al., 2020). Therefore, the instructional need extends beyond increasing drill repetition; it requires designing basketball learning experiences that integrate technical execution, tactical awareness, learning motivation, cooperation, and active involvement. Within this framework, TGfU provides cognitive tactical scaffolding through modified games and reflective questioning, while gamification provides motivational support through challenges, missions, points, achievements, feedback, and teamwork.

TGfU serves as the first specific solution because it places game understanding at the core of learning. Within TGfU, students encounter simplified or modified games that retain primary tactical structures, encouraging them to analyze situations, understand game problems, and select appropriate responses. Barba-Martín et al. (2020) found that motor and cognitive outcomes are the most frequently assessed aspects in TGfU implementations, particularly those related to game development, tactical aspects, decision-making, technical skills, and physical activity levels. Theoretically, the strength of TGfU lies in presenting authentic game problems that require tactical solutions before movement execution is refined, making game

understanding and tactical awareness the primary learning outcomes (Barba-Martín et al., 2020; González-Valero et al., 2024). In basketball, this approach helps students recognize why passing to an open teammate is necessary, when dribbling is useful to exploit open court space, and when shooting represents a viable option. Thus, techniques are not acquired merely as mechanical actions, but as functional tools to solve tactical challenges.

Team Quest Gamification represents the second specific solution, recognizing that game decision-making depends not only on tactical knowledge, but also on motivation, engagement, willingness to take initiative, and social interaction. Gamification in physical education can be defined as the application of game elements, mechanics, and principles to non-game contexts to enhance engagement and intrinsic motivation (Ferraz et al., 2024). In this study, Team Quest Gamification was operationalized as a team-based challenge structure that converts learning tasks into collaborative tactical missions. Students work collectively within squads to complete challenges, accumulate points, receive feedback, reflect on performance, and achieve common objectives. Ferraz et al. (2024) explained that gamification strategies in physical education provide clear goals, achievement trajectories, problem-solving opportunities, decision-making practice, and strategic thinking. Moreover, evidence from game-based physical education interventions shows improved enjoyment among children and adolescents (MD = 0.53, 95% CI [0.27–0.79]), with larger effects observed in interventions lasting more than three weeks (MD = 0.81) (Mo et al., 2024). This confirms that challenging, enjoyable, and meaningful environments support sustained active participation.

Literature on hybrid pedagogical models supports the premise that combining two distinct approaches can address the limitations of standalone models. Shen & Shao (2022) identified seven types of hybrid models in physical education, indicating that model combinations positively influence motor, cognitive, affective, and social learning domains. Several studies demonstrate the potential of hybrid models to improve motivation, decision-making, participation, and game performance. For instance, Gil-Arias et al. (2021) found that a hybrid TGfU and Sport Education unit increased self-determined motivation compared to Direct Instruction, establishing an autonomy-supportive, inclusive, and equitable environment that enhanced engagement, enjoyment, and social interaction. Chiva-Bartoll et al. (2018) demonstrated that hybridizing TGfU with Cooperative Learning positively shaped the motivational climate by fostering task involvement, role accountability, personal effort, and continuous improvement. In basketball contexts, Práxedes et al. (2021) reported that complementing a TGfU unit with unstructured small-sided games during school recess yielded significantly higher posttest scores in both decision making ($p = .001$) and execution ($p = .024$), whereas the standalone TGfU cohort only achieved significant gains in decision making ($p = .021$). These empirical findings collectively suggest that integrating tactical models with collaborative social structures or motivational frameworks holds strong potential to enhance overall learning outcomes.

A notable research gap persists nonetheless. Although both TGfU and gamification have advanced as prominent pedagogical innovations, few studies have directly tested a structured integration between TGfU tactical problem-solving and team-based gamification elements such as quests, challenges, points, rewards, and feedback to enhance decision making in basketball or other invasion games. Wang et al. (2024) emphasized that despite the growing body of literature on the Tactical Games Model, particularly across K to 12 settings and team sports, its impact on cognitive outcomes and decision making remains comparatively under-explored. At the same time, gamification research in physical education concentrates primarily on motivation, student engagement, and physical activity levels, leaving cognitive tactical outcomes such as decision quality, tactical awareness, and game understanding

without adequate empirical attention (Ferraz et al., 2024; Mo et al., 2024). This gap is particularly evident given that basketball represents a frequent focus in team sports intervention studies. Mazzardo et al. (2022) documented that basketball accounts for 17.95% of pedagogical interventions in collective sports, ranking second only to soccer, yet most of these interventions apply tactical frameworks without gamified structures. Furthermore, persistent methodological constraints such as brief intervention durations, design heterogeneity, low certainty of evidence evaluated through GRADE criteria, fidelity issues, and a lack of direct comparisons between hybrid and standalone models remain notable considerations in the field (Barba-Martí-n et al., 2020; Robles et al., 2020; Shen & Shao, 2022; Zhang et al., 2024).

Based on the aforementioned rationale, this study aimed to analyze the effect of Teaching Games for Understanding on junior high school students' basketball decision-making skills, evaluate the impact of Team Quest Gamification, and examine the interaction between both variables. The investigation compared four instructional configurations: TGfU with Team Quest Gamification, TGfU without gamification, Direct Instruction with Team Quest Gamification, and Direct Instruction without gamification. The novelty of this work rests on empirically testing the integration of TGfU as a tactical pedagogical model with Team Quest Gamification as a collaborative motivational strategy within a unified factorial design. Conceptually, the study builds upon previous empirical evidence indicating that TGfU enhances decision making more effectively than Direct Instruction through contextual tactical problems and reflective debriefs, whereas Team Quest Gamification reinforces student motivation, participation, peer cooperation, and overall engagement. Their interaction was anticipated to yield the most pronounced effect by linking cognitive tactical frameworks with social motivational structures in basketball instruction. Consequently, this study is expected to provide a scholarly contribution toward developing physical education pedagogies that are innovative, participatory, and centered on advancing students' tactical reasoning capabilities.

METHODS

Research Design

This study adopted a quantitative approach using a 2 x 2 factorial pretest posttest quasi-experimental design. This design was selected because school-based physical education research typically occurs within intact classroom settings, where full individual randomization remains difficult to implement without disrupting the regular curriculum. Under such circumstances, a quasi-experimental framework enables researchers to examine treatment effects within an authentic learning environment while preserving systematic comparative rigor across groups. Student decision-making capabilities were measured prior to and following the intervention to determine performance changes resulting from the combined instructional models and gamification strategies.

The 2 x 2 factorial design was configured to test two independent variables: instructional model and gamification strategy. The instructional model variable comprised two levels, namely Teaching Games for Understanding and Direct Instruction. The gamification strategy variable likewise involved two levels, namely Team Quest Gamification and non-gamified instruction. Consequently, the research established four treatment combinations: TGfU with Team Quest Gamification, TGfU without Gamification, Direct Instruction with Team Quest Gamification, and Direct Instruction without Gamification. This factorial configuration facilitated the examination of the main effect of instructional models, the main effect of gamification strategies, and their interaction on student decision making in basketball. Employing this comparative structure aligns with methodological recommendations in hybrid

physical education models, where quasi-experimental investigations with comparison cohorts are essential to establish the empirical advantages of hybrid designs over standalone models (Shen & Shao, 2022; Zhang et al., 2024).

Table 1. Factorial 2 x 2 Matrix of Instructional Models and Gamification Strategies in Basketball Learning

Instructional Model	With Team Quest Gamification	Without Team Quest Gamification
<i>Teaching Games for Understanding (TGfU)</i>	Group 1: TGfU plus Team Quest Gamification	Group 2: TGfU without Gamification
<i>Direct Instruction</i>	Group 3: Direct Instruction plus Team Quest Gamification	Group 4: Direct Instruction without Gamification

Participants and Group Allocation

The study involved 32 junior high school students allocated across four distinct treatment conditions, with each group comprising eight participants. The intervention was conducted at SMP Negeri 21 Pontianak during the second academic semester. Participants were eighth-grade students enrolled in physical education classes covering the basketball curriculum unit. A purposive sampling technique was utilized because the experiment was embedded within pre-existing school classes. Inclusion criteria required students to maintain active school registration, participate in the instructional basketball unit, obtain informed consent from parents or guardians, and attend all pretest, intervention, and posttest sessions. Students who were absent during any primary assessment stage were excluded from the final analytical dataset.

Baseline decision-making proficiencies across the four cohorts were equivalent, with group pretest averages ranging tightly between 48.00 and 49.00. Establishing baseline parity was essential to ensure that observed post-intervention gains reflected treatment efficacy rather than pre-existing individual differences. Group distribution corresponded to the factorial combination of the two independent factors. The first group received Teaching Games for Understanding integrated with Team Quest Gamification, the second received TGfU without gamification, the third completed Direct Instruction combined with Team Quest Gamification, and the fourth received Direct Instruction without gamification. This allocation was designed to examine whether tactical game-based pedagogies differed meaningfully from teacher-directed approaches, and whether team gamification strengthened learner engagement and decision making in basketball gameplay. Recognizing that the sample size within each factorial cell was relatively modest ($n = 8$ per cell), which could constrain statistical power, inferential findings were interpreted with caution and accompanied by effect size estimates, specifically partial eta squared, to provide robust statistical interpretation beyond relying solely on significance testing.

Intervention Protocols

The instructional intervention spanned three weeks, comprising three structured learning sessions with one session conducted each week. Each session lasted 120 minutes and followed a standardized lesson plan framework consisting of an introduction, dynamic warm-up, core instructional activities corresponding to the assigned condition, applied gameplay, reflective debriefing, and cool-down. The instructional focus centered on basketball decision-making competencies, specifically passing, dribbling, shooting, court positioning, support play, and action timing. The Teaching Games for Understanding intervention was organized by placing tactical game comprehension at the core of the learning experience. Within the TGfU cohorts, students practiced through small-sided, conditioned games tailored to their

developmental levels, ensuring that instructional scenarios reflected authentic competitive dynamics while remaining accessible. Instructors guided learners to navigate fundamental tactical dilemmas, including creating open space, selecting delivery windows, supporting teammates off the ball, evaluating viable shooting chances, and managing game tempo. Guided inquiry and reflective questions were systematically embedded to help students evaluate their tactical choices during play, prompting them to explain why a particular pass was optimal, when dribbling was necessary, or how off-ball movement facilitated offensive progression. This design aligns directly with established TGfU principles emphasizing game comprehension, tactical awareness, and contextual decision making through authentic problem-solving (Barba-Martín et al., 2020; González-Valero et al., 2024).

The Direct Instruction treatment served as the comparative control condition. In this group, teaching remained teacher-centered, structured through explicit verbal explanations, motor demonstrations, isolated skill drills, movement corrections, and closed practice before concluding with standard, unconditioned scrimmages. Direct Instruction represents a conventional physical education model that prioritizes technical mastery prior to contextual gameplay application. Although beneficial for establishing basic movement patterns, this framework can be limited when developing tactical decision making because game choices require learners to recognize the underlying tactical purpose behind technical execution. Contrasting TGfU with Direct Instruction provides important empirical insight, as tactical models demonstrate more consistent benefits for decision-making development than isolated technical approaches (Robles et al., 2020).

The Team Quest Gamification strategy was implemented by embedding collaborative team challenges, pedagogical missions, group scoring systems, formative feedback, and collective milestone achievements into basketball lessons. In this investigation, Team Quest operated as an instructional gamification system that reorganized learning drills into sequential tactical missions accomplished through peer collaboration. The structural framework of Team Quest consisted of five sequential phases: (1) formation of small student squads, (2) assignment of specific session tactical quests, (3) collective point accrual upon successful mission completion, (4) teacher feedback paired with squad tactical debriefing, and (5) aggregate team milestone recognition at the conclusion of the session. Exemplary tactical missions included the Smart Passing Quest, where teams earned points by choosing an open teammate rather than forcing passes into defensive pressure; the Space Creator Quest, where points were awarded when off-ball players executed purposeful cuts to create space; and the Support Play Quest, where squads accrued points by establishing continuous passing triangles to support the ball carrier. Students collaborated toward shared objectives, solved gameplay dilemmas, and reflected on squad performance. Gamification was utilized as a supportive motivational catalyst rather than an alternative to core pedagogy, functioning to foster engagement, peer collaboration, and decision-making confidence during play. As noted by Ferraz et al. (2024), gamification in physical education provides clear targets, achievement trajectories, problem-solving opportunities, decision-making scenarios, and strategic thinking practice. Integrating TGfU and Team Quest Gamification thereby combines cognitive tactical scaffolding with collaborative motivational structures into a unified learning experience.

Implementation fidelity was controlled through the development of structured lesson plans for each instructional session, the use of systematic observational checklists, and continuous monitoring by independent observers. Each lesson plan specified the learning objectives, pedagogical content, activity progressions, time allocations, teacher instructions, game or drill configurations, reflective debriefing prompts, and performance indicators. Observers systematically recorded adherence to the lesson plans, cross-group treatment

consistency, the delivery of TGfU inquiry elements, and the execution of Team Quest gamification components. The fidelity percentage was calculated by dividing the number of successfully implemented instructional components by the total planned components, multiplied by 100%.

Table 2. Summary of The Basketball Intervention Protocols

Component	Description
Intervention duration	3 weeks
Number of sessions	3 sessions
Session duration	120 minutes per session
Primary instructional content	Basketball decision making: passing, dribbling, shooting, positioning, support play, and timing
TGfU	Small-sided games, modified gameplay, reflective questioning, and tactical problem-solving
Direct Instruction	Teacher explanations, technical demonstrations, repetitive movement drills, form corrections, and limited applied gameplay
Gamification Team Quest	Team missions, collective points, tactical challenges, feedback loops, squad debriefings, and group achievements
Without Gamification Team Quest	Instructional delivery conducted without missions, point tallies, or team achievement systems

Instruments and Research Procedures

The primary assessment instrument was an observational basketball decision-making rubric administered during pretest and posttest evaluations. The pretest measured baseline proficiency prior to the intervention, whereas the posttest evaluated student performance following the completion of all instructional sessions. Decision-making indicators encompassed passing, dribbling, shooting, positioning, support play, and timing. These six indicators capture fundamental tactical choices in basketball, encompassing both on-ball actions and off-ball court movements. Passing evaluates accuracy in choosing the appropriate recipient and delivery timing; dribbling assesses the decision to advance possession into open court space; shooting reflects the selection of viable scoring opportunities; positioning evaluates purposeful off-ball spacing; support play measures the ability to offer accessible passing angles to teammates; and timing reflects the synchronization of tactical actions during play.

Employing these indicators is consistent with established assessment traditions in invasion sports that frequently utilize observational instruments such as the Game Performance Evaluation Tool and the Game Performance Assessment Instrument. Instruments like the GPET and GPAI capture cognitive tactical behaviors during play, including decision quality, skill execution, supporting play, and active game involvement (Mahedero et al., 2021; Práxedes et al., 2021). The observational rubric in this study adapted performance evaluation principles from the GPET and GPAI, tailored to the instructional context of junior high school basketball learners. Content validity was evaluated and confirmed by a panel of three independent experts comprising a physical education specialist, a basketball coaching expert, and an educational measurement scholar. Inter-rater reliability was determined using the Intraclass Correlation Coefficient, yielding an ICC value of 0.87, which confirmed that the instrument is highly reliable and well suited for assessing student decision-making capabilities.

The experimental procedure commenced with administering the basketball decision-making pretest to all participating students. Subsequently, each experimental cohort engaged

in instruction according to its designated treatment configuration. The TGfU plus Team Quest Gamification group participated in tactical problem-solving pedagogy integrated with cooperative squad missions and gamified challenges. The TGfU without Gamification group received game-centered tactical instruction delivered without the gamified mission system. The Direct Instruction plus Team Quest Gamification group followed direct technical instruction supplemented with cooperative team missions. The Direct Instruction without Gamification group completed standard direct technical instruction without any gamification components. Upon completing the intervention period, all students took part in the posttest assessment evaluating the identical decision-making indicators. Both pretest and posttest evaluations occurred within standardized gameplay environments featuring equivalent rules, game durations, squad sizes, and assessment parameters to ensure objective score comparisons across testing points. Assessors utilized the identical observational rubric throughout the pretest and posttest stages. The posttest performance data were subsequently used to calculate absolute gain scores and normalized gain (N-Gain) values, enabling systematic comparison of learning gains across all cohorts.

Table 3. Specifications of The Basketball Decision-Making Assessment Rubric

Indicator	Operational Definition	Observational Focus	Scale
Passing	Appropriateness in selecting pass target and delivery timing	Observed when the ball carrier selects the most appropriate teammate to receive the pass	1-5
Dribbling	Discretion in advancing the ball into open court space or maintaining possession under pressure	Observed when the player chooses between dribbling and passing	1-5
Shooting	Discernment of genuine scoring opportunities	Observed when the player decides to shoot or delay the attempt	1-5
Positioning	Spatial awareness and off-ball court repositioning	Observed as movement without the ball to create functional space	1-5
Support play	Ability to provide functional passing support to teammates	Observed when opening passing lanes or assisting offensive progression	1-5
Timing	Temporal appropriateness of gameplay actions	Observed when the player coordinates the execution moments of passing, dribbling, shooting, or moving without the ball	1-5
Validity	Content validity assessed by 3 experts	Aiken's V coefficient	Valid
Reliability	Inter-rater evaluation consistency	Intraclass Correlation Coefficient (ICC = 0.87)	Reliable

Beyond raw pretest and posttest scores, this study calculated absolute gain and normalized gain metrics. Absolute gain captured raw score advancement from pretest to posttest, whereas normalized gain reflected the proportional effectiveness of the improvement relative to the maximum possible growth from baseline performance. Improvement effectiveness was classified as high when N-Gain reached 0.70 or greater, medium when ranging from 0.30 to 0.69, and low when falling below 0.30. Incorporating N-Gain facilitated a nuanced interpretation of practical intervention efficacy rather than evaluating between-group variations based solely on post-intervention terminal scores.

Data Analysis

Data were analyzed using descriptive and inferential statistics. Descriptive statistics were employed to calculate pretest means, posttest means, raw gain scores, normalized gain (N-Gain) values, and effectiveness classifications for each treatment group. These descriptive outputs established the initial basis for illustrating improvement patterns in decision making across treatment conditions. Comparing posttest scores, gains, and N-Gain values helped characterize the practical effectiveness of each instructional configuration, particularly the integration of game-centered tactical learning and team gamification.

The primary inferential analysis utilized a Two-Way Analysis of Covariance (ANCOVA). Within this statistical model, posttest decision-making scores served as the dependent variable, pretest decision-making scores functioned as the baseline covariate, and the instructional model alongside the gamification strategy served as fixed factors. ANCOVA was chosen because it adjusts for baseline variations through covariate control, minimizes residual error variance, and improves the precision of treatment effect estimates when parametric assumptions are met. Applying ANCOVA is particularly suitable for pretest posttest quasi-experimental designs, as it allows for valid post-intervention comparisons across groups after controlling for initial entry differences. In addition to significance values, this study reported partial eta squared as an effect size metric to reinforce statistical interpretations, especially given the modest sample size within each treatment cell.

Prior to conducting ANCOVA, prerequisite statistical assumption testing was completed, evaluating residual normality, homogeneity of variance, linearity between the covariate and the dependent variable, homogeneity of regression slopes, and baseline pretest equivalence across cohorts. All prerequisite tests applied an alpha significance threshold of .05. Data satisfied ANCOVA assumptions when resulting p-values exceeded .05. Once assumptions were confirmed, the analysis evaluated the main effect of instructional models, the main effect of Team Quest Gamification, and the interaction effect between both factors. Where significant differences emerged, pairwise comparisons were performed using the Bonferroni adjustment to identify specific group differences. The final interpretation synthesized ANCOVA results, partial eta squared values, absolute gains, and normalized gains so that the study conclusions reflect both statistical significance and practical educational efficacy.

RESULTS

Descriptive Statistics of Student Decision Making

This section outlines the empirical findings regarding basketball decision-making performance among junior high school students following the implementation of the four instructional conditions. In accordance with the 2 x 2 factorial design, 32 students participated across four cohorts of eight students each: TGfU with Team Quest Gamification, TGfU without Gamification, Direct Instruction with Team Quest Gamification, and Direct Instruction without Gamification.

Baseline pretest scores across all cohorts fell within a narrow range between 48.00 and 49.00, confirming that initial decision-making competence was equivalent prior to the intervention. Following the intervention period, the TGfU plus Team Quest Gamification cohort achieved the highest posttest mean, absolute gain, and normalized gain relative to the other three groups. A comprehensive summary of these descriptive metrics is presented in Table 4.

Table 4 indicates that the TGfU plus Team Quest Gamification group achieved the highest outcomes, recording a posttest mean of 88.79, an average gain of 40.54, and a normalized gain of 0.784, which falls into the high category. The TGfU without Gamification group

registered a posttest mean of 77.04, an average gain of 28.04, and a normalized gain of 0.550, categorized as medium. The Direct Instruction plus Team Quest Gamification group obtained a posttest mean of 74.02, an average gain of 26.02, and a normalized gain of 0.500, also falling within the medium category. Meanwhile, the Direct Instruction without Gamification group demonstrated the lowest performance, yielding a posttest mean of 64.13, an average gain of 15.13, and a normalized gain of 0.296, classified into the low category.

Table 4. Descriptive Statistics of Pretest, Posttest, Gain, and N-Gain for Student Decision Making

Group	N	Pretest Mean	Posttest Mean	Mean Gain	Mean N-Gain	Category
TGfU + Team Quest Gamification	8	48.25	88.79	40.54	0.784	High
TGfU without Gamification	8	49.00	77.04	28.04	0.550	Medium
Direct Instruction + Team Quest Gamification	8	48.00	74.02	26.02	0.500	Medium
Direct Instruction without Gamification	8	49.00	64.13	15.13	0.296	Low

Results Across Decision-Making Indicators

Posttest performance was further evaluated across the six core decision-making indicators: passing, dribbling, shooting, positioning, support play, and timing. The posttest means for each indicator are outlined in Table 5.

Table 5. Posttest Mean Scores Across Decision-Making Indicators

Group	Passing	Dribbling	Shooting	Positioning	Support Play	Timing
TGfU + Team Quest Gamification	87.62	87.38	89.00	90.00	90.75	88.00
TGfU without Gamification	76.00	76.00	77.50	77.75	78.50	76.50
Direct Instruction + Team Quest Gamification	73.00	73.00	74.50	74.62	75.50	73.50
Direct Instruction without Gamification	63.25	63.00	64.62	64.62	65.62	63.62

Table 5 demonstrates that the TGfU plus Team Quest Gamification group achieved the highest scores across all decision-making indicators, with peak values recorded in support play at 90.75 and court positioning at 90.00. The TGfU without Gamification cohort ranked second across every indicator, maintaining scores ranging between 76.00 and 78.50. The Direct Instruction plus Team Quest Gamification group consistently outperformed the non-gamified Direct Instruction group on all dimensions, yet remained below both TGfU treatment groups. The Direct Instruction without Gamification group registered the lowest scores across all sub-dimensions, with averages spanning from 63.00 to 65.62. Overall, the performance patterns across specific indicators aligned with the aggregate score outcomes.

Prerequisite Analysis Results

Prerequisite assumption testing demonstrated that the empirical data satisfied all required criteria for Two-Way ANCOVA. Standardized residuals were normally distributed ($p = 0.205$), between-group error variances were homogeneous ($p = 0.967$), regression slopes exhibited homogeneity ($p = 0.982$), and baseline proficiencies across cohorts were equivalent based on pretest scores ($p = 0.636$). Because all resulting p -values exceeded the 0.05

significance threshold, the analysis proceeded with Two-Way ANCOVA. All significance values derived from the prerequisite tests were greater than 0.05.

Two-Way ANCOVA Results

Two-Way ANCOVA was performed to examine the main effects of the instructional model and Team Quest Gamification, as well as their interaction effect on posttest decision-making performance while statistically controlling for baseline pretest scores. The findings of this inferential analysis are presented in Table 6.

Table 6. Two-Way ANCOVA Results for The Effects of Instructional Model and Team Quest Gamification on Decision Making

Source of Variation	Sig.	Partial Eta Squared	Conclusion
Instructional Model (X₁)	< 0.001	0.963	Statistically significant main effect
Team Quest Gamification (X₂)	< 0.001	0.941	Statistically significant main effect
Interaction (X₁ x X₂)	0.018	0.190	Statistically significant interaction

The ANCOVA results demonstrated that the instructional model exerted a statistically significant effect on student decision making, yielding a significance level of $p < .001$ and a partial eta squared of 0.963. Team Quest Gamification also significantly affected student decision making, with $p < .001$ and a partial eta squared of 0.941. Furthermore, the interaction between the instructional model and Team Quest Gamification was statistically significant, recording $p = .018$ and a partial eta squared of 0.190. In descriptive terms, the posttest mean difference between TGfU with Team Quest Gamification and TGfU without Gamification reached 11.75 points, whereas the difference between Direct Instruction with Team Quest Gamification and Direct Instruction without Gamification was 9.89 points.

Effectiveness Based on N-Gain and Synthesis of Findings

Based on normalized gain scores, the TGfU plus Team Quest Gamification group attained the high effectiveness category with an N-Gain of 0.784. The TGfU without Gamification group fell into the medium category with an N-Gain of 0.550, while the Direct Instruction plus Team Quest Gamification group also placed in the medium category with an N-Gain of 0.500. Meanwhile, the Direct Instruction without Gamification group was categorized as low, recording an N-Gain of 0.296. Overall, the findings demonstrate that the instructional model, Team Quest Gamification, and their interaction significantly influenced student decision making. The TGfU plus Team Quest Gamification cohort consistently demonstrated superior performance across posttest scores, absolute gains, normalized gains, and every individual decision-making indicator.

DISCUSSION

The Influence of Teaching Games for Understanding on Decision Making

The findings demonstrate that Teaching Games for Understanding exerts a statistically significant influence on basketball decision-making performance among junior high school students. This outcome indicates that instructional environments situating learners within representative game contexts provide superior support for developing action selection compared to teaching formats that emphasize isolated technical drill repetitions. Consequently, the discussion focuses not merely on numerical score differences, but on the pedagogical mechanisms that explain why TGfU systematically reinforces tactical decision-making capabilities in youth basketball.

The primary advantage of TGfU stems from its instructional architecture, which embeds learners in developmentally conditioned game scenarios that require reading emergent tactical dilemmas, selecting suitable motor responses, and reflecting critically on the choices made. In basketball, sound decision making depends not only on the mechanical execution of passes, dribbles, or shots, but also on reading court space, assessing teammate and defender movements, timing distribution windows, identifying viable scoring opportunities, and adopting functional supporting positions off the ball. TGfU closely reflects authentic game demands because motor skills are practiced in direct response to tactical problems rather than as isolated movement drills. Through this process, students discover when and why specific tactical actions should be deployed during live play. This experiential learning helps students establish a direct connection between situational perceptual cues, tactical understanding, and appropriate action selection.

These findings corroborate established physical education scholarship showing that TGfU provides distinct advantages over technique-centered direct instruction for advancing tactical reasoning by coupling perceptual information directly with action selection in representative play settings. González-Valero et al. (2024) noted that decision making within TGfU specifically pertains to tactical choices aligned with emergent player roles and game moments. In this regard, the current findings reinforce the view that decision making does not develop optimally through drill repetition alone, but through gameplay experiences requiring students to evaluate situations, select tactical options, and evaluate the consequences of their actions. Broader evidence reported by Robles et al. (2020) demonstrated that tactical pedagogies regularly surpass technical approaches in fostering decision making, noting an overall effect size of approximately 0.89, although intervention heterogeneity and varying certainty of evidence remain notable considerations. Barba-Martín et al. (2020) similarly confirmed that TGfU empirical investigations consistently target higher-order cognitive tactical outcomes, notably tactical awareness, problem-solving, and in-game decision making.

The Influence of Team Quest Gamification on Decision Making

The findings demonstrate that Team Quest Gamification exerted a statistically significant influence on student decision making. This effect can be understood because gamification does more than incorporate game mechanics; it establishes an intentional, challenging, collaborative learning environment that provides immediate feedback to learners. Accordingly, the primary focus of this discussion addresses how the Team Quest structure prompted students to take initiative, engage in tactical discussions, and refine their choices throughout basketball lessons.

Team Quest Gamification operated by integrating structured challenges, collaborative squad missions, milestone achievements, team points, and iterative feedback loops into basketball learning tasks. These components transformed instructional activities into purposeful, healthy competitive, cooperative, and meaningful learning experiences. When learners became socially and emotionally engaged, they secured greater opportunities to test alternative decisions, evaluate resulting outcomes, adapt tactical responses, and learn through interactions with peers. Within the Team Quest framework, decision making transitioned from an isolated individual responsibility into an interdependent squad effort aimed at completing collective missions. This dynamic is critical because basketball decision making occurs in a social tactical environment where individual choices directly govern the effectiveness of team coordination.

This mechanism aligns with motivational theories linking gamification elements to motivational design. Gamification supports feelings of competence, autonomy, and relatedness within the framework of self-determination theory, thereby augmenting intrinsic motivation and participatory intent compared to conventional instruction (Sailer & Homner, 2020). Sailer & Homner (2020) demonstrated that narrative framing, social interaction, and balanced competition combined with collaboration strengthen behavioral outcomes such as student engagement. In physical education contexts, Arufe-Giráldez et al. (2022) and Camacho-Sánchez et al. (2023) highlighted that gamified environments foster motivation, task commitment, engagement, and enriched learning experiences, despite methodological variations across interventions. Consequently, the present outcomes can be explained by the role of gamification as a catalyst for active engagement, which in turn offers learners frequent opportunities to rehearse tactical choices during dynamic play.

Nonetheless, these findings indicate that gamification is insufficient when utilized in isolation without a pedagogical foundation that supports tactical exploration. Team Quest Gamification is appropriately conceptualized as a supportive instructional strategy that reinforces motivation, peer cooperation, decision-making confidence, and active involvement, rather than an alternative to pedagogical models designed specifically to build tactical awareness and authentic game problem solving.

Interaction Between TGfU and Team Quest Gamification

A central finding of this investigation is the statistically significant interaction between the instructional model and Team Quest Gamification on student basketball decision making. This interaction indicates that instructional efficacy is governed not merely by an isolated teaching model or a gamification strategy operating independently, but by the pedagogical alignment between cognitive tactical scaffolding and motivational structures embedded within physical education lessons.

This interaction can be understood through two complementary dimensions. The TGfU model establishes cognitive tactical architecture through conditioned gameplay, guided inquiry, and authentic tactical problem solving. Concurrently, Team Quest Gamification introduces a socio-motivational framework through collaborative squad quests, structured challenges, team scoring mechanisms, feedback loops, and shared milestones. When integrated, learners not only develop an understanding of emergent tactical situations, but also feel driven to participate actively, communicate with peers, and fulfill collective mission objectives. In basketball settings, this environment encourages students to perceive tactical choices as cooperative team solutions rather than isolated, individual actions. In practical terms, TGfU clarifies what constitutes an appropriate tactical decision, whereas Team Quest addresses why students actively invest effort into the tactical decision-making process.

Substantively, passing decisions gained greater contextual relevance because they were tied directly to completing squad missions, manipulating defensive alignments, and generating higher quality scoring opportunities. Off-ball decisions such as positioning and support play also took on heightened significance because students recognized that collective success was determined not only by the player in possession of the ball, but equally by teammates who created functional space, provided passing relief, and preserved game timing. This dynamic explains why the integration of TGfU and Team Quest reinforced both on-ball and off-ball decisions, as learners came to understand that every action on the court carries direct consequences for the overall tactical strategy of the team.

Existing literature supports the plausible synergy between game-centered tactical instruction and collaborative team gamification frameworks. Teaching Games for

Understanding intentionally targets tactical awareness and situational decision making aligned with player roles and emergent game moments, backed by meta-analytic confirmation of meaningful improvements in decision-making capacity (González-Valero et al., 2024). In parallel, gamification yields small to medium gains across motivational and behavioral metrics, particularly when instructional designs leverage social interaction alongside balanced elements of competition and collaboration (Li et al., 2023; Sailer & Homner, 2020). Arufe-Giráldez et al. (2022) as well as Camacho-Sánchez et al. (2023) further reported that gamification in physical education is frequently coupled with complementary pedagogical models, typically enhancing student motivation and learning commitment. Although empirical testing directly evaluating the interaction between TGfU and gamification remains scarce, the present findings demonstrate that this integration rests on a sound pedagogical foundation. Consequently, these results enrich the scholarly discourse on hybrid pedagogical models by showing that merging tactical game approaches with gamified team structures can be targeted specifically to strengthen cognitive tactical learning outcomes.

Practical Effectiveness and Pedagogical Implications

From the standpoint of practical effectiveness, the findings demonstrate that the most substantial gains in decision making occur when tactical instruction and gamification are systematically integrated. This outcome underscores that physical education practitioners should structure basketball units not simply as isolated skill drills, but as comprehensive learning environments that merge authentic problem solving, social interaction, guided reflection, and mission-based motivational scaffolding.

The marked effectiveness observed in the TGfU plus Team Quest Gamification cohort indicates that middle school basketball instruction benefits considerably from learning designs that are challenging, contextually situated, reflective, and collaborative. Learners within this developmental stage require concrete, socially supportive, and engaging activities to foster higher-order tactical reasoning. Instructional formats focused exclusively on technical drill repetition often fall short because basketball decision making demands that students actively read emergent court dynamics, connect movement skills to tactical intentions, and select timely actions under pressure. Coupling game-centered pedagogy with cooperative team missions enables students to interpret live situations, test tactical solutions, and receive immediate feedback grounded in actual match play.

A core pedagogical implication is that physical education instructors must position tactical decision making as an explicit learning objective rather than an assumed byproduct of play. Teaching cannot stop at mechanical competency in passing, dribbling, shooting, or individual defending; it must explicitly teach learners when, why, and how to execute those skills within dynamic game flow. TGfU serves as a student-centered framework by providing developmentally modified games accompanied by structured tactical questioning. In tandem, Team Quest Gamification functions as an engine to bolster student motivation, active engagement, peer collaboration, and self-efficacy when taking tactical risks. Crucially, gamification should not be reduced to superficial points or arbitrary rewards. Instead, it must be carefully crafted around transparent learning goals, clear rule structures, pedagogically grounded missions, and meaningful reflective debriefs.

These findings must nevertheless be interpreted with appropriate caution given the modest sample size of 32 participants, corresponding to eight students per instructional condition. Consequently, broader generalizations should be drawn prudently. Future research should incorporate larger cohorts, extended intervention timelines, validated observational rubrics, and rigorous assessment protocols. These methodological refinements

are vital because the broader literature on TGfU and gamification in physical education frequently encounters common limitations, including brief intervention durations, procedural heterogeneity across implementations, variable measurement tools, and inconsistent reporting of implementation fidelity (Arufe-Giráldez et al., 2022; Barba-Martín et al., 2020).

Subsequent empirical inquiries should also examine cognitive tactical outcomes through more granular evaluations. Wang et al. (2024) underscored that the cognitive and decision-making dimensions of tactical games models remain comparatively underexplored. Similarly, Camacho-Sánchez et al. (2023) highlighted the pressing need for heightened methodological rigor within physical education studies evaluating game-based learning and gamified environments. Furthermore, adolescent gamification research warrants robust designs featuring active control groups and longitudinal follow-up evaluations to test the durability of motivational gains while monitoring for unintended consequences associated with digital badges, public leaderboards, or excessive peer rivalry (Melero-Cañas et al., 2021; Sal-de-Rellán et al., 2025). Prospective investigations could productively test the influence of integrated TGfU and Team Quest models across broader outcome domains, including situational motivation, motor skill execution, moderate-to-vigorous physical activity levels, peer cohesion, decision-making confidence, and students' subjective lived experiences within mission-based tactical units.

CONCLUSION

This study demonstrates that the integration of Teaching Games for Understanding and Team Quest Gamification produces the highest decision-making gains in middle school basketball instruction. The empirical findings confirm that the instructional model, Team Quest Gamification, and their interaction exert statistically significant effects on student decision making. The central outcome confirms that developing in-game decision making is substantially optimized when game-centered tactical inquiry is systematically paired with motivational and collaborative structures. Specifically, TGfU supports learners in interpreting emergent gameplay, identifying tactical solutions, and aligning motor skills with context-specific demands, while Team Quest Gamification fosters engagement, cooperative problem solving, personal initiative, and active participation through team-oriented missions and challenges.

The primary contribution of this research lies in advancing a hybrid pedagogical framework that bridges tactical game models and gamified learning mechanics to target higher-order cognitive-tactical outcomes in physical education. Nonetheless, the modest sample size warrants caution regarding broader generalization. Future investigations should incorporate larger cohorts, extended intervention durations, standardized outcome measures, and rigorous observational assessment protocols.

AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. The authors confirmed that the paper was free of plagiarism.

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