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PROMOTING ENGAGEMENT AND LEARNING IN BASIC STATISTICS: IMPLEMENTING THE TEAMS-GAMES- TOURNAMENT APPROACH FOR GRADE 8 STUDENTS

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Abstract

Statistics is often perceived by students as abstract and complex, which leads to disengagement and poor comprehension. To address this challenge, the present study examined the effectiveness of the Teams-Games-Tournament (TGT) cooperative learning strategy in improving Grade 8 students' performance in basic statistics at Nueva Ecija University of Science and Technology, Gabaldon Laboratory High School. TGT integrates teamwork, competitive games, and tournaments with the goal of enhancing students' academic performance, engagement, and attitudes toward learning. A one-group pre-test-post-test quasi-experimental design and a descriptive correlational approach were employed, involving 37 purposively sampled Grade 8 students. Over six weeks, the students participated in TGT-based lessons, with data collected through pre-tests, post-tests, and engagement surveys. The results revealed a notable improvement in students' academic performance following the intervention. Student engagement was generally rated high, especially in activities involving collaborative learning, although relatively lower engagement was observed in inquiry-based tasks. Furthermore, a positive relationship was identified between student engagement and academic performance, emphasizing the importance of active participation in enhancing learning outcomes. The TGT effectively improves academic performance and engagement in basic statistics. However, individual variability in post-test results and lower engagement in inquiry suggest the need for strategies that foster questioning and equitable participation. This research contributes to pedagogical innovations, emphasizing statistical literacy as foundational for data-driven careers and higher-level analytical skills.

Keywords: academic performance, basic statistics education, cooperative learning, statistical literacy, student engagement, teams-games-tournament (TGT)

Introduction

Helping students make sense of data is more crucial than ever in an age where information is abundant and decisions are increasingly data-driven. Yet, for many Grade 8 students, learning basic statistics can feel overwhelming, often seen as abstract, difficult, and detached from their everyday experiences. This disconnect can lead to low engagement and poor comprehension of core statistical concepts. To address these challenges, educators must adopt innovative teaching strategies that transform statistics into an interactive, relatable, and meaningful subject. Mastering statistical concepts is fundamental in equipping students with the skills to analyze and interpret data effectively, an increasingly valuable competency in today's data-driven world (Nwala, 2023). However, teaching basic statistics to Grade 8 students poses unique challenges, as many learners perceive the subject as abstract, complex, and disconnected from their everyday experiences. This perception often results in a lack of interest

and engagement, ultimately hindering their understanding of fundamental statistical principles. Addressing these challenges necessitates implementing innovative teaching strategies that foster interactive, engaging, and meaningful learning experiences. As highlighted by Razali et al. (2023), cultivating positive attitudes and enhancing students' confidence levels are essential for improving academic success in statistics courses.

The Teams-Games-Tournament (TGT) technique, initially developed by DeVries and Edwards (1972), is a cooperative learning strategy designed to address common educational challenges by fostering collaboration, active participation, and deeper understanding through cooperative problem-solving (Agustina et al., 2024; Capinding, 2021). TGT combines teamwork, competitive games, and structured tournaments to create a dynamic classroom environment that encourages peer interaction, enhances motivation, and makes learning more enjoyable and relevant (Matitaputty et al., 2023; Wiratama, 2024). By leveraging these social and competitive elements, TGT significantly improves students' conceptual understanding, problem-solving abilities, and academic performance (Bunag, 2024).

One of the primary advantages of TGT is its proven ability to enhance academic outcomes. Research demonstrates that implementing the TGT model can substantially improve students' performance. For instance, average student scores in mathematics increased from 61.48 to 86.78, with mastery rates rising from 40.74% to 85% (Isaloka et al., 2024). Similarly, a study focusing on multiplication topics reported a rise in mastery from 37.04% to 85.19%, showcasing significant gains in understanding and engagement (Maghfiroh et al., 2024).

The TGT model also plays a crucial role in increasing students' motivation and engagement (Luo et al., 2020; Putri et al., 2023). Its competitive and interactive nature, involving games and tournaments, creates an enjoyable and stimulating learning atmosphere (Vijayta & Isnawati, 2021). This environment encourages students to actively participate and engage more deeply with the content, as evidenced by studies where students' motivation levels improved from "Moderate" to "High" after TGT implementation (Pasaribu & Sihotang, 2024). In addition to academic and motivational benefits, TGT contributes to developing essential social and cooperative skills (Wulandari & Rosdiana, 2024). Through group interactions and collaborative activities, students enhance their teamwork and communication abilities (Nisa et al., 2024). These skills are crucial for academic success and preparing students for future collaborative endeavors and professional growth (Nisa et al., 2024).

On the other hand, there are several challenges in implementing the TGT related to classroom management, group dynamics, and practical implementation. One significant issue is the potential for increased noise levels and difficulties in managing the classroom environment, especially in larger or overcrowded settings. These factors can disrupt the flow of lessons and reduce their effectiveness, particularly when responsibilities and rewards are not distributed fairly among group members (Baydar, 2020). Additionally, the collaborative nature of TGT can sometimes lead to imbalances in group contributions, with more capable students dominating participation and overshadowing those who may require additional support to grasp the material (Ambarwati, 2014). This "domino effect" undermines the equitable engagement of all learners, a key goal of cooperative learning strategies. Another disadvantage lies in the challenge of dividing classes into balanced groups based on students' varying intelligence levels and learning paces. Creating equitable groupings that maximize the benefits of collaboration while minimizing disparities can be complex and time-consuming (Ambarwati, 2014). Furthermore, while TGT can be a valuable tool in teaching English and other subjects, its implementation demands substantial preparation and planning. Teachers must design engaging games, structure tournaments effectively, and anticipate potential disruptions. For some students, the cooperative aspects of TGT may not align well with their individual learning preferences, further complicating its success (Solekhah, 2020).

Statistics education at the Grade 8 level is a critical foundation for higher-level mathematical and analytical skills. It equips students with tools to organize, summarize, and interpret data, which are essential for informed decision-making. Despite its importance, studies and classroom observations indicate that many students struggle with basic statistical concepts, such as measures of central tendency, probability, and data visualization. For example, the Grade 8 Laboratory High School students of Nueva Ecija University of Science and Technology Gabaldon Campus show a low engagement and performance in basic statistics as shown in their recent performance, where only 8.1% of the students got an outstanding performance, 13.51% got a very satisfactory performance, 27.02% got a satisfactory performance, and 51.35% got a fairly satisfactory performance (NEUST Gabaldon Laboratory High School, 2024). This was also notable in the PISA 2022 results, which show that in the Philippines, only 16% of students achieved at least Level 2 proficiency in mathematics, far below the OECD average of 69%, while almost none reached top levels (5 or 6), compared to the OECD average of 9%. These difficulties often stem from traditional teaching approaches that rely heavily on lectures and rote memorization, leaving little room for active learning and collaboration. According to Lapinid et al. (2022), there is a need to address students' social and psychological factors, requiring a deeper focus on making learning environments more effective.

Recognizing this problem, the present study aims to explore the implementation of the Teams-Games-Tournament (TGT) technique in teaching basic statistics to Grade 8 students. This classroom-based action research seeks to determine whether TGT can enhance student engagement, foster a positive attitude toward statistics, and improve their overall performance. By introducing a structured yet flexible approach that combines teamwork and competition, the research intends to make the learning process more accessible and enjoyable for students.

Furthermore, the study addresses the broader need for effective pedagogical practices that prepare students to meet the demands of the modern educational landscape. As statistical literacy becomes increasingly relevant across various fields, equipping learners with a strong foundation in statistics not only supports their academic success but also their future careers. By examining the potential of the TGT technique, this research contributes to the growing body of knowledge on innovative teaching methodologies and their impact on student learning outcomes.

Finally, the study aimed to provide educators with concrete insights into how the TGT approach might be incorporated into classroom procedures to improve engagement and learning in basic statistics, thereby setting the framework for a more engaging and successful learning environment. Specifically, this study intended to address the following questions: a.) How can the students' statistical performance be described before and after the TGT intervention? b.) Is there a substantial difference between the pre-test and post-test scores? c.) How should the general student's involvement in statistics be portrayed following the deployment of TGT? and d.) Is there a substantial association between the students' post-test scores and their overall involvement in statistics?

Research Methodology

Design

This study utilizes both a one-group pre-test and post-test quasi-experimental design and a descriptive correlational design. The one-group pre-test and post-test quasi-experimental design was used to evaluate the efficacy of the Teams-Games-Tournament (TGT) approach in teaching basic statistics to Grade 8 students. This design, a type of quasi-experimental research, involves assessing a single group of participants on the same dependent variable before and after a specific treatment or intervention (Choueiry, 2023). Specifically, a pre-test was administered

to gauge students' initial understanding of basic statistics, followed by the implementation of the TGT approach, and then a post-test to measure improvements in their skills and engagement. The quasi-experimental nature of this design ensures its practical applicability in a classroom setting while providing data to assess the intervention's impact (Lam & Wolfe, 2023). Additionally, the descriptive correlational design was utilized to explore the relationship between students' post-test results and their general engagement in basic statistics. This design is used to identify and describe relationships between variables without manipulation, offering insights into their natural associations (Brodowicz, 2024).

Sampling Technique

This study utilizes purposive sampling to select participants. This method ensures that the sample includes students who are representative of the target population and possess characteristics relevant to the study's objectives (Andrade, 2021). Grade 8 students from a selected class were chosen based on their current performance in statistics and their availability to participate in the intervention.

Participants

The participants consisted of 37 Grade 8 students enrolled in a mathematics course that included a unit on basic statistics. This number was determined by the actual enrollment in the class, rather than being arbitrarily set. While the sample size is relatively small, it represents the complete population of students available in the selected class. Such naturally bounded samples are common in educational intervention studies and are considered valid as they reflect authentic classroom contexts. The group was also diverse in terms of mathematical abilities, which strengthens the reliability of the findings and supports the potential to generalize insights to similar learner populations.

Experimental Procedure

This study was conducted over six weeks (January 6 to February 14, 2025) and divided into three phases. During the Pre-Test Phase, a pre-test was administered to assess students' initial knowledge and skills in basic statistics. In the Intervention Phase, the TGT approach was applied in regular mathematics classes, where students were organized into teams and participated in lessons using teamwork, competitive games, and structured tournaments. Finally, in the Post-Test Phase, a post-test was conducted to evaluate improvements in students' statistical skills. Additionally, a questionnaire was administered to measure students' engagement in learning basic statistics.

Teams-Games-Tournament Procedure

According to Slavin (1995), the Teams Games Tournament (TGT) model promotes collaborative learning by organizing students into diverse groups of 4-6 members. The process involves forming groups, presenting the lesson, completing group worksheets, engaging in inter-group tournaments, and concluding with reflection and reinforcement. Similarly, Annurwanda (2018) outlines three key components of the TGT model: 1) Teams, where students are assigned to balanced groups based on academic ability; 2) Games, interactive activities designed to reinforce learning; and 3) Tournaments, where students compete individually to earn points for their teams, with the highest-scoring team declared the champion. Guided by the frameworks

of Slavin (1995) and Annurwanda (2018), these principles were applied in the experimental procedure.

1. To form teams, the researcher divides the total number of students by six. In this case, since there are 37 students in the class, $37 \div 6 = 6$ teams. Assign numbers sequentially, alternating direction (e.g., 1, 2, 3, 4, 5, 6, 6, 5, 4, 3, 2, 1). This method creates academically balanced, diverse teams while ensuring equal ability (Capinding, 2021).
2. There are four hours of class meetings each week. The first two hours are dedicated to pure discussion, employing the traditional teaching method where chalk and a chalkboard are used, supplemented by PowerPoint presentations. Students are encouraged to actively participate in classroom discussions. During this two-hour session, students' recitations are recorded as individual scores under the performance task category (Department of Education [DepEd], 2015).
3. The third hour is dedicated to collaboration with group mates, during which students practice the statistical skills taught in the first two hours of discussion. During this collaborative time, the highest-performing student(s) in the group, or their leader, tutors the lower-performing student(s). This one-hour team collaboration is also referred to as peer tutoring. Additionally, during this hour, students also practice the necessary skills required for the actual tournament (Capinding, 2022).
4. The fourth hour is dedicated to the actual tournament, where teams compete in a game. In these games, students participate either individually or as a group. Individual scores contribute to the overall team score, fostering personal accountability and effort (Patil et al., 2023). Additionally, the competitive nature of the tournament motivates students to collaborate, share knowledge, and support one another in achieving common goals (Astuti et al., 2022).
5. After the tournament, the winning group received recognition, and the "Most Performing Player of the Week" was also acknowledged. The winning group and top-performing student(s) were awarded prizes, such as chocolates, snacks, and/or toys. Students or groups who did not win were given consolation prizes. Additionally, the winning team and the most performing player were featured on the TGT board.

Prizes serve to stimulate student interest and engagement, making learning more enjoyable (Faysal et al., 2023). Similarly, students in game-based learning environments who receive rewards demonstrate higher motivation and better educational outcomes compared to those who do not (Duisenova & Zhorabekova, 2024). Furthermore, rewards can act as catalysts, helping students shift from extrinsic to intrinsic motivation and ultimately fostering a genuine love for learning (Sigalingging et al., 2023).

Games and Game Procedures

The TGT sessions featured a variety of games designed to reinforce statistical concepts, including summation notation, measures of central tendency, quantiles, measures of dispersion, and the coefficient of variation. Some games were adapted and modified to incorporate statistical questions while the researcher developed others. Below is a list of games implemented during the tournament.

1. The Ball Asks is a game adapted from SantoPixel (2024). To begin, all students form a circle, and music is played while a ball is passed around. When the music stops, the student holding the ball must answer a question. A correct answer earns the student 3 points, which are added to their team's total. If the student answers

incorrectly, another team has the opportunity to “steal” and respond. A correct answer by the stealing team earns them 2 points. If no team answers correctly, the game continues, with the music resuming.

2. The Squid Game is a highly popular Korean series. A variation of this game was adapted for an activity involving students. The researcher recruited six students from higher grade levels to act as “Young-hee.” The objective of the game was for participants to retrieve questions located behind the six “Young-hee” and answer them correctly.

Students had to approach the “Young-hee” stealthily to avoid being noticed. If a participant was seen or noticed by “Young-hee,” they were immediately eliminated from the game. If a student successfully retrieved a question without being detected and answered it correctly, their team earned three points. However, if the question was answered incorrectly, the participant was eliminated. The team with the highest score at the end of the activity was declared the winner of the week.

3. “Family Feud,” an American TV icon since 1976 with Richard Dawson as its first host, features dueling families and the famous phrase, “Survey says!” Despite changes in hosts, cancellations, revivals, and syndication, it remains popular with loyal fans while attracting new ones.

In the main game of “Family Feud,” one member from each team faces off to answer the first question. The first to buzz in gives an answer; if it’s the top response, their family gains control. Otherwise, the other contestant tries to provide a better answer to win control.

The winning family guesses the remaining answers without consulting each other. Incorrect answers earn strikes, and three strikes transfer control to the opposing team, who gets one chance to guess correctly and win the round. Typically, four rounds are played, with additional sudden-death rounds if time permits (Kelly et al., 2024).

4. Tied up game. Divide participants into teams of 6. Form circles with team members facing each other and tie their wrists to their neighbors using rope or strings. Each team must then complete and answer the given questions together while their hands remain tied (Toggle Track, 2024).
5. The “Pop the Balloon” game features six teams of six members each, competing to answer questions hidden in balloons and earn points. Teams take turns popping a balloon, retrieving the question, and answering it within 30 seconds. Correct answers earn 10 points, while incorrect ones earn none. The game proceeds in rotation, ensuring equal turns for all teams. The team with the highest score wins, with a tiebreaker round if necessary. Participants must remain respectful and avoid outside assistance. The facilitator ensures fair play and accurate scoring in this fun, team-based activity (Indoor Party Games, 2024).
6. Statistical Race. This game challenges participants to solve statistical problems in the shortest possible time. There will be four different stations, located both inside and outside the room, each containing a specific question that teams must answer correctly. The team that completes all stations in the shortest time will be declared the winner.

Materials and Instruments

The researcher employed two essential tools in this study. A 50-item test was developed by the researcher for both the pre-test and post-test to assess the participants’ knowledge and skills. While the items in the pre-test and post-test were similar in difficulty, they were not identical. Additionally, a questionnaire designed to measure general student engagement in learning basic statistics was also created by the researcher. The questionnaire used a 4-point

Likert scale with the following response options: 4 (strongly agree), 3 (agree), 2 (disagree), and 1 (strongly disagree).

Validity of Test Questions and General Student Engagement

To ensure the validity of the test items and the questionnaire on general student engagement in learning basic statistics, the researcher utilized the Lawshe (1975) method. This approach involves expert evaluation of each item's relevance to the construct being measured. The researcher enlisted the assistance of 10 mathematics faculty members from NEUST to review and rate each item in the test questions and the Likert scale questionnaire. Each item was assessed based on its essentiality, with ratings used to compute the Content Validity Ratio (CVR) using the formula: $CVR = [ne - (N/2)] / (N/2)$, where ne represents the number of panelists rating the item as "essential," and N is the total number of panelists. Items that achieved a minimum CVR of 0.667, as required for a panel of 12 experts, were considered valid and relevant for inclusion in the test and questionnaire (Ayre & Scally, 2014). This process ensured the reliability and appropriateness of the tools for assessing knowledge, skills, and engagement in basic statistics.

Table 1 shows that the Content Validity Ratio (CVR) for the items in the pre-test and post-test ranges from .667 to 1.00, exceeding the critical value of .667. Similarly, the Content Validity Index (CVI) for these items is .863, which is also above the critical threshold of .667. Likewise, the CVR for the General Engagement Questionnaire for Statistics (GEQS) ranges from .667 to 1.00, with a CVI of .833, both surpassing the critical value of .667. Based on these results, the pre-test, post-test, and GEQS are deemed valid.

Table 1
Content Validity of Test Questions and Questionnaire

	Content Validity Ratio Ranges	Content Validity Index (CVI)	Critical Value	Interpretation
Pre-test and Post-test	.667 – 1.00	.863	.667	Valid
General Engagement Questionnaire (GEQS)	.667 – 1.00	.833	.667	Valid

Item-Analysis

Table 2 presents the ranges of the difficulty index and discriminating power for each item in the pre-test and post-test. The difficulty index for the pre-test ranges from .43 to .53, while that of the post-test ranges from .43 to .67, indicating that the items for both tests are of average difficulty. Additionally, the discriminating power for the pre-test ranges from .38 to .50, and for the post-test, it ranges from .38 to .63. Both ranges are interpreted as reflecting very good item quality.

Table 2
Difficulty Index and Discriminating Power

	Ranges of Difficulty Index	Difficulty	Ranges of Discriminating Power	Interpretation
Pre-test	.43-.53	Average	.38-.50	Very Good Items
Post-test	.43-.67	Average	.38-.63	Very Good Items

Reliability of Instruments

Table 3 presents the Cronbach's alpha values for the pre-test and post-test as .91 and .90, respectively, which indicate excellent reliability. The General Engagement Questionnaire for Statistics (GEQS) yielded a Cronbach's alpha of .88, signifying good reliability. These findings suggest that the pre-test, post-test, and questionnaire possess strong internal consistency (Middleton, 2019). Furthermore, the alpha values remain below .95, implying that the items are sufficiently distinct and not overly redundant (Frost, 2023).

Table 3
Reliability of Test Questions and Questionnaire

	Cronbach's alpha	Interpretation
Pre-test	.91	Excellent
Post-test	.90	Excellent
General Engagement Questionnaire (GEQS)	.88	Good

Data Collection

The researcher respectfully sought permission from the principal of the Laboratory High School and the Campus Director of the Nueva Ecija University of Science and Technology, Gabaldon Campus, to conduct the study. During the initial meeting, the pre-test was administered to assess the students' knowledge and skills in basic statistics, serving as baseline data for the experiment (All et al., 2017). Following a six-week intervention using the Teams-Games-Tournament approach, the post-test was administered to evaluate the students' learning in basic statistics. Additionally, the general questionnaire on students' engagement in basic statistics was distributed to gather further insights.

Data Analysis

The data analysis utilized both descriptive and inferential statistical techniques. Descriptive statistics, such as the mean and standard deviation, were used to summarize the pre-test and post-test results, along with students' engagement levels. For inferential analysis, a paired sample t-test was conducted to assess whether the improvement in post-test scores compared to pre-test scores was statistically significant. Moreover, the Pearson correlation coefficient (r) was applied to explore the association between engagement levels and post-test performance, offering insights into how engagement may influence learning outcomes.

Normality Test

Table 4 indicates that the pre-test ($W = .973, p > .05$), post-test ($W = .917, p > .05$), and the General Engagement Questionnaire ($W = .905, p > .05$) are normally distributed. Hence, the t-test for correlated samples and Pearson's correlation coefficient were utilized for data analysis.

Table 4
Normality Test

Data Sources	Shapiro-Wilk		
	<i>W</i>	<i>df</i>	<i>p</i>
Pre-test	.973	37	.491
Post-test	.917	37	.309
General Engagement Questionnaire (GEQS)	.905	37	.314

Research Results

Pre-test and Post-test Results

Table 5 presents the descriptive statistics for the pre-test and post-test scores of Grade 8 students in basic statistics conducted before and after the implementation of the Teams-Games-Tournament (TGT) intervention. The average score in the pre-test was 11.59, with a standard deviation of 4.33, indicating relatively low initial performance with moderate variability among the 37 students. After the intervention, the post-test average increased to 31.43, with a higher standard deviation of 7.43. This indicates a substantial improvement of approximately 20 points in the mean score, though the increased variability suggests that some students benefited more from the intervention than others.

Table 5
Descriptive Statistics for Pre-test and Post-test

Test Before and After TGT	<i>M</i>	<i>MD</i>	<i>N</i>	<i>SD</i>
Pre-test	11.59	19.84	37	4.33
Post-test	31.43		37	7.43

Paired Sample t-test for Pre-test and Post-test

The table displays the results of a paired sample t-test comparing Grade 8 students' pre-test and post-test scores in basic statistics after implementing the Teams-Games-Tournament (TGT) strategy. A correlation coefficient of .850 indicates a strong positive relationship, suggesting that students who scored well on the pre-test also tended to do well on the post-test. The p-value ($p < .01$) shows that the improvement in scores is statistically significant. The t-value ($t = -27.502, p < .01$) further supports this significant difference, with the negative sign indicating higher post-test scores. Moreover, a *Cohen's d* of 4.52 suggests a very large effect size, underscoring the notable educational impact of the TGT intervention.

Table 6.
Paired Sample t-test for Pre-test and Post-test

	Correlation	<i>p</i>	<i>t</i>	<i>df</i>	<i>p</i> (2-tailed)	Cohen's <i>D</i>	Effect Size
Pre-test & Post-test	.850	< .001	-27.502	36	< .001	4.52	Large Effect

General Engagement of Students in Basic Statistics After the TGT Intervention

After implementing the Teams-Games-Tournament (TGT) strategy as an intervention, the data revealed a significant level of student engagement in basic statistics, as reflected in the overall weighted mean of 3.38, verbally interpreted as “Strongly Agree.” The strategy appears to have effectively fostered collaboration and teamwork, with the highest mean score of 3.54 observed in students’ collaboration with classmates to solve statistical problems. This indicates that the TGT approach successfully promoted interactive and cooperative learning among students.

Additionally, students showed strong engagement in various aspects of the learning process, such as actively participating in discussions (3.49), applying statistical knowledge to real-world situations (3.35), and enjoying the challenge of working on statistical problems (3.46). These results suggest that the TGT strategy enhanced their motivation and interest in learning basic statistics. However, the lowest mean score of 3.16, corresponding to asking questions during lessons, indicates that while engagement improved overall, there remains room for growth in encouraging students to clarify concepts through active questioning.

The variability in responses, as indicated by standard deviations ranging from 0.50 to 0.80, further suggests that students experience differing levels of impact. The highest variability was seen in the aspect of asking questions (0.80), potentially reflecting differences in confidence or willingness to participate in this way. Overall, the data suggest that the TGT strategy positively influenced student engagement, particularly in collaborative and applied learning, while emphasizing the need to create an environment that further supports inquiry and clarification during lessons.

Table 7
General Engagement Questionnaire (GEQS)

General Students' Engagement in Basic Statistics	M	SD	Verbal Interpretation
1. I actively participate in class discussions about basic statistics.	3.49	0.56	Strongly Agree
2. I regularly complete assignments and activities related to basic statistics on time.	3.30	0.70	Strongly Agree
3. I feel motivated to learn and understand statistical concepts.	3.41	0.50	Strongly Agree
4. I collaborate with my classmates to solve statistical problems.	3.54	0.56	Strongly Agree
5. I find the topics in basic statistics interesting and engaging.	3.30	0.74	Strongly Agree
6. I ask questions during lessons to clarify my understanding of statistical concepts.	3.16	0.80	Agree
7. I use additional resources (e.g., books, videos, or online tutorials) to enhance my learning of basic statistics.	3.27	0.65	Strongly Agree
8. I apply the knowledge I learn in basic statistics to real-world situations or other subjects.	3.35	0.59	Strongly Agree
9. I enjoy working on statistical problems, even when they are challenging.	3.46	0.65	Strongly Agree
10. I feel that my instructor's teaching methods encourage my active participation in learning statistics.	3.57	0.55	Strongly Agree
Total Weighted Mean	3.38	0.64	Strongly Agree

Correlation Between Post-test Results and Students' General Engagement in Basic Statistics

Table 8 shows that the relationship between the post-test results and students' engagement in basic statistics is highly significant ($r = .518, p < .01$). The positive relationship suggests that higher levels of student engagement, fostered by the TGT intervention, are associated with improved academic performance.

Table 8
Correlation of Engagement and Scores in Basic Statistics

		General Engagement
Post-test	Pearson r	.518**
	p -value (2-tailed)	.001
	N	37

Discussion

The large mean difference of 19.84 suggests that the TGT approach equipped with different games had a positive impact on the students' performance in basic statistics. These

results highlight the effectiveness of active and collaborative learning strategies, as the TGT intervention likely made the learning process more engaging and interactive, thereby enhancing understanding and retention. Similarly, Hasibuan et al. (2022) found that the Teams Games Tournament (TGT) learning model, when paired with general media and cooperative learning, increased student learning outcomes in biology. This finding supports the view that TGT is an effective strategy for enhancing student achievement across different subject areas. Comparable results have also been reported internationally, where game-based and cooperative learning methods enhanced students' cognitive outcomes and motivation in mathematics and science education (Hui & Mahmud, 2023). However, the higher variability in the post-test scores in the present study implies that individual differences may have influenced how students responded to the intervention, a challenge also noted in cross-cultural contexts.

The results clearly indicate that the TGT intervention was highly effective in improving students' performance in basic statistics. The strong correlation suggests that the method worked consistently across students with varying initial skill levels, while the large effect size emphasizes the magnitude of the improvement. The statistically significant increase in scores supports the idea that the TGT approach, which incorporates active and collaborative learning, enhances students' understanding and engagement in the subject matter. Likewise, the Teams Games Tournament (TGT) cooperative learning model has been found effective in ecosystem education (Ghaemi et al., 2023) and in mathematics classrooms in Indonesia (Wahjusaputri et al., 2024). These findings are consistent with research in other fields; for example, Bhat et al. (2020) reported that TGT boosted performance and collaboration in engineering students, while Syaifuddin et al. (2020) highlighted its benefits in improving students' learning outcomes in Civics Education.

These findings have important implications for educational practices. The substantial improvement in post-test scores demonstrates the value of interactive and student-centered teaching methods like TGT in fostering meaningful learning (Saputri & Sukmawati, 2024). Moving forward, educators could consider applying similar strategies to other subjects to achieve comparable outcomes. However, future studies could also explore the variability in individual responses to the intervention to ensure its effectiveness for all learners. Overall, the TGT intervention appears to be a transformative approach to improving academic performance in statistics. Similarly, Wahjusaputri et al. (2024) show that team-assisted Individualization and Team Games Tournament models effectively improve academic achievement and engagement in seventh-grade Math students. Comparable findings are also reported by Fonseca et al. (2023), where cooperative game-based learning significantly improved student engagement and problem-solving skills.

Furthermore, the results highlight the effectiveness of the Teams-Games-Tournament (TGT) strategy in enhancing student engagement in basic statistics. The findings underscore the significant impact of this cooperative learning approach, with students showing the highest engagement in collaborative learning, particularly when working with classmates to solve statistical problems. This suggests that the TGT strategy successfully fostered teamwork and a sense of community, which are essential elements of interactive learning (Capinding, 2021). Comparable studies confirm that fostering teamwork through structured competition improves not only academic achievement but also communication and social interaction skills (Amri et al., 2025).

Additionally, the strategy improved students' active participation in discussions, motivation to apply statistical knowledge to real-world contexts, and enjoyment in tackling statistical problems. These outcomes indicate that the competitive yet cooperative nature of the TGT strategy effectively stimulated interest and sustained engagement in the subject. By integrating games and tournaments into the learning process, students likely found the activities more engaging, which contributed to their overall positive experience. Similar conclusions

were drawn by Peña et al. (2024), who found that structured competition enhanced students' motivation and classroom participation in U.S. settings.

However, the results also reveal an area for improvement. Students demonstrated less confidence in asking questions during lessons, indicating that while the TGT strategy encouraged other forms of engagement, it did not fully address students' hesitation to seek clarification. The variability in this area reflects differences in comfort levels, suggesting the need for targeted efforts to support inquiry and active questioning. This limitation aligns with findings from international studies where game-based learning improved collaboration and motivation but was less effective in promoting critical questioning and inquiry (Capinding & Salazar, 2023).

Furthermore, the findings demonstrate that the TGT strategy is a valuable tool for promoting engagement in basic statistics, particularly in enhancing collaboration, participation, and motivation. Future implementations could incorporate activities or incentives that specifically encourage students to ask questions and seek clarification during lessons. Creating a classroom environment that normalizes and values inquiry can further enhance the effectiveness of the strategy and support all students in their learning journey. On the other hand, according to Fortepiani (2023), game-based learning strategies increased student engagement and perception of learning but did not significantly improve academic performance in Health Professions education. Similarly, Yu et al. (2020) stated that educational games have the potential to improve student engagement and satisfaction, but their impact on learning outcomes depends heavily on the game's design and implementation. Consequently, the design of this TGT, incorporating various games, appears particularly effective in improving students' performance in statistics while also boosting their engagement.

The moderate positive correlation suggests that as students' engagement in learning activities increases, their academic performance in basic statistics also improves. This relationship highlights the effectiveness of the Teams-Games-Tournament (TGT) intervention in promoting active participation, collaboration, and motivation among students. By making the learning process interactive and enjoyable, the TGT strategy likely encouraged students to invest more effort and interest in their studies, resulting in better academic outcomes. Likewise, according to Nisa et al. (2024), the Team Games Tournament (TGT) learning model positively impacts student mathematics learning outcomes by increasing motivation, engagement, and understanding while developing social and cooperative skills. However, not all studies align; Tejada-Simon (2024) found that game-based learning enhances engagement but does not directly improve grades in higher education, which suggests that context and implementation are critical factors.

Ultimately, these findings reinforce the value of implementing innovative teaching strategies, such as TGT, that emphasize engagement and active learning. Furthermore, the significant correlation suggests that enhancing student engagement should be a priority in instructional planning, as it directly impacts academic success. Future interventions can build upon these results by further optimizing engagement strategies to maximize both learning experiences and performance outcomes.

Conclusions and Implications

This study contributes to closing the gap in empirical research on the effectiveness of structured game-based collaborative strategies, such as the Teams-Games-Tournament (TGT) approach, in teaching statistics. While active and collaborative learning methods have been widely advocated, limited evidence exists on how combining them with competitive, game-based elements can influence both cognitive and affective learning outcomes in quantitative subjects. The findings demonstrate that TGT significantly improves students' performance in basic statistics, with a large mean difference, strong correlation, and substantial effect size,

underscoring its effectiveness. Beyond academic gains, the strategy fostered engagement, teamwork, and motivation, creating a dynamic classroom environment that supported students across varying skill levels. However, the persistent challenge in students' confidence to ask questions highlights the need for complementary interventions to strengthen inquiry skills and classroom discourse. These findings suggest that integrating TGT into teaching practice can enhance learning effectiveness in statistics education, while also pointing to the importance of designing supportive structures that encourage student questioning and critical thinking.

Recommendations

Educators are encouraged to incorporate the TGT strategy into their teaching practices, not only for statistics but also for other subjects where active and collaborative learning can be beneficial. To maximize the effectiveness of the approach, efforts should focus on designing activities that balance competitive and cooperative elements, ensuring sustained student interest and participation. Additionally, future implementations of the TGT strategy should address students' hesitation to seek clarification by fostering a classroom culture that values inquiry and critical thinking. This can be achieved through targeted activities, such as structured questioning sessions or incentives for active participation. Researchers are also encouraged to investigate the variability in students' responses to the TGT approach and explore its application in diverse educational contexts to ensure inclusivity and consistency in its impact.

Acknowledgements

The author extends sincere gratitude to the Campus Director of NEUST for granting permission to conduct this study. Special appreciation is also given to the students who willingly participated and contributed valuable insights as respondents of this research.

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Received: May 11, 2025

Revised: March 09, 2026

Accepted: April 10, 2026

Andie Tangonan CAPINDING. Promoting engagement and learning in basic statistics: Implementing the teams-games-tournament approach for grade 8 students

Cite as: Capinding, A. T. (2026). Promoting engagement and learning in basic statistics: Implementing the teams-games-tournament approach for grade 8 students. *Problems of Education in the 21st Century*, 84(2), 277–294. <https://doi.org/10.33225/pec/26.84.277>

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