HYDROGEN
JURNAL KEPENDIDIKAN KIMIA
https://e-journal.undikma.ac.id/index.php/hydrogen/index

August 2026. 14(4)
e-ISSN: 2656-3061
p-ISSN: 2338-6487
pp. 777-790

The Influence of the Teams Games Tournament (TGT) Cooperative Learning Model on Grade X Students' Learning Outcomes in Learning the Basic Laws of Chemistry at SMA N 1 Sungayang

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Article History
Received: 13-05-2026
Revised: 09-06-2026
Published: 31-08-2026

Keywords: Cooperative learning model, learning outcomes, basic laws of chemistry, Teams Games Tournament (TGT).

Abstract
This study was conducted to examine the effect of the Teams Games Tournament (TGT) cooperative learning model on the learning outcomes of tenth-grade students at SMA Negeri 1 Sungayang in the topic of the basic laws of chemistry. The novelty of this research is reflected in the integration of the TGT model with academic games and tournament-based activities designed to enhance students' engagement and conceptual understanding in chemistry instruction. This study applied a quasi-experimental approach using a nonequivalent control group design. The population comprised all tenth-grade students, with two classes selected as samples through purposive sampling. The experimental group was taught using the TGT cooperative learning model, while the control group received conventional instruction. Data were collected using pretest and posttest instruments that had previously undergone validity and reliability testing. The data analysis included tests of normality and homogeneity, N-gain analysis, and an independent samples t-test. The findings revealed that the experimental class achieved an N-gain score of 0.303, which falls into the moderate category, whereas the control class obtained an N-gain score of 0.089, categorized as low. The hypothesis testing showed a significance value below 0.05 with a t-value of −7.154, indicating a statistically significant difference in learning outcomes between the two groups. These results demonstrate that the TGT cooperative learning model has a significant positive effect on students' learning outcomes. Furthermore, its implementation promotes active student involvement, collaborative learning, increased motivation, and deeper conceptual understanding, which collectively contribute to improved academic achievement.

How to Cite: Hayati, K., & Herman, M. (2026). The Influence of the Teams Games Tournament (TGT) Cooperative Learning Model on Grade X Students' Learning Outcomes in Learning the Basic Laws of Chemistry at SMAN 1 Sungayang. *Hydrogen: Jurnal Kependidikan Kimia*, *14*(4), 777-790. https://doi.org/10.33394/hjkk.v14i4.20687

https://doi.org/10.33394/hjkk.v14i4.20687

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INTRODUCTION

Chemistry learning at the senior high school level has characteristics that demand strong conceptual understanding and high-level abstract thinking skills. Chemistry does not merely study changes in matter, but also examines composition, structure, properties, and the energy associated with those changes. The nature of chemistry encompasses both chemistry as a body of knowledge (product) and as a process; therefore, chemistry instruction should ideally emphasize Developing conceptual understanding together with scientific process skills is an essential objective in chemistry learning. However, the abstract and complex nature of chemical concepts—including atoms, molecules, the basic laws of chemistry, and quantitative calculations—often presents challenges for students in achieving a thorough understanding of the subject matter. This situation highlights the need for instructional

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approaches that enable students to actively build and strengthen their conceptual knowledge. As one of the core branches of science, chemistry encompasses numerous abstract principles and theoretical frameworks, which frequently contribute to students' learning difficulties and misconceptions. (Gurses et al., 2015).

The use of learning modules is considered an effective strategy for supporting the achievement of instructional goals in a more efficient manner, as it allows students to learn independently according to their own pace and learning preferences. Previous studies have shown that students who learn through modules in chemistry topics such as atomic structure, reaction rates, and thermochemistry demonstrate better learning outcomes compared with those who learn through conventional instruction without modules. In addition, modules designed with attractive visual elements, including color and illustrations, can increase students' interest in the learning materials, which in turn enhances their motivation and engagement in the learning process. (Ellizar et al., 2013).

The topic of the basic laws of chemistry is one of the fundamental subjects that serves as a foundation for understanding subsequent chemical concepts. This topic covers the Law of Conservation of Mass, the Law of Definite Proportions, the Law of Multiple Proportions, and Avogadro's law, all of which require students to develop strong conceptual understanding alongside mathematical reasoning and analytical problem-solving skills. Students often experience difficulties in relating these concepts to quantitative calculations, which in turn affects their learning outcomes. These difficulties arise from the abstract nature of the material, which demands logical and systematic thinking skills. Therefore, an instructional strategy is needed to enhance students' engagement in understanding the concepts of the basic laws of chemistry in a more meaningful way (Priliyanti et al., 2021).

Based on interviews conducted with a chemistry teacher of tenth-grade students at a senior high school, it was identified that students' learning outcomes on the topic of the basic laws of chemistry remain relatively low. This can be observed from the results of daily assessments, where the majority of students have not yet achieved the minimum mastery criteria established for the learning objectives. The teacher further explained that during the instructional process, students tend to show low participation, ask limited questions, and experience difficulties in solving chemistry-related problems, particularly those involving conceptual understanding and calculations problems that require conceptual understanding and calculations. In addition, the teaching methods used are still dominated by lectures and practice exercises, resulting in suboptimal interaction among students during the learning process.

The findings from interviews with several tenth-grade students also revealed that the topic of the basic laws of chemistry is perceived as challenging to understand. Students reported difficulties in grasping fundamental concepts, connecting different chemical laws, and performing simple stoichiometric calculations. Some students also stated that the learning process was less engaging and lacked group discussion, leading them to passively receive information without deep understanding. This condition contributes to students' low learning motivation and has a negative effect on their learning outcomes in this topic (Ula N.S,2023).

Students' low learning outcomes are influenced by several factors, including the instructional model applied, the degree of student participation during the learning process, and the strategies used to deliver the learning material. Teacher-centered instruction limits students' opportunities to interact, discuss, and construct understanding independently. In contrast, effective learning should actively involve students through collaborative and interactive activities. Interaction among teachers, students, and learning materials is a key component in achieving successful learning outcomes (Mamangkai et al., 2019).

One alternative learning model that can enhance student engagement is the cooperative learning model. This model emphasizes collaboration among students in small groups to achieve shared learning objectives. Through cooperative learning, students can support one another in understanding the material, engage in discussions, and develop social skills. This model also provides opportunities for students to actively participate in the learning process, thereby improving their learning outcomes (Slavin 2020).

One type of cooperative learning model that can be applied in chemistry instruction is the Teams Games Tournament (TGT). The TGT model combines group work with academic games and healthy competitive tournaments. Within this model, students collaborate in heterogeneous groups and subsequently engage in academic games and tournament activities to contribute points toward their group achievement. These activities can enhance learning motivation, active participation, and conceptual understanding through group discussions and enjoyable competition (Sutrisno,2020).

Several previous studies have reported that the implementation of the Teams Games Tournament (TGT) cooperative learning model can enhance students' learning outcomes. This model has been shown to foster an active, engaging, and interactive learning atmosphere, which supports students in understanding the subject matter more effectively. Furthermore, the TGT model promotes collaboration among students while simultaneously encouraging healthy competition to achieve optimal learning performance. Nevertheless, research specifically focusing on the application of the TGT model to the topic of the basic laws of chemistry at the tenth-grade level remains limited. This indicates the need for further investigation to provide deeper insight and address the existing gap in the literature.

Based on the issues identified through interviews with teachers and students, supported by findings from previous studies, the implementation of an instructional model capable of improving students' learning outcomes on the topic of the basic laws of chemistry is considered necessary. The Teams Games Tournament (TGT) cooperative learning model was chosen because its characteristics are believed to promote active learning, strengthen group collaboration, and increase students' motivation during the learning process. Therefore, the application of this model is expected to provide an effective solution to the problem of low student achievement in this topic.

The aim of this study is to examine the effect of the TGT cooperative learning model on students' learning outcomes in the topic of the basic laws of chemistry among tenth-grade students. This research is expected to contribute theoretically to the development of cooperative learning approaches in chemistry education and to enrich the existing literature regarding the effectiveness of the TGT model in improving learning outcomes. Practically, the findings of this study are expected to provide useful insights for teachers in selecting appropriate instructional models to enhance student achievement. In addition, this study is expected to serve as a reference for future research related to the implementation of the TGT cooperative learning model in other chemistry topics.

METHOD

This study applied a quantitative approach using a quasi-experimental method with a non-equivalent control group design. A quantitative approach was selected because the data were presented in numerical form and analyzed statistically to test the research hypothesis objectively. The quasi-experimental method was employed to investigate the effect of a specific treatment on the dependent variable, while recognizing that external variables influencing the experimental process could not be fully controlled (Sugiyono, 2019).

This study consisted of two groups, namely an experimental class and a control class. The experimental class received instruction through the TGT cooperative learning model, whereas the control class was taught using conventional learning methods. Both groups were administered a pretest and a posttest to measure changes in students' learning outcomes before and after the implementation of the treatment.

This research was carried out at SMA Negeri 1 Sungayang during the second semester of the 2025/2026 academic year on the topic of the basic laws of chemistry. The population comprised all tenth-grade students of SMA Negeri 1 Sungayang, totaling 179 students across seven classes. The sample was determined using purposive sampling by considering the similarity of class characteristics, including the number of students, academic ability, and the absence of a class categorized as academically advanced.

Based on these considerations, class X.E1 was assigned as the experimental group, while class X.E4 served as the control group. The total number of participants involved in the study was 48 students, with 24 students in the

experimental class and 24 students in the control class (Sugiyono, 2019).

Research Variables

The variables in this study consist of independent and dependent variables. The independent variable is the Teams Games Tournament (TGT) cooperative learning model, while the dependent variable is students' learning outcomes on the topic of the basic laws of chemistry. Research variables are attributes or characteristics that exhibit certain variations and become the focus of analysis in a study (John W. Creswell dan J. David Creswell 2023).

Data Collection Technique

The data in this study were collected using a learning achievement test. The instrument was administered as both a pretest and a posttest to measure the effect of the Teams Games Tournament (TGT) learning model on students' learning outcomes. The test was designed as a multiple-choice assessment based on learning indicators for the topic of the basic laws of chemistry. A test is a measurement tool used to obtain data on students' abilities, knowledge, or skills after participating in the learning process (Arikunto, 2018). The test scores were then used as quantitative data for statistical analysis.

Research Procedure

The research procedure was conducted through three main stages: preparation, implementation, and data analysis. The preparation stage involved preliminary observation, selection of the research sample, development of learning materials, preparation of research instruments, instrument validation, and item testing. Once the instruments were confirmed to be valid and appropriate, the study proceeded to the implementation stage. At this stage, both the experimental and control classes were first administered a pretest. The experimental class then received instruction using the Teams Games Tournament (TGT) model, whereas the control class was taught through conventional learning methods. After the instructional activities were completed, both classes were given a posttest to assess students' learning outcomes. The final stage consisted of data analysis, in which the pretest and posttest results were analyzed to identify the improvement in learning outcomes and to evaluate the effect of the learning model applied during the study (John W. Creswell dan J. David Creswell 2023).

Research Instrument

The research instrument used in this study was an objective multiple-choice test designed to assess students' learning outcomes. The test items were developed based on the learning indicators related to the topic of the basic laws of chemistry. Before being administered, the instrument underwent a series of evaluations, including validity, reliability, item difficulty level, and discrimination index testing. Validity was examined to ensure that the instrument accurately measured the intended learning outcomes. Reliability testing was conducted to determine the consistency of the instrument in producing stable measurement results. The item difficulty level analysis was used to identify the degree of difficulty of each test item, while the discrimination index was applied to evaluate each item's ability to differentiate between students with higher and lower levels of ability (Arikunto, 2018).

Data Analysis Technique

The research data were analyzed statistically through several stages. First, a normality test was conducted using the Shapiro–Wilk test to determine whether the data followed a normal distribution. Second, a homogeneity test was carried out using Levene's test to examine the equality of variances between the two groups. Third, the N-gain analysis was used to measure the improvement in students' learning outcomes after the learning process. Furthermore, hypothesis testing was performed using an independent samples t-test at a significance level of 0.05 to identify differences in learning outcomes between the experimental and control classes. A significance value below 0.05 indicated that the research hypothesis was accepted, demonstrating that the Teams Games Tournament (TGT) learning model had a significant effect on students' learning outcomes in the topic of the basic laws of chemistry (Sugiyono, 2019).

RESULTS

This study is a quantitative research employing a quasi-experimental method with a nonequivalent control group design. In this study, there were two sample groups: an experimental class and a control class. Both

classes were given an initial test (pretest) before the treatment and a final test (posttest) after the treatment. The administration of the pretest and posttest was intended to assess students' initial abilities and their learning outcomes after the implementation of different instructional models. The differences in learning outcomes were subsequently analyzed by comparing the pretest and posttest scores of the experimental and control groups.

The research sample was determined through purposive sampling by considering the equivalence of students' academic abilities and recommendations from the chemistry teacher. Based on these considerations, class XE.1 was assigned as the experimental class, while class XE.4 was designated as the control class. Each class consisted of 24 students, resulting in a total sample of 48 participants. The population of this study included all tenth-grade students in Phase E, comprising classes XE.1 through XE.7, with a total of 179 students.

The experimental class received instruction through the Teams Games Tournament (TGT) cooperative learning model, whereas the control class was taught using conventional instructional methods. The material examined in this study was the basic laws of chemistry, which constitutes an introductory topic in tenth-grade chemistry during the second semester at SMAN 1 Sungayang in the 2025/2026 academic year.

Data collection was carried out using a learning outcomes test instrument in the form of pretest and posttest questions. The pretest was administered before the treatment to measure students' prior knowledge, while the posttest was given after the treatment to evaluate students' learning outcomes following the implementation of the learning model. Prior to being used in the research classes, the instrument was first validated by expert lecturers and subsequently tested in a class outside the research sample. Once the instrument was confirmed to be valid and appropriate, it was administered to both the experimental and control classes.

Instrument Testing

The test instrument used in this study consisted of learning outcome questions on the topic of the basic laws of chemistry, comprising 10 essay items. This instrument was designed to assess students' abilities before and after the treatment in both the experimental and control classes. The scores obtained from the instrument trial were subsequently analyzed to evaluate the quality of the test items, including their validity, reliability, difficulty level, and discrimination index.

Instrument analysis was conducted to ensure that the test items fulfilled the requirements of a valid and reliable measurement tool. Validity testing was performed to examine the accuracy of the instrument in measuring students' learning outcomes, while reliability testing was used to determine the consistency of the instrument in producing dependable results. In addition, item difficulty analysis was carried out to identify the level of difficulty of each question, whereas discrimination index analysis was used to evaluate each item's ability to distinguish between students with high and low levels of achievement. Based on the overall analysis, the test instrument was found to meet the criteria of a good and appropriate assessment tool for use in this study. The results of the item analysis were then compiled and presented in a recapitulation table summarizing the outcomes of the instrument trial.

Table 1. Recapitulation of Pre-test Item Trial Results

Item	Validity	Reliability	Difficulty	Discrimintaion	Item Retention
1	VALID	0.745	Easy	Fair	Used
2	VALID		Easy	Fair	Used
3	VALID		Moderate	Fair	Used
4	VALID		Moderate	Good	Used
5	VALID		Moderate	Good	Used
6	VALID		Moderate	Good	Used
7	VALID		Moderate	Good	Used
8	VALID		Moderate	Good	Used
9	VALID		Moderate	Good	Used
10	VALID		Moderate	Good	Used
11	VALID		Moderate	Very Good	Used
12	VALID		Moderate	Good	Used

Item	Validity	Reliability	Difficulty	Discrimintaion	Item Retention
13	VALID		Moderate	Good	Used
14	VALID		Easy	Fair	Used
15	VALID		Easy	Fair	Used
16	VALID		Easy	Good	Used
17	VALID		Easy	Fair	Used
18	VALID		Moderate	BAIK	Used
19	VALID		Easy	Fair	Used
20	VALID		Easy	Fair	Used

Table 2. Recapitulation of Post-test Item Trial Results

Item	Validity	Reliability	Difficulty	Discrimintaion	Item Retention
1	VALID	0.745	Easy	Fair	Used
2	VALID		Moderate	Fair	Used
3	VALID		Easy	Fair	Used
4	VALID		Moderate	Good	Used
5	VALID		Moderate	Good	Used
6	VALID		Moderate	Good	Used
7	VALID		Moderate	Good	Used
8	VALID		Moderate	Fair	Used
9	VALID		Moderate	Good	Used
10	VALID		Moderate	Good	Used
11	VALID		Moderate	Very Good	Used
12	VALID		Moderate	Good	Used
13	VALID		Moderate	Very Good	Used
14	VALID		Easy	Fair	Used
15	VALID		Easy	Fair	Used
16	VALID		Easy	Fair	Used
17	VALID		Easy	Good	Used
18	VALID		Easy	Good	Used
19	VALID		Moderate	Fair	Used
20	VALID		Easy	Good	Used

Based on the recapitulation of the research instrument analysis, which included validity, reliability, discrimination index, and difficulty level testing, it can be concluded that the test items used in this study met the criteria of a valid and appropriate research instrument. The results of the validity analysis showed that the majority of the items were categorized as valid, indicating that they were capable of measuring the intended learning outcomes in accordance with the indicators of the basic laws of chemistry topic. These findings demonstrate that each test item had a strong correspondence with the construct being assessed.

Furthermore, the results of the reliability analysis indicate that the instrument has a high level of consistency. The reliability coefficient obtained was classified in the high category, showing that the instrument is sufficiently dependable for measuring students' learning outcomes. Therefore, the instrument demonstrates good consistency when administered under relatively similar conditions.

Based on the discrimination index analysis, most of the test items were categorized as fair to good. This suggests that the items were able to effectively differentiate between students with higher and lower levels of ability. Although several items showed relatively low discrimination power, the instrument as a whole still met the required criteria, as it was predominantly composed of items with adequate discriminatory capacity.

The results of the difficulty level analysis indicate that the test items used have a range of difficulty levels, namely easy, moderate, and difficult categories, with a predominance in the moderate category. This proportional distribution of difficulty levels shows that the instrument is capable of measuring students' abilities comprehensively, both at the level of basic understanding and higher-order thinking. Overall, the results of the analyses of validity, reliability, discrimination index, and difficulty level indicate that the research instrument meets good quality standards. Therefore, all test items

are deemed appropriate for use in collecting pretest and posttest data to measure students' learning outcomes on the topic of the basic laws of chemistry.

Learning Outcomes

Pretest and Posttest Data of the Control Class

Table 3 Criteria for Pretest Scores of the Control Class and Experimental Class

Score Criteria	Experimental Class (Pretest)	Control Class (Pretest)
Total Score	1140	925
Average	47,5	38,5
Lowest Score	35	20
Highest Score	65	55

Based on the pretest results, it can be observed that the initial abilities of students in both the experimental and control classes were relatively low. The experimental class obtained a total score of 1140 with a mean score of 47.5, whereas the control class achieved a total score of 925 with an average of 38.5. In the experimental class, the lowest score was 35 and the highest was 65, while in the control class the scores ranged from 20 to 55. These findings suggest that students in the experimental class demonstrated slightly higher initial ability compared with those in the control class prior to the implementation of the instructional treatment. Nevertheless, overall, students in both groups showed a low level of prior understanding of the topic of the basic laws of chemistry. Therefore, both classes were considered appropriate as research subjects for examining the effect of different learning models on students' learning outcomes.

Table 4 Posttest Criteria for the Control Class and Experimental Class

Score Criteria	Experimental Class (Post-test)	Control Class (Post-test)
Total Score	1540	1050
Average	64,16	43,75
Lowest Score	50	25
Highest Score	80	65

Based on the posttest results, it can be seen that the mean learning outcome score of students in the experimental class (XE.1) was higher than that of the control class (XE.4). The difference in average scores indicates that students who learned through the Teams Games Tournament (TGT) cooperative learning model achieved better learning outcomes than those who received conventional instruction on the topic of the basic laws of chemistry. These findings suggest that the implementation of the TGT learning model had a positive contribution to improving students' learning outcomes. However, to determine whether the difference in learning outcomes between the experimental and control classes is statistically significant, hypothesis testing using inferential statistical analysis is required. Before conducting the hypothesis test, prerequisite tests must first be carried out, including tests of normality and homogeneity on the students' learning outcome data.

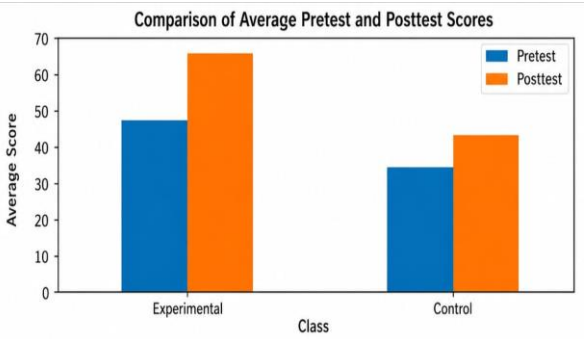


Figure 1. Bar Chart of the Comparison of Average Pretest and Posttest Scores

Based on the posttest results, it can be seen that the mean learning outcome score of students in the experimental class (XE.1) was higher than that of the control class (XE.4). The difference in average scores indicates that students who learned through the Teams Games Tournament (TGT) cooperative learning model achieved better learning outcomes than those who received conventional instruction on the topic of the basic laws of chemistry. These findings suggest that the implementation of the TGT learning model had a positive contribution to improving students' learning outcomes.

Table 5 N-Gain Data of the Experimental Class and Control Class

N-gain	Experimental Class	Control Class
Average	0,303	0,089
Category	Moderate	Low

Based on the analysis of the pretest and posttest results, the N-gain score of the experimental class (XE.1) was 0.303, while the control class (XE.4) obtained an N-gain score of 0.089. The N-gain analysis was used to measure the extent of improvement in students' learning outcomes following the instructional treatment.

The N-gain value of 0.303 in the experimental class is categorized as moderate, indicating that students' learning outcomes improved after the implementation of the Teams Games Tournament (TGT) cooperative learning model.

This finding suggests that the TGT model was effective in helping students develop a better understanding of the topic of the basic laws of chemistry compared with their understanding before the treatment. In contrast, the N-gain value of 0.089 in the control class falls into the low category, indicating that the improvement in students' learning outcomes was relatively limited. This lower improvement may be associated with the use of conventional instructional methods, which tend to provide fewer opportunities for student involvement and do not optimally encourage active participation during the learning process. The difference in N-gain scores between the experimental and control classes demonstrates that the experimental class experienced a greater improvement in learning outcomes than the control class. Therefore, it can be concluded that the implementation of the TGT cooperative learning model had a positive effect on improving students' learning outcomes in the topic of the basic laws of chemistry compared with conventional instruction.

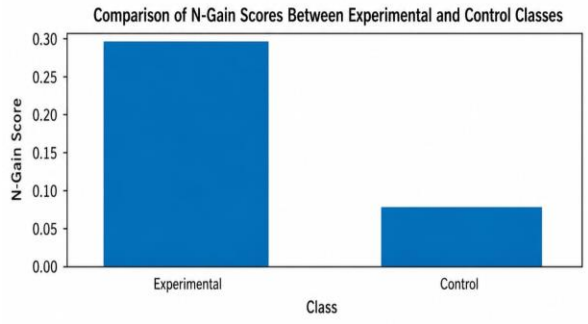


Figure 2. Bar Chart of the Comparison of Average N-Gain Scores

Based on the N-gain bar chart, it can be seen that the experimental class achieved an average N-gain score of 0.30, which is categorized as moderate, whereas the control class obtained an N-gain score of 0.08, which falls into the low category. The difference in these N-gain values indicates that the improvement in students' learning outcomes in the experimental class was higher than that of the control class. These findings suggest that students in the experimental class experienced a greater increase in learning outcomes compared with those in the control class. Therefore, it can be concluded that the implementation of the Teams Games Tournament (TGT) cooperative learning model was more effective in improving students' learning outcomes on the topic of the basic laws of chemistry than conventional instruction.

Inferential Statistical Analysis

The normality test was conducted to determine whether the students' learning outcome data in both the experimental and control classes were normally distributed. This test served as one of the prerequisite analyses prior to hypothesis testing using parametric statistical methods. In this study, normality was assessed using the Shapiro–Wilk test. The Shapiro–Wilk test was selected because each group consisted of fewer than 50 students, making it an appropriate method for evaluating the distribution of the research data. The criteria used for decision-making in the normality test were as follows: data were considered normally distributed if the significance value (Sig.) was ≥ 0.05, whereas data were considered not normally distributed if the significance value (Sig.) was < 0.05. The results of the normality analysis for the pretest and posttest data of both the experimental and control classes are presented in Table 6.

Table 6 Normality of Learning Outcomes

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Kelas	Statistic	Df	Sig.	Statistic	Df	Sig.
Result	Pretest A (Kontrol)	.154	24	.146	.932	24	.107
	Posttest A (Kontrol)	.166	24	.088	.942	24	.182
	Pretest B (Eksperiment)	.158	24	.126	.943	24	.190
	Posttest B (Eksperiment)	.163	24	.100	.954	24	.323

a. Lilliefors Significance Correction

The homogeneity test was performed to determine whether the variances of the learning outcome data in the experimental and control classes were equal. This test is an important

prerequisite before conducting hypothesis testing using parametric statistical analysis. In this study, homogeneity of variance was assessed using Levene's test. The decision criteria applied were as follows: if the significance value (Sig.) was ≥ 0.05, the data were considered to have homogeneous variance; conversely, if the significance value (Sig.) was < 0.05, the variances were considered non-homogeneous. The results of the homogeneity analysis of students' learning outcome data in both the experimental and control classes are presented in Table 6.

Based on the results of the homogeneity analysis using Levene's test, a significance value of 0.205 was obtained. Since this value is greater than 0.05, it indicates that the variance of the students' learning outcome data in both the experimental and control classes is homogeneous. This finding suggests that the two sample groups originated from populations with equal variances. Because the assumption of homogeneity was fulfilled, the learning outcome data met the requirements for further hypothesis testing using parametric statistics, specifically the independent samples t-test. Therefore, the analysis could be continued to examine the effect of the TGT cooperative learning model on students' learning outcomes in the topic of the basic laws of chemistry.

Table 7 Homogeneity of Learning Outcomes

Tests of Homogeneity of Variances

		Levene Statistic	df1	df2	Sig.
Result	Based on Mean	1.558	3	92	.205
	Based on Median	1.362	3	92	.259
	Based on Median and with adjusted df	1.362	3	84.228	.260
	Based on trimmed mean	1.564	3	92	.203

The hypothesis test in this study was conducted to determine whether there was a significant difference in students' learning outcomes between the experimental class taught using the TGT cooperative learning model and the control class taught through conventional instruction. Hypothesis testing was performed using the independent samples t-test with the assistance of IBM SPSS Statistics. This statistical test was selected because the learning outcome data had met the required assumptions, namely normal distribution and homogeneity of variance. The criteria used for decision-making in the independent samples t-test as follows: if the significance value (Sig. 2-tailed) was less than 0.05, H_0 was rejected and H_1 was accepted, indicating a significant difference between the two groups. Conversely, if the significance value (Sig. 2-tailed) was greater than or equal to 0.05, H_0 was accepted and H_1 was rejected.

Table 8 Independent Samples (t-Test Results)

Independent Samples Test

		t-test for Equality of Means							
				Significance				95% Confidence Interval of the Difference	
		T	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
Nilai	Equal variances assumed	-7.154	46	<,001	<,001	-20.417	2.854	-26.161	-14.672
	Equal variances not assumed	-7.154	40.072	<,001	<,001	-20.417	2.854	-26.184	-14.649

Based on the results of the independent samples t-test, the calculated t-value was −7.154 with a significance value (Sig. 2-tailed) of < 0.001. Since the significance value was lower than 0.05, the null hypothesis (H_0) was rejected and the alternative hypothesis (H_1) was accepted. This indicates that there was a statistically significant difference in students' learning outcomes between the experimental class (XE.1) and the control class (XE.4). The mean difference

between the two groups was 20.417 points, which shows that the students in the experimental class obtained higher scores than those in the control class. These findings indicate that the implementation of the TGT cooperative learning model had a significant positive influence on students' learning outcomes in the topic of the basic laws of chemistry. In other words, students who learned through the TGT model achieved better learning outcomes compared to students who were taught using conventional teaching methods.

DISCUSSION

Based on the results of the data analysis, it was found that students' learning outcomes in the experimental class taught using the Teams Games Tournament (TGT) cooperative learning model were higher than those of students in the control class who received conventional instruction. This improvement in learning outcomes indicates that the implementation of the TGT learning model had a positive effect on students' understanding of the topic of the basic laws of chemistry, which is consistent with the findings of Robyn M. Gillies (2016). This may be explained by the characteristics of the TGT model, which encourages students to actively participate in the learning process through group discussions, academic games, and intergroup tournaments. Through these activities, students are given greater opportunities to engage with the learning material, exchange ideas with peers, and actively construct their understanding of the concepts being studied (Rahmawati et al 2019).

After the class presentation stage, the learning process continued to the teams stage. At this stage, students were divided into several heterogeneous groups consisting of 4–5 members. Each group was given a worksheet related to the topic of the basic laws of chemistry to be discussed together. In this activity, each group member worked collaboratively to understand the material and solve the problems provided by the teacher. Group discussion activities made students more active in the learning process. Students were observed exchanging opinions and helping group members who experienced difficulties (Gillies, 2016). Through this activity, students were able to learn from their peers, so that their understanding of the concepts being studied became better. (Parinduri & Riyanto, 2020). Slavin (2020), states that peer learning in cooperative groups can improve students' motivation and conceptual understanding.

The next stage is games. At this stage, the teacher provided questions in the form of academic quizzes related to the topic of the basic laws of chemistry. Students were asked to answer the questions according to the rules of the game, and each correct answer contributed to the group score. The game activities made the learning atmosphere more active and enjoyable. Students appeared more enthusiastic in answering questions because they wanted to obtain the highest score for their group. Even students who were previously less active became more willing to participate in the game activities. This is consistent with (Slavin 2020). who states that academic games in the TGT model are designed to assess and strengthen students' conceptual understanding through enjoyable activities.

The next stage is the tournament. At this stage, students participated in academic competitions with students from other groups who had relatively similar ability levels. In this activity, students attempted to answer questions correctly in order to earn group points. The questions used in the tournament had varying levels of difficulty, namely low, medium, and high. This variation was intended to comprehensively assess students' abilities and provide opportunities for all students to participate according to their respective capabilities. The tournament activity increased students' motivation to understand the learning material. Students were observed trying to answer questions quickly and accurately and becoming more confident in expressing their answers. This is in line with (Slavin 2020). who states that academic competition in the TGT model can enhance students' learning motivation and participation.

The final stage of the Teams Games Tournament (TGT) model is team recognition. At this stage, the teacher awarded the groups that achieved the highest scores in the tournament. The awarding of recognition aimed to appreciate the effort and collaboration demonstrated by each group during the learning process. In this study, group rewards made students feel proud of their group's performance and further

motivated them to learn. Students also appeared more enthusiastic in working together with their group members to achieve better results. This is in line with (Gunarta 2019), who states that giving rewards can increase students' interest and learning motivation.

These findings indicate that the implementation of the TGT cooperative learning model is an effective and practical form of cooperative learning because it involves all students without differentiating them based on academic ability. In its implementation, students are encouraged to act as peer tutors through collaborative group activities combined with game elements and reinforcement. These characteristics enable students to participate actively in the learning process while supporting one another in understanding the learning material, as stated by Jumantra (2016).

The use of game-based activities in the TGT model also provides students with opportunities to be directly involved in the learning process, creating a more engaging and enjoyable classroom atmosphere. This condition can increase students' interest, participation, and enthusiasm toward the material being learned during instruction (Syifa, 2019). Furthermore, learning activities presented in the form of games can create a sense of enjoyment among students, which may enhance their learning motivation and ultimately contribute to improved learning outcomes (Fiah & Purbaya, 2017).

Learning outcomes are essentially changes in students' behavior that occur after participating in the learning process. These changes cover the cognitive, affective, and psychomotor domains, allowing students to develop various competencies as a result of their learning experiences (Nana, 2011). Therefore, learning outcomes are not only reflected in students' mastery of knowledge but also in the attitudes and skills they develop throughout the learning process.

Student learning outcomes are influenced by two factors, namely internal and external factors. Internal factors include prior knowledge, motivation, and learning interest possessed by students. Meanwhile, external factors come from the environment outside the students, one of which is the quality of the learning process. The quality of learning is highly determined by the effectiveness of the teaching and learning process in achieving learning objectives, including the selection of appropriate learning models and methods used by the teacher.

In line with these findings, the implementation of the Teams Games Tournament (TGT) cooperative learning model can positively influence students' learning outcomes compared to direct instruction (Putri, 2023). The TGT model promotes active student participation through collaborative group work, academic games, and healthy competition, making the learning process more interactive and meaningful. Through these learning activities, students are encouraged to engage more actively with the material, exchange ideas with peers, and strengthen their conceptual understanding. As a result, students are able to understand the material more effectively, which ultimately contributes to improved learning outcomes.(Syifa (2019).

In contrast, the learning process in the control class was carried out using conventional instruction, which was primarily dominated by the lecture method. The teacher explained the material directly, followed by note-taking activities and practice exercises completed by the students. In this approach, students tended to be less actively involved, with only a few students participating by asking questions or responding during the lesson. As a result, student engagement in the learning process was relatively limited, which affected their understanding of the concepts being studied. These differences in learning conditions between the experimental and control classes contributed to differences in students' learning outcomes.

The results of the hypothesis test using the independent samples t-test showed a t-value of −7.154 with a significance value of < 0.001. Since this value was lower than 0.05, H_0 was rejected and H_1 was accepted. This indicates that there was a statistically significant difference in learning outcomes between students in the experimental class and those in the control class. The mean difference between the two groups was 20.417 points, indicating that students in the experimental class achieved higher learning outcomes than those in the control class. This result is also supported by the average posttest score of the experimental class, which was 64.16, compared to 43.75 in the control class.

The improvement in students' learning outcomes was further supported by the N-gain analysis. The experimental class obtained an N-gain score of 0.303, while the control class obtained 0.089. These results indicate that the experimental class showed a greater improvement in learning outcomes compared to the control class after the learning treatment was implemented.

These findings are consistent with previous studies showing that the Teams Games Tournament (TGT) learning model can improve students' learning outcomes. Aprianty (2017) reported that the application of TGT in the topic of the basic laws of chemistry improved students' learning outcomes. Similarly, Sugiata (2019) concluded that the TGT model was effective in increasing students' motivation and conceptual understanding in chemistry learning. In addition, Putri (2023) found that the TGT model can create an enjoyable learning environment and enhance students' conceptual understanding. Therefore, the results of this study further strengthen previous findings that the implementation of the TGT cooperative learning model has a positive effect on students' learning outcomes, particularly in learning the basic laws of chemistry. (Agustina et al. (2020).

Although the implementation of the Teams Games Tournament (TGT) learning model can improve students' learning outcomes, several challenges were encountered during its application. These included the need for additional time to explain the game procedures, difficulties in maintaining student discipline during learning activities, and differences in students' abilities in understanding and answering the questions given (Christianto et al., 2023). Nevertheless, these challenges can be managed through effective classroom time management, clear explanation of rules and procedures, and the use of peer tutoring strategies among students. With these efforts, the learning process can continue to run effectively and support students' active participation in class (Lestari et al., 2022).

These findings are consistent with previous studies reporting that the Teams Games Tournament (TGT) learning model can improve students' academic achievement, learning motivation, and classroom participation through cooperative learning activities combined with academic games and healthy competition (Rahmawati et al., 2021).

CONCLUSION

The implementation of the Teams Games Tournament (TGT) cooperative learning model for tenth-grade students at SMA Negeri 1 Sungayang had a significant positive effect on students' learning outcomes in the topic of the basic laws of chemistry compared with conventional instruction. The TGT model promoted active student participation, collaboration, and interaction through several learning stages, including class presentations, teamwork, academic games, tournaments, and team recognition activities. These activities created a more interactive and student-centered learning environment.

The novelty of this study lies in the integration of collaborative discussion, academic games, and tournament-based activities in chemistry learning as an effort to improve students' conceptual understanding of abstract chemistry concepts. The findings indicate that the TGT model not only improves students' learning outcomes but also increases learning motivation, cooperation, and engagement throughout the learning process.

The results of this study imply that the Teams Games Tournament (TGT) model can be used as an innovative and effective instructional strategy in chemistry learning, particularly for topics that are abstract and conceptually challenging. In addition, this study contributes to the development of student-centered learning practices and may serve as a useful reference for future research related to the implementation of cooperative learning models in chemistry education.

RECOMMENDATION

Based on the findings of this study regarding the effect of the Teams Games Tournament (TGT) cooperative learning model on students' learning outcomes in the topic of the basic laws of chemistry, future researchers are recommended to conduct further investigations on the implementation of the TGT model in other chemistry topics and at different levels of education. Expanding the application of this learning model across various subject matter and educational contexts may provide broader insight into its effectiveness.

Future studies may explore other related variables, such as students' learning motivation, critical thinking skills, learning activities, and communication skills, in order to obtain more comprehensive and in-depth findings. Examining these variables may contribute to a better understanding of the broader impact of the Teams Games Tournament (TGT) learning model on the teaching and learning process.

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