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Effectiveness of the Teams Games Tournament (TGT) Cooperative Learning Model on Students' Mathematics Achievement

Lira karina[1*], Patricia V.J Runtu[2], Marvel Grace Maukar[3]

[1,2,3]Department of Mathematics Education, Faculty of Mathematics, Natural Sciences and Earth Sciences, Universitas Negeri Manado

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ABSTRACT

Students' limited mastery of algebra remains a persistent obstacle in achieving the expected mathematics competencies. At MTs Negeri 1 Manado, instruction is still dominated by teacher-centered lectures, which often lead to passive learning behavior, declining motivation, and difficulties in understanding mathematical concepts. This study was conducted to examine the effectiveness of the Teams Games Tournament (TGT) cooperative learning model as an alternative approach to improve students' mathematics achievement. A quantitative approach with a quasi-experimental pretest–posttest control group design was applied. The population consisted of all seventh-grade students, and a random sample of two classes (VII-B and VII-I) was selected. The research instrument comprised five essay-type test items that had been validated by experts (lecturers and teachers) and demonstrated acceptable reliability. The procedure included four main stages: preparation, pretest administration, instructional treatment, and posttest administration, followed by statistical analysis. Data were analyzed using normality and homogeneity tests, independent and paired-sample t-tests, and effect size estimation through Cohen's d. The results indicated a significant improvement in the experimental group, with the mean score rising from 69.52 to 76.97, corresponding to a large effect size (d = 1.09). These findings confirm that the TGT model is effective in enhancing mathematics learning outcomes. Furthermore, the study highlights the pedagogical potential of TGT in promoting active participation, fostering motivation, and offering an engaging alternative to conventional lecture-based teaching in mathematics classrooms.

Corresponding Author:

Lira Karina,
Department of Mathematics Education,
Faculty of Mathematics, Natural Sciences and Earth Sciences,
Universitas Negeri Manado
Jl. Kampus Unima, Tonsaru, South Tondano District, Minahasa Regency, North Sulawesi 95618, Indonesia
Email: lirakarina19@gmail.com

Introduction

Teaching and learning activities constitute the core element of school education. The quality of classroom instruction is a crucial factor in achieving educational objectives (Hermanto, 2020; Andriani & Hidayani, 2024). Among school subjects, mathematics holds a central position as it serves as the foundation for developing logical and analytical thinking skills. Nevertheless, mathematics is often perceived as challenging by students, particularly when delivered monotonously and with limited opportunities for active engagement (Arlina, 2023; Hasanah & Himami, 2021). This indicates the urgency of adopting more engaging and student-centered approaches in mathematics learning.

The significance of mathematics learning lies in its ability to sharpen students' reasoning skills. More broadly, learning itself is an interactive process between educators and learners, aiming not only at knowledge transfer but also at character formation and the cultivation of thinking skills (Pesik, 2024). Consequently, teaching strategies that foster a conducive, enjoyable atmosphere and encourage active student participation are essential (Kaniawati et al., 2023; Fernando et al., 2024). Hence, innovative instructional strategies must be prioritized to align with the broader goals of education.

In practice, however, mathematics achievement among seventh-grade students at MTs Negeri 1 Manado remains low, particularly in algebra. Preliminary observations at the school revealed that instruction is predominantly lecture-based, resulting in limited student engagement, boredom, and difficulties in understanding the material. The average student score reached only 60, which is below the minimum mastery criterion (KKM) of 75. These findings clearly demonstrate the need for an alternative model that can address both engagement and achievement issues.

The Teams Games Tournament (TGT) model has emerged as a promising alternative to address this problem. Tanjung (2022) emphasizes that this approach combines teamwork and competition to foster students' motivation and active involvement (Palupi & Rahayu, 2021). At the same time, TGT provides opportunities for peer tutoring and enables students to share their understanding, while making learning more meaningful and enjoyable (Winarto Silaban, 2024; Novia, 2022). These features suggest that TGT has the potential to transform passive classroom settings into active and collaborative learning environments

Although several studies have demonstrated the effectiveness of TGT across various mathematical topics at the senior high school level, often with the support of supplementary media such as flashcards or manipulatives (Dewi, 2021; Bilqist, 2024; Sya'adah, 2023), research on its application in algebra learning at the junior secondary (MTs) level without additional media remains scarce. This gap is particularly relevant in the context of MTs Negeri 1 Manado, where limited teaching resources frequently constrain learning. Therefore, it is important to examine whether TGT remains effective in improving mathematics achievement even without the support of supplementary media. By focusing on this gap, the present study seeks to provide empirical insights into the independent effectiveness of TGT.

The novelty of this study lies in the application of the TGT model without additional learning media in algebra instruction at the junior secondary school level. This approach emphasizes the core strengths of TGT (namely group collaboration, peer tutoring, and healthy competition) as drivers of student engagement. The main contribution of the study is to provide adaptive instructional strategies for schools with limited resources. Theoretically, this study offers empirical evidence of the effectiveness of TGT in algebra learning at the junior secondary level, while its practical significance lies in guiding educators to optimize collaboration and positive competition without reliance on supplementary teaching aids. Thus, this research

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contributes both to the theoretical discourse on cooperative learning and to the practical improvement of mathematics instruction in resource-limited contexts.

Method

Type of Research

The primary method employed in this study was quantitative, emphasizing objectivity in the collection and analysis of numerical data. To examine causal relationships, a quasi-experimental design with a pretest–posttest control group model was used. Two randomly selected groups were given a pretest, followed by different treatments, and then a posttest. The treatment effects were evaluated by comparing the improvement in outcomes between the two groups. The research design is illustrated in the Table 1

Table 1. Research Design

Group	Pretest	Treatment (X)	Posttest
Experimental	O_1	X_1	O_2
Control	O_3	X_2	O_4

(Sukarelawan et al., 2024)

Research Subjects

The research population comprised all seventh-grade students at MTs Negeri 1 Manado in the 2024/2025 academic year. From this population, two classes were randomly selected using a simple random sampling technique. Class VII-B (29 students) was assigned as the experimental group, while class VII-I (28 students) served as the control group. The slight difference in group sizes did not affect the validity of the experimental design.

Instruments

The research instrument consisted of five essay-type pretest and posttest items designed to measure students' conceptual understanding of algebra. The items were constructed based on the scope of the material and guided by the instrument blueprint to ensure content relevance and significance. Validation of the instrument involved a panel of experts comprising one university lecturer and two teachers from MTs Negeri 1 Manado. The lecturer evaluated the appropriateness of the items as measures of algebraic understanding, while the teachers assessed their alignment with the curriculum and their practicality in accurately capturing students' abilities. In this study, only expert validation was employed, without subsequent reliability testing. The cognitive levels of the items were determined according to the revised Bloom's Taxonomy (C2–C4). Item weights were assigned proportionally to reflect their level of difficulty and cognitive demand. The instrument blueprint is presented in Table 2. Thus, the instrument met the minimum standards of content validity required for experimental research in mathematics education, ensuring its appropriateness for measuring students' algebraic understanding in both the pretest and posttest phases.

Table 2. Test Instrument

No	Indicator	Item	Cognitive Level	Weight (%)	Item Type
1	Students can identify terms in algebraic expressions, distinguishing between variables, coefficients, and constants.	1	C2	15	Essay
	Students can identify and group like terms in an algebraic expression and simplify them.	2	C2	15	Essay
	Students can perform simplification of algebraic forms at a higher level of reasoning.	3	C3	20	Essay
2	Students can construct a mathematical model in algebraic form based on word problems.	4	C3	25	Essay
	Students can solve algebraic operations applied in everyday life situations.	5	C4	25	Essay

Procedures

The research procedure consisted of three main phases—preparation, execution, and completion. In the preparation stage, the test instruments were designed, validated, and the research sample was selected. The initial measurement stage involved administering a pretest on algebra to both groups in order to determine their baseline knowledge. During the treatment phase, the experimental group received instruction using the Teams Games Tournament (TGT) model, while the control group was taught through conventional lecture-based methods across several meetings. After the treatment, a posttest was administered to both groups to evaluate their learning progress. Finally, the data compilation stage entailed collecting the pretest and posttest results for subsequent statistical analysis.

Analysis

This study analyzed quantitative data using t-tests to test the research hypotheses. The preliminary stage involved assumption testing, which comprised: (a) normality of the data distribution, examined using the Kolmogorov–Smirnov test (criterion: $p > 0.05$), and (b) homogeneity of variances, examined using Levene's test (criterion: $p > 0.05$). Both assumptions were required to be satisfied before the t-tests were conducted. The hypotheses of the study were as follows:

$\boldsymbol{H_0}$: $\boldsymbol{\mu_1 = \mu_2}$ (the mean algebra learning outcomes of the experimental and control groups are equivalent).

$\boldsymbol{H_1}$: $\boldsymbol{\mu_1 > \mu_2}$ (the mean algebra learning outcomes of the experimental group are significantly higher than those of the control group).

To test these hypotheses, an Independent Samples t-test was employed to compare the means of the two independent groups. The decision criteria were:

Reject H_0: a significant difference in learning outcomes is found.

Accept H_1 : the experimental group demonstrates significantly better learning outcomes.

To further examine within-group improvement, a Paired Samples t-test was applied by comparing the pretest and posttest scores of students in the experimental group exposed to the TGT model (Muhid, 2019). The hypotheses were:

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H_0: there is no significant improvement in learning outcomes after the intervention

H_1: there is a significant improvement in learning outcomes after the intervention.

All statistical analyses were conducted using SPSS software for both assumption testing and hypothesis testing. In addition, Cohen's d effect size was calculated to estimate the magnitude of the instructional impact, thereby complementing the significance tests with a measure of practical importance (Sukarelawan et al., 2024). The classification of effect sizes followed Cohen's guidelines, as presented in Table 3.

Table 3. Effect Size Classification

Range	Criteria
ES < 0.2	Small
0.2 ≤ ES < 0.8	Medium
ES ≥ 0.8	Large

Results

Descriptive Statistics

The descriptive analysis of students' mathematics achievement is presented in Table 4. Both groups showed improvement from pretest to posttest; however, the experimental group demonstrated higher gains after the implementation of the TGT model compared to the control group.

Table 4. Descriptive Statistics of Students' Achievement

Group	Test	Mean	Median	SD	Variance	Min	Max
Experimental	Pretest	69.52	70.00	5.84	34.12	55	78
	Posttest	76.97	75.00	5.93	35.11	66	89
Control	Pretest	66.14	67.00	5.29	27.98	54	77
	Posttest	71.39	70.50	4.15	17.21	60	80

The experimental group's mean score increased by 7.45 points, while the control group improved by 5.25 points, indicating a stronger improvement in the experimental group. This result suggests that the TGT model not only elevated students' average performance but also broadened the performance range, as seen in the higher maximum score (89 compared to 80 in the control group). Such findings imply that the TGT model provided more effective scaffolding for both average and high-achieving students.

Assumption Testing

Normality tests (Shapiro–Wilk) confirmed that all datasets were normally distributed ($p > .05$). Levene's test further indicated that the assumption of homogeneity of variance was met ($p = .122$). Thus, parametric tests were considered appropriate for subsequent analyses. This means that any observed differences between groups are unlikely to be caused by violations of normality or unequal variances, ensuring that the statistical inferences drawn are valid and reliable.

Hypothesis Testing

An independent samples t-test was conducted to examine differences between groups (Table 5). The results revealed a statistically significant difference in posttest scores between the experimental and control groups, $t(55) = -4.10$, $p < .001$, favoring the experimental group.

Table 5. Independent Samples t-test Results

Test	t	df	Sig. (2-tailed)
Experimental vs. Control	-4.10	55	.000

This result highlights that the TGT model was effective in producing measurable gains within the same group of students, strengthening the evidence that the model facilitated active participation, collaboration, and deeper conceptual understanding of algebra.

Effect Size

The effect size, calculated using Cohen's d, was 1.09. This represents a large effect size, indicating that the TGT model had a substantial positive impact on students' mathematics achievement compared to conventional instruction. Such a magnitude suggests that the improvement was not only statistically significant but also educationally meaningful, reflecting a robust practical effect in real classroom contexts. In other words, the TGT model was powerful enough to produce improvements that would be clearly noticeable in actual teaching practice, not just in statistical terms.

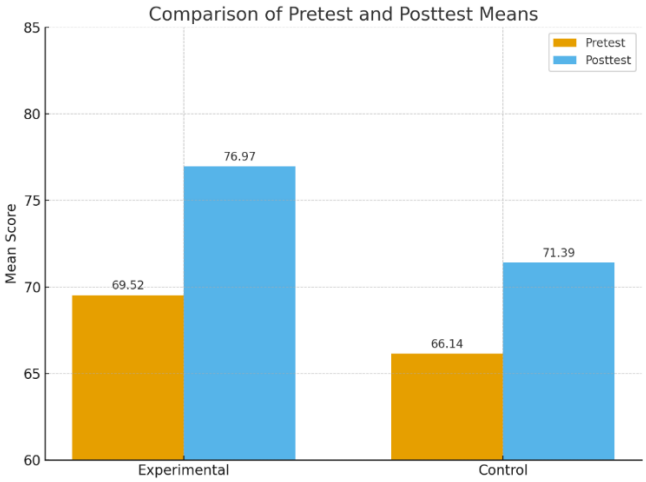

Figure 1. Comparision of Pretest and Posttest

The chart illustrates the comparison of mean pretest and posttest scores between the experimental and control groups. In the experimental group, the mean score increased from 69.52 at pretest to 76.97 at posttest. Similarly, the control group also showed improvement, but to a lesser extent, rising from 66.14 to 71.39. The larger gain observed in the experimental group suggests that the implementation of the Teams Games Tournament (TGT) model exerted a stronger influence on students' mathematics achievement compared to conventional instruction. Moreover, the wider gap between pretest and posttest bars in the experimental group highlights the model's effectiveness in fostering deeper understanding and engagement. Therefore, this chart visually reinforces the statistical findings, indicating that the TGT model not only produced a significant difference but also yielded a practically meaningful improvement in student learning outcomes.

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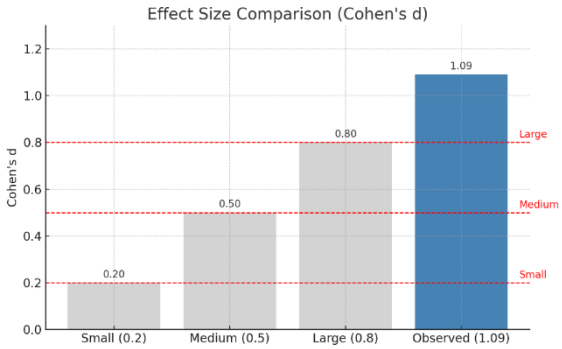

Figure 2. Effect Size Comparison

Figure 2 compares the observed effect size with Cohen's conventional benchmarks. While Cohen (1988) categorizes effect sizes of 0.2, 0.5, and 0.8 as small, medium, and large respectively, the observed effect size of 1.09 in this study surpasses the threshold for a large effect. This indicates that the implementation of the TGT model exerted a very strong and practically meaningful influence on students' mathematics achievement. Such a magnitude of effect suggests that the benefits of TGT were not only statistically significant but also substantively evident in classroom practice, reflecting improvements that are both educationally relevant and pedagogically impactful.

Discussion

The findings demonstrate that the TGT model was effective in improving seventh-grade students' mathematics scores on the topic of algebra. The mean score of the experimental class increased from 69.52 to 76.97, indicating a significant and substantial improvement compared to the control class. The independent samples t-test confirmed that this difference was statistically significant, providing robust evidence of the effectiveness of TGT in enhancing mathematics achievement, particularly in algebra. This conclusion is further reinforced by the large effect size (d = 1.09), which highlights the strong instructional impact of TGT on student learning outcomes. The superior effectiveness of the TGT model can be attributed to its ability to create an active and engaging classroom atmosphere by combining group collaboration with healthy competition through games or tournaments. This approach stimulates students' motivation to participate in discussions, express their ideas, and support one another in understanding the material, particularly through the role of peer tutors. In contrast to conventional lecture-based methods, which tend to be passive and one-directional, TGT promotes active involvement and encourages students to contribute within their teams, thereby fostering responsibility and a sense of belonging.

These findings are consistent with prior research by Dewi (2021), Bilqist (2024), and Wenas et al. (2020), who confirmed the effectiveness of TGT in improving students' mathematics achievement. Similarly, Sya'adah et al. (2023) demonstrated that TGT can enhance both interest and achievement, even when supported with supplementary media such as flashcards. The present study, however, contributes new evidence by showing that TGT remains significantly effective even in the absence of additional instructional aids, thereby emphasizing the intrinsic strength of the model itself. A key distinction from previous studies lies in the present study's focus on the MTs context, where limited instructional resources often constrain learning. The results indicate that the advantages of TGT are grounded in its structural features (particularly the tournament mechanism and the peer tutoring role) that ensure the engagement of all students, rather than in the use of external media. This highlights that the

pedagogical value of TGT is not dependent on material resources but on its cooperative and competitive design.

From a theoretical perspective, the results support the argument of Palupi & Rahayu (2021) that TGT fosters critical thinking through structured social interaction. From a practical perspective, the findings are highly relevant for schools, as TGT can be implemented effectively without incurring additional costs for specialized media. Nevertheless, the success of TGT may vary depending on teachers' ability to manage the classroom, facilitate discussion, and maintain a positive competitive atmosphere. Therefore, teacher preparation and classroom management emerge as essential conditions for maximizing the benefits of the TGT model.

Despite these positive findings, this study has certain limitations. The research was conducted in a single school with a relatively small sample, which may restrict the generalizability of the results. In addition, the study focused exclusively on algebra in the context of seventh-grade MTs students, leaving open questions regarding the applicability of the TGT model to other mathematical topics or educational levels. Future research should therefore replicate this study with larger and more diverse samples across different contexts and explore the integration of TGT with digital platforms or other innovative pedagogical strategies. Such extensions would provide deeper insights into the scalability and adaptability of the TGT model in enhancing mathematics learning outcomes.

Conclusion

This study demonstrates the effectiveness of the TGT model in improving mathematics learning outcomes, particularly students' mastery of algebraic concepts. The dynamic nature of the model fosters active student participation through group collaboration and positive competition, resulting in superior academic achievement compared to traditional lecture-based instruction. The findings provide both theoretical support for cooperative learning approaches and practical guidance for educators seeking low-cost, engaging strategies to enhance mathematics instruction. Future studies are encouraged to extend this investigation across different mathematical topics and educational contexts.

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Conflict of Interest

The authors declare that there is no conflict of interest.

Authors' Contributions

The first author, L.K., contributed to designing the research, collecting data, and discussing the results. The other authors, P.V.J.R. and M.G.M., participated in revising and refining the manuscript. The overall contributions to the conceptualization, writing, and revision of this article are as follows: L.K. :70%, P.V.J.R.: 15%, and M.G.M.: 15%.

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Data Availability Statement

The authors declare that the data supporting the findings of this study will be made available by the corresponding author, [L.K.], upon reasonable request.

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Author Biographies

	**Lira Karina** is a Student at the department of Mathematics Education, Faculty of Mathematics, Natural Sciences and Earth Sciences at the State Universitas Negeri Manado. Email : lirakarina19@gmail.com
	**Patricia V.J Runtu,** is a lecturer and researcher at the department of Mathematics Education, Faculty of Mathematics, Natural Sciences and Earth Sciences at the State Universitas Negeri Manado. Email: patricia_runtu@unima.ac.id
	**Marvel Grace Maukar** is a lecturer and researcher at the department of Mathematics Education, Faculty of Mathematics, Natural Sciences and Earth Sciences at the State Universitas Negeri Manado. Email: marvelgrace@unima.ac.id .