



## The Effect of Problem Based Learning Based on Multiple Representations on Ecosystem Material in Class X on Problem Solving Ability by Students

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### Abstract

This study aimed to analyze the effect of the TGT (Teams Games Tournament) learning model assisted by Wordwall on student activity and cognitive learning outcomes in the digestive system material. The research employed a one-shot case study design, with the subjects being students of classes XI.1 and XI.2 at SMA Negeri 1 Bukateja, selected through purposive sampling. The independent variable in this study was the TGT learning model assisted by Wordwall, while the dependent variables were student activity and cognitive learning outcomes. The research results showed that student activity indicators, including visual, oral, listening, motoric, and mental aspects, achieved an average activity percentage of 87.5% by the fourth meeting, categorized as excellent. Cognitive learning outcomes also demonstrated a significant improvement, with an average N-gain score of 0.81 (high category). The highest improvement was observed in the understanding indicator (C2), which increased by 34%. The findings revealed that the TGT learning model assisted by Wordwall positively impacted both dependent variables. This study concludes that the TGT learning model assisted by Wordwall is effective in enhancing student activity and cognitive learning outcomes.

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## **INTRODUCTION**

21st-century skills have become a primary focus, emphasizing students' cognitive abilities such as critical thinking, creativity, and problem-solving. These skills enable students to adapt and generate innovative and relevant ideas. Learning activities that actively engage students in discussions, teamwork, and exploration can enhance their ability to develop collaborative solutions.

Issues observed in schools indicate problems related to student engagement and cognitive learning outcomes. Based on initial observation data, student engagement during the learning process on the digestive system topic only reached an average of 65%, which falls into the moderately active category. Several engagement indicators, such as visual engagement (paying attention to learning media) and mental engagement (analyzing problems), showed low student involvement. On the other hand, students' cognitive learning outcomes remain relatively low, with an average pre-test score of 55, where only 40% of students achieved the Minimum Mastery Criteria (MMC) score of 75. This indicates that the majority of students face difficulties in understanding concepts and materials related to the digestive system.

The lack of student engagement in classroom learning can be attributed to several factors, one of which is the use of teaching models that do not fully focus on student needs and active participation. Low engagement during lessons negatively impacts cognitive learning outcomes. Many biology lessons tend to rely on less varied teaching approaches and mainly use textbooks or lecture-based methods as the primary learning resources (Paramita et al., 2019). In the digestive system topic, students struggle to understand the mechanisms involved, leading to boredom and a lack of interest in the subject matter. The digestive system is a complex topic due to the numerous concepts that must be understood and its direct relevance to everyday life (Lestari, 2021).

Enhance student engagement and cognitive learning outcomes, teachers need to implement appropriate learning strategies in the classroom. One effective approach to improving both student engagement and cognitive learning outcomes is through cooperative learning strategies. Cooperative learning has been proven to foster students' academic progress by boosting their self-esteem and group interactions (Slavin, 2005), which in turn enhances their cognitive learning outcomes (Marpaung et al., 2021)

The Teams Games Tournament (TGT) learning model is an alternative approach that creates a fun and interactive learning environment in the classroom. A more engaging and enjoyable learning process can motivate students to study biology, increasing their engagement and cognitive learning outcomes (Lestari, 2022). In cooperative learning, students are encouraged to construct their own knowledge, actively participate, and improve their academic achievements. The goal is not only to enhance academic performance in terms of mastering subject material but also to develop teamwork skills in comprehending the material. Collaboration is a key characteristic of cooperative learning, particularly in the Teams Games Tournament (TGT) model (Hikmah et al., 2023).

Various educational games can be incorporated into learning, one of which is Wordwall, a digital learning platform designed to support interactive and self-paced learning (Febryanti et al., 2024). Wordwall offers several advantages in improving the learning experience, including a diverse range of game templates that make learning more engaging. It provides various types of games, such as crossword puzzles, quizzes, random card activities, and more. Additionally, Wordwall games can be easily shared across multiple online platforms and saved as PDF files for offline use. To implement that enhance student engagement and cognitive learning outcomes, the researcher is interested in conducting a study titled: "The Influence of Cooperative Learning Type Teams Games Tournament (TGT) Assisted by Wordwall Media on Student Engagement and Cognitive Learning Outcomes in Digestive System Material." The impact of the TGT learning model assisted by Wordwall is expected to serve as an effective solution in enhancing student engagement and cognitive learning outcomes, particularly in biology lessons.

## RESEARCH METHOD

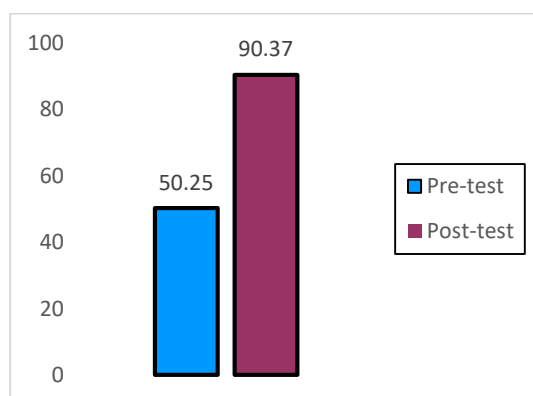
This research was conducted at SMA N 1 Bukateja in the even semester of the 2024/2025 academic year. The population of this study included all eleventh-grade students, consisting of 10 classes. The sampling technique used was purposive sampling. The sample selected comprised two classes, namely XI-1 and XI-2, based on the research objectives. The data in this study included student activities, cognitive learning outcomes, and student responses. The indicators for student activities were categorized into visual, oral, listening, motoric, and mental aspects. Cognitive learning outcomes were measured based on Bloom's taxonomy, focusing on remembering (C1), understanding (C2), applying (C3), and analyzing (C4). Student responses were assessed using a Likert scale to evaluate their perceptions of the learning model. All data were analyzed using descriptive quantitative methods.

## RESULTS AND DISCUSSION

The purpose of this study is to analyze the influence of the TGT learning model assisted by Wordwall on students' activity and learning outcomes in the digestive system material. The influence of the TGT model assisted by Wordwall in the digestive system material is measured based on predetermined indicators, namely: Learning activity reaches > 80% of students in the active and very active categories, Learning outcomes > 75 with a minimum mastery criterion (KKM) of 75..

### RESEARCH RESULT

Pretest was given before the related material was delivered. This test is given to determine the ability of students before getting digestive system. Posttest is used to determine the ability of students after the material is delivered using the respective learning models in the classroom. The following data on the average pretest and posttest scores are shown in figure 1.



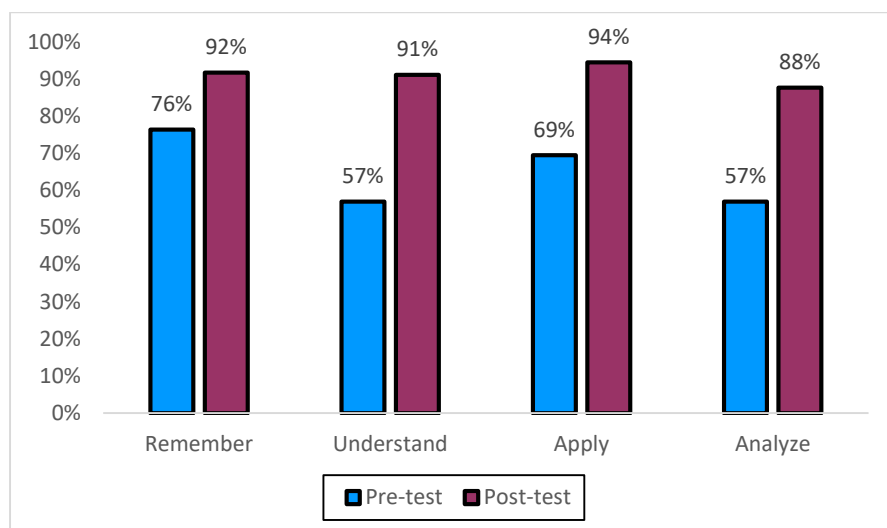
**Figure 1** Bar Diagram of Pretest and Posttest Data

The study began with a pre-test to measure students' initial abilities. The results showed that the average initial abilities of students in classes XI-1 and XI-2 were equivalent. Subsequently, students were given a post-test at the end of the lesson to measure their final abilities and analyze the improvement in cognitive learning outcomes. The post-test results indicated an improvement in both classes.

The influence of the TGT learning model assisted by Wordwall reduced student boredom, increased participation, and enhanced students' interest in understanding the digestive system material. Interactive strategies can improve student interaction and motivation in classroom learning (Nisa khairun, 2021). This is supported by student response questionnaire data, where 70 students expressed enjoyment of the varied activities in class using the TGT learning model assisted by Wordwall.

Cognitive learning outcomes in this study were measured through tests designed based on cognitive learning indicators. The average post-test score was 90.37, which falls into the "excellent" category. The

improvement in students' cognitive learning outcomes can be attributed to several factors, including a supportive and comfortable learning environment, the use of engaging learning media, and active student involvement in the learning process.



**Figure 2** Bar Diagram of Cognitive Ability Improvement

Cognitive learning encompasses several indicators that describe the extent to which a person can understand, analyze, evaluate, and apply the knowledge they have acquired. This research not only identifies the overall improvement in cognitive abilities but also analyzes the improvement in each indicator of cognitive ability. Figure 4.1 presents a chart of cognitive ability improvement. The indicator with the highest improvement is understanding, with an increase of 34 points.

The TGT model assisted by Wordwall has an impact on the improvement of cognitive learning outcomes (Rahmatussolihah, 2024). The TGT model assisted by Wordwall presents learning with a teamwork concept that can attract students to actively engage during the learning process. The educational activities and games provided on Wordwall enable students to interact directly. The active interaction built between students can have a positive impact and increase student engagement.

### N-gain Test

The N-Gain test used data from the pretest and posttest scores of the class. N-gain shows the difference in scores from pretest to posttest on the use of learning models. The data was analysed to get a conclusion about the influence of the learning model. The N-gain test results are shown in the following table.

**Table 1** N-Gain test data table of class

N	Average score n-gain	Category
72	0,810	High

The analysis of the impact of the learning model on students' cognitive learning outcomes can be carried out using the N-gain test. The N-gain test can be used as a solid foundation to evaluate how much a learning program contributes to students' understanding (Sukarelawan et al., 2024) Overall, the class shows an average N-gain of 0.81, which falls into the high category. The high category achieved by the class

indicates that the learning model has an impact on improving cognitive learning outcomes.

### Student Feedback Questionnaire

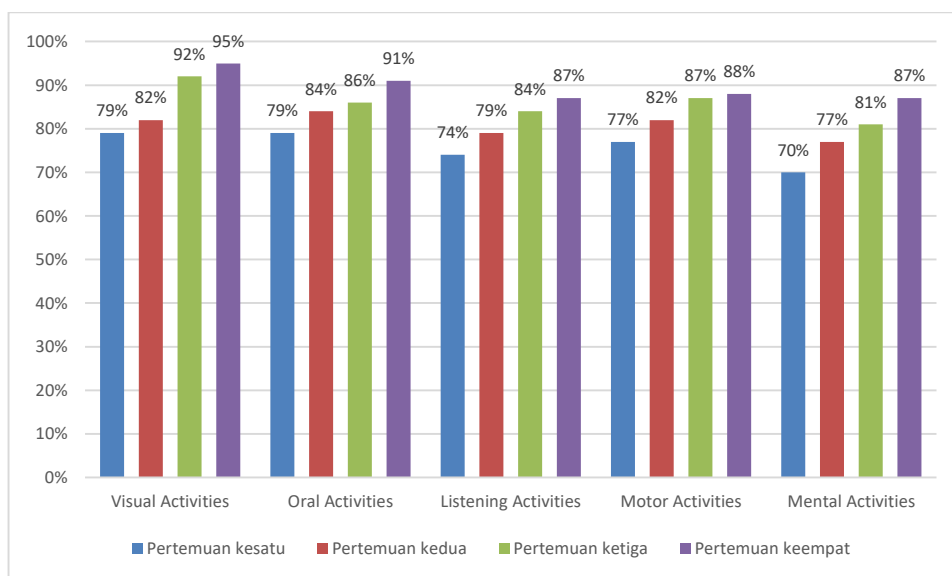
Students' responses were given after the whole series of learning models had been given to find out the response to the inquiry learning model with mnemonic strategy in the treatment class. The questionnaire consists of 25 statement items with three response options. Student responses consisted of thirteen indicators that included positive and negative statements. Scores were calculated according to the positive responses for each indicator. The response results obtained from 59 students. The percentage results for each indicator are presented in table 4.

**Table 2** Results of Student Responses to the TGT

No.	Questionnaire Indicator	Percentage	Criteria
1.	After learning with the TGT model assisted by Wordwall, I can conduct self-evaluation on the digestive system material.	85,45	Very good
2.	Learning activities using Wordwall help me be more diligent in studying the human digestive system material.	84,37	Very good
3.	Learning with the TGT model assisted by Wordwall makes it easier for me to understand the concept of the digestion process.	83,33	Very good
4.	The TGT learning model increases my engagement in classroom learning activities.	87,5	Very good
5.	Learning with the TGT model encourages me to be more active in asking and answering questions during games and tournaments.	82,29	Very good
6.	I find it easier to remember the digestive system material after learning with Wordwall.	83,68	Very good
7.	I feel happy with the varied activities in class by applying the TGT learning model assisted by Wordwall.	88,5	Very good
8.	The TGT learning model assisted by Wordwall makes it easier to memorize the organs and enzymes in the digestive system.	82,98	Very good

Based on the percentage in the table above, students' responses to the TGT learning model assisted by Wordwall are very good, with a percentage of 84.75%. The influence of the learning model is considered positive if the percentage of positive student responses is >70%. This means that the TGT learning model assisted by Wordwall has an impact during the learning process.

## Learning Activities



**Figure 3** Bar Diagram of Activity Ability Improvement

The analysis results show that the most significant improvement in activity scores is in the mental activities indicator, with an increase of 16%. This activity is marked by student participation, social interaction, the development of cognitive skills, the development of psychomotor skills, engagement levels, responses to feedback, and mastery of the material. This study measured student activity in each meeting, assessed by an observer,

namely the biology teacher.

Based on Figure 3, it is evident that there is an increase in student activity across all indicators, indicating that the applied learning strategy successfully enhanced student engagement in the learning process. The most prominent improvement is observed in the mental activities indicator. This indicator assesses activities such as remembering, analyzing, and decision-making during the learning process.

Student activities during the learning process on the digestive system material, measured through five indicators—visual, oral, listening, motor, and mental activities—show consistent improvement in each meeting. In the visual activities indicator, there is an increase from 79% in the first meeting to 95% in the fourth meeting. This improvement indicates that the use of interactive media such as Wordwall successfully motivated students to pay attention to the learning material, such as diagrams of the digestive system or questions in games. This aligns with the characteristics of the TGT (Teams-Games-Tournament) model, which optimizes visualization to facilitate students' understanding of complex material.

The oral activities indicator also shows an increase, from 79% in the first meeting to 91% in the fourth meeting. This activity includes group discussions, question-and-answer sessions, and expressing opinions during the learning process. The TGT learning model encourages verbal interaction through discussions among groups before entering the game and tournament stages, prompting students to actively communicate their ideas. As many as 71 students stated that learning with the TGT model assisted by Wordwall encouraged them to collaborate more actively with their group members.

In the listening activities indicator, the percentage increased from 74% to 87%. This rise indicates that students were more focused on listening to the teacher's explanations, game instructions, and their classmates' presentations. The cooperative approach in TGT directs students to listen actively, especially during discussions or when receiving feedback during game evaluations.

A significant improvement is also seen in the motor activities indicator, from 77% to 88%. This activity involves physical skills such as note-taking, drawing diagrams of the digestive system, or conducting food substance testing experiments. Hands-on experiments provide students with concrete experiences, supporting their understanding of bioprocess concepts in the digestive system, such as testing the content of food substances in everyday meals. Questionnaire data shows that 70 students agreed that the TGT learning model increased their engagement in classroom learning activities. Experiments in biology learning help students gain direct experience in proving theories through a series of experiments to draw conclusions (Jumrodah et al., 2023).

The mental activities indicator shows an increase from 70% in the first meeting to 87% in the fourth meeting. Mental activities involve critical and analytical thinking skills, such as analyzing the functions of digestive organs, understanding the role of enzymes in the digestive process, and linking experimental results with the theories learned. The tournament stage in the TGT model pushes students to use logical and strategic thinking to solve questions and win competitions. As many as 66 students agreed that TGT learning assisted by Wordwall encouraged them to collaborate actively in teams. This proves that the right combination of learning methods can effectively improve the quality of learning and student engagement.

The class has an average n-gain score of 0.51, which falls into the moderate category. The application of the learning model in the class is considered more influential in increasing student activity. Overall, TGT learning assisted by Wordwall is able to improve student activity across all indicators. This shows that the combination of cooperative learning models with interactive technology media successfully creates a fun learning environment, encourages active participation, and enhances students' understanding of the complex digestive system material.

The applied learning model is one of the factors contributing to the increase in student activity. Students responded positively to the influence of the TGT model assisted by Wordwall in learning the digestive system material in this study. Learning with the TGT model improves collaboration skills, makes learning enjoyable, engaging, and challenging, and increases active participation and learning outcomes (Andono, 2024). Teachers can innovate by providing various interesting activities, especially through games assisted by Wordwall. Biology learning is not merely textual; some materials are difficult for students to understand if they only study through textbooks. Therefore, biology learning must be conducted in a fun way to encourage student activity. The learning model used in this study successfully attracted student interest and activity based on student response questionnaires, with 70 students giving positive feedback regarding learning combined with games and tournaments. Students also felt that the learning conducted in this study influenced their learning and activity during the process.

This study combines the TGT model with Wordwall. Wordwall, which presents a variety of interactive quizzes, can be a factor in increasing student activity in the classroom. Wordwall is an educational game that influences the improvement of student learning activity. The difference between learning conducted with the influence of educational games and learning that does not apply educational games is that the class given educational games excels in activity, creativity, imagination, and innovation (Yanuarto, 2015). The teaching and learning process in classes with educational games runs enjoyably and is not boring, which then becomes the main factor in increasing student creativity in that study.

The influence of the learning model and strategy on student activity in this study can be explained

through the implementation of the applied model and strategy. Classroom presentations introduced the material about the human digestive system, explaining key concepts such as food substances, digestive organs, mechanical and chemical processes, and enzymes involved in digestion. Teamwork involved dividing students into groups of 4-5 members. Each group discussed the assigned topics and worked on questions. Games included quizzes with various challenges, requiring students to concentrate fully and collaborate solidly to answer each question. Tournaments involved competitions between groups, with each group competing to answer questions provided through Wordwall. As many as 66 students stated that learning with the TGT model encouraged them to ask and answer questions more actively during games and tournaments. Additionally, answering questions using Wordwall with various question formats created a varied learning atmosphere. Group awards were given to the team with the highest score in the tournament.

The influence of the TGT model assisted by Wordwall in learning can increase student activity. The increase in student activity is shown by the analysis results and supported by previous research. Learning with the TGT cooperative model makes students more active in the learning process, creating a more interesting, effective, and less boring learning atmosphere for students (Fenanlampir, 2021).

This study provides insights into the influence of the TGT model assisted by Wordwall in learning the digestive system material. A series of analyses were conducted to observe the influence of the learning model on cognitive learning outcomes and student activity. However, this study also has limitations, such as the material being limited to one sub-topic in the digestive system, and the sample consisting of 72 students from two classes with similar abilities, so the results may not fully reflect the variability of the learning model's effectiveness in general. These limitations may affect the generalization of the research results to a broader population.

## CONCLUSION

Based on the analysis and discussion, it can be concluded that the Teams Games Tournament (TGT) learning model assisted by Wordwall on the digestive system material has a positive impact on increasing student activity and cognitive learning outcomes. This is indicated by the average student activity reaching 87.5% in the "very good" category and a 34% improvement in the understanding indicator (C2). Students' cognitive learning outcomes demonstrate classical mastery with an average N-gain of 0.81, which falls into the "high" category. Thus, the TGT learning model assisted by Wordwall positively influences students' activity and learning outcomes.

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