



## The Effect of the Teams Games Tournament (TGT) Learning Model on Students' Learning Activities and Learning Outcomes in the Topic of Viruses among Tenth-Grade Senior High School Students

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**Abstract:** This study aimed to determine the effect of the Teams Games Tournament (TGT) learning model on students' learning activities and learning outcomes in the topic of viruses among Grade X senior high school students. The study employed a quasi-experimental method using a Non-Equivalent Control Group Design. The sample was selected through purposive sampling based on the equivalence of pretest scores, resulting in Class X-3 as the experimental group and Class X-4 as the control group, with 34 students in each class. The research instruments consisted of multiple-choice questions to measure learning outcomes and observation sheets to assess students' learning activities. The data were analyzed using parametric statistics, including tests of normality, homogeneity, and a one-tailed independent-samples *t*-test (right-tailed). The results showed that the mean score of students' learning activities in the experimental class (79.67) was higher than that in the control class (44.31), with a significance value of  $0.000 < 0.05$ . Similarly, the mean learning outcome score in the experimental class (84.71) was higher than that in the control class (79.56), with a significance value of  $0.0045 < 0.05$ . Therefore, the TGT learning model was effective in improving both students' learning activities and learning outcomes in the topic of viruses for Grade X senior high school students and may serve as an alternative interactive biology teaching strategy to help students understand the abstract concept of viruses.

**Keywords:** Teams Games Tournament (TGT) learning model; learning activities; learning outcomes; viruses

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### INTRODUCTION

Biology learning requires students to understand a wide range of scientific concepts, some of which are complex and abstract. One topic that frequently creates learning difficulties is viruses, because they are microscopic and cannot be observed directly, thereby requiring a high level of abstract thinking (Asmayani et al., 2024). The unique characteristics of viruses, which place them at the boundary between living and non-living entities and allow them to replicate only within host cells, often create conceptual barriers for students in understanding the subject matter (Lorika & Syamsurizal, 2022). As a result, some students experience difficulties in developing a comprehensive understanding of viral concepts, which in turn contributes to low learning activity and poor learning outcomes in biology.

In the context of instruction, student learning activity is an important indicator of successful teaching and learning, because active engagement through observing, discussing, and asking questions can improve conceptual understanding and learning outcomes (Marzuki, 2024). Conversely, low levels of learning activity lead to passive classroom processes, which negatively affect students' academic achievement (Amni et al., 2021).

These problems are also evident in teaching virus-related material at the secondary school level. Based on an interview with a Biology teacher at SMA Swasta Budisatrya Medan, student achievement on the topic of viruses was found to remain relatively low, with an average daily test score of 72.30. This score falls below the school's Minimum Mastery Criterion (Kriteria Ketuntasan Minimal, KKM) for Biology, which is 75; consequently, 54.41% of students had not achieved learning mastery. This condition indicates that students still experience difficulties in understanding viral concepts comprehensively. The low level of achievement is influenced by instructional practices that are still dominated by lecture-based teaching and exercise drills, thereby limiting students' participation in the learning process. Low learning activity makes instruction less interactive and results in suboptimal learning outcomes (Pratiwi et al., 2023).

Although numerous studies have shown that cooperative learning models are effective in improving student activity and learning outcomes, their implementation in classrooms still faces several challenges. One of these challenges lies in selecting instructional strategies that are appropriate for the characteristics of the material. In principle, biology learning emphasizes the process of scientific discovery through students' active involvement in inquiry-based and constructivist learning, enabling them to build conceptual understanding independently (Sudarisman, 2015). However, in practice, teacher-centered instruction still predominates, causing students to remain passive and insufficiently engaged in the learning process; as a consequence, student learning activity and outcomes often fail to reach the expected level (Dimiyati & Mudjiono, 2015). In addition to instructional strategies, learning media also play an important role in helping students understand abstract concepts (Armella, 2022). Because viruses are microscopic, this topic requires learning media capable of visualizing concepts more concretely. Modified domino cards, which contain paired questions and answers related to the learning material, can create more interactive learning activities and enhance student interaction during the lesson (Octavia et al., 2021). Other studies have also shown that the use of domino cards can train students' speed of thinking while increasing their activeness and learning outcomes (Wiratni et al., 2021).

A growing body of research suggests that the implementation of cooperative learning models can serve as an alternative solution for improving student learning activity and achievement. The Teams Games Tournament (TGT) learning model has been shown to increase students' active participation through academic competition and teamwork during the learning process (Hafizah et al., 2024). In addition, the use of educational game media such as domino cards has been reported to help students understand concepts through more interactive and enjoyable learning activities (Octavia et al., 2021).

Nevertheless, previous studies have generally focused only on the implementation of the TGT learning model without integrating it with instructional media specifically designed to support game-based activities in the learning process. For example, the study by Hafizah et al. (2024) examined the implementation of the TGT model in biodiversity material without employing any specific educational game media. Similarly, Astriana (2021) emphasized improvements in student activeness and learning outcomes through the application of the TGT model in classroom action research, but did not combine it with interactive learning media. Therefore, studies integrating the TGT learning model with educational game media such as domino cards in biology learning, particularly on the topic of viruses, remain limited.

Pedagogically, cooperative learning is grounded in the constructivist view that knowledge is actively constructed by students through social interaction, discussion,

and collaboration in learning groups (Sudarisman, 2015). The TGT model is one form of cooperative learning that emphasizes group collaboration and academic competition in the instructional process. Through teamwork, educational games, and academic tournaments, students are encouraged to exchange ideas, explain concepts to their peers, and actively participate in learning activities. These processes enable students to build deeper conceptual understanding, because they do not merely receive information from the teacher but also construct knowledge through shared learning experiences (Dimiyati & Mudjiono, 2015). Moreover, the elements of play and competition embedded in the TGT model can enhance students' learning motivation, thereby promoting active engagement in classroom activities and ultimately contributing to improved learning outcomes (Fadly, 2022).

In this study, the TGT learning model was combined with domino cards as an educational game medium. The use of domino cards is expected to strengthen the implementation of this learning model by creating an interactive and enjoyable learning environment while also helping to simplify instructional concepts (Octavia et al., 2021). The modified domino cards contain paired questions and answers as well as images related to virus concepts, thereby encouraging students to discuss and match concepts collaboratively. In practice, the domino card medium was integrated into the phases of the TGT model. In the class presentation phase, the teacher introduced the basic concepts of viruses as an entry point to the lesson. In the team phase, students worked in groups to discuss the material and complete the student worksheet (LKPD). In the games phase, domino cards were used as instructional media containing paired questions and answers that students had to match through group discussion. In the tournament phase, the domino cards were used in intergroup competition to answer questions quickly and accurately, thereby creating a more active and competitive learning atmosphere. The integration of domino cards into the phases of the TGT model is expected to increase student engagement in the learning process while also helping students develop a deeper understanding of virus concepts.

Based on the foregoing, this study aimed to examine the effect of the TGT learning model on improving student learning activity and learning outcomes in the topic of viruses among tenth-grade students at SMA Swasta Budisatrya Medan. This study is expected to provide practical contributions as a reference for teachers in implementing innovative learning models to improve student activity and learning outcomes, while also enriching the scholarly discourse on the development of biology instruction in secondary schools (Lestari et al., 2023).

## METHOD

This study employed a quantitative approach using a quasi-experimental method with a Non-Equivalent Control Group Design. The independent variable was the Teams Games Tournament (TGT) learning model, whereas the dependent variables were students' learning activities and learning outcomes. In this design, the experimental class was taught using the TGT model, while the control class was taught using the Direct Instruction model. The research design is presented in Table 1.

**Table 1.** Research design

| Class        | Pretest | Treatment | Posttest |
|--------------|---------|-----------|----------|
| Experimental | O1      | X         | O2       |
| Control      | O1      | –         | O2       |

Notes:

O1 : pretest administered to both the experimental and control classes before instruction

O2 : posttest administered to both the experimental and control classes after instruction

X : treatment using the TGT learning model

The population of this study consisted of all Grade X students at SMA Swasta Budisatrya Medan, comprising four classes: X-1, X-2, X-3, and X-4. The sample was selected using purposive sampling. This technique was chosen because, in experimental research, the selection of sample classes must consider the equivalence of students' initial abilities so that differences in learning outcomes are more likely to be attributable to the treatment rather than to pre-existing differences between classes (Tajik et al., 2024).

At the preliminary stage, all classes were administered a pretest to determine students' initial ability on the topic of viruses. The pretest scores were then analyzed to compare the mean initial ability of each class. Classes with relatively equivalent mean pretest scores were subsequently selected as the research sample. The mean pretest scores of each class are shown in Table 2.

**Table 2.** Mean pretest scores of the research population

| No. | Class | Number of Students | Mean Pretest Score |
|-----|-------|--------------------|--------------------|
| 1.  | X-1   | 35                 | 30.43              |
| 2.  | X-2   | 33                 | 34.85              |
| 3.  | X-3   | 34                 | 36.76              |
| 4.  | X-4   | 34                 | 36.91              |

Based on Table 2, classes X-3 and X-4 had relatively equivalent mean pretest scores compared with the other classes; therefore, they were designated as the experimental and control classes, respectively. Class X-3 was taught using the TGT learning model, whereas class X-4 was taught using the Direct Instruction model.

Data were collected using both test and non-test techniques. The test instrument consisted of 20 multiple-choice items designed to measure students' cognitive learning outcomes at the levels of C1 (remembering), C2 (understanding), and C3 (applying). Before being used, the test instrument was validated by expert validators and piloted on 32 Grade XI MIPA students at SMA Swasta Budisatrya Medan to determine its quality. The instrument testing results showed that, out of 40 items administered, 20 items were valid, consisting of 1 item in the very high category, 5 items in the high category, and 14 items in the moderate category. Validity testing was conducted using the product-moment correlation (Winarti et al., 2023).

The difficulty level analysis indicated that all items used in the study were in the moderate category. Item difficulty was calculated using the item difficulty index formula (Basri et al., 2021). The discrimination power analysis showed that 2 items were in the very good category, 14 items were in the good category, and 4 items were in the fair category. The discrimination index was used to distinguish between upper- and lower-group students and was calculated using the discrimination index formula (Rahman & Nasryah, 2019). Furthermore, the reliability test yielded a reliability coefficient ( $r_{11}$ ) of 0.918, which falls into the very high category, indicating that the test instrument was appropriate for use in this study. Reliability was calculated using the Kuder–Richardson (KR-20) formula (Masullah et al., 2024).

The non-test instrument used in this study was an observation sheet of students' learning activities, assessed by one observer during the learning process. Observation was conducted using a checklist-based observation sheet containing five indicators of learning activity: visual activities, oral activities, listening activities, motor activities, and emotional activities. Each indicator consisted of three behavioral descriptors observed during instruction. The observer placed a check mark on each descriptor demonstrated by each student. Students' activity scores were obtained by summing all observed descriptor scores (Parhusip et al., 2023). Students' learning activity scores were calculated using the following formula:

$$\text{Score} = \frac{\text{student's obtained score (n)}}{\text{maximum score (N)}} \times 100\%$$

The level of students' learning activity was interpreted based on the percentage of activeness, as shown in Table 3 (Mardiana et al., 2025).

**Table 3.** Categories of students' learning activity

| No. | Percentage Range | Category          |
|-----|------------------|-------------------|
| 1.  | > 80%            | Very Active       |
| 2.  | 60%–79.99%       | Active            |
| 3.  | 40%–59.99%       | Moderately Active |
| 4.  | 20%–39.99%       | Less Active       |
| 5.  | 0%–19.99%        | Very Inactive     |

The research procedure was carried out in several stages, namely the pre-research, preparation, implementation, and final stages. The pre-research stage involved initial observation and interviews to identify problems in the learning process. The preparation stage included the development of learning instruments and the validation of research instruments by expert validators. During the implementation stage, data were collected through the administration of the pretest, observation of students' learning activities during instruction, and administration of the posttest at the end of the lesson. In the final stage, the data were tabulated and statistically analyzed to draw the research conclusions.

Data analysis was performed using SPSS 25.0 for Windows. Before hypothesis testing, the data were first subjected to prerequisite tests, namely the normality test and homogeneity test. Normality was tested using the Shapiro–Wilk test at a significance level of 0.05 to determine whether the data were normally distributed. The data were considered normally distributed if the significance value was greater than 0.05 (Nurhaswinda et al., 2025). Subsequently, homogeneity was tested using Levene's test to determine the equality of variances between sample groups. The data were considered homogeneous if the significance value exceeded 0.05 (Nurhaswinda et al., 2025).

Hypothesis testing was conducted using a one-tailed (right-tailed) Independent Samples t-test to compare the mean learning activities and learning outcomes between the experimental and control classes. This test is a parametric statistical procedure used to compare the means of two independent groups with interval- or ratio-scale data (Setyawan, 2021). The decision criterion was set at a significance level of 0.05: if the significance value was < 0.05, then H<sub>0</sub> was rejected and H<sub>a</sub> was accepted, indicating that the mean learning activities and learning outcomes of students taught using the TGT learning model were higher than those of students taught using the Direct Instruction model (Syafriani et al., 2023).

## RESULTS AND DISCUSSION

A comparison of the mean pretest and posttest scores indicated differences in learning achievement gains between the experimental and control classes after the instructional intervention. The comparison of the mean pretest and posttest scores for both classes is presented in Table 4.

**Table 4.** Mean pretest and posttest scores in both classes

| Class        | Pretest | Posttest |
|--------------|---------|----------|
| Experimental | 36.77   | 84.71    |
| Control      | 36.91   | 79.56    |

As shown in Table 4, the mean pretest score of the experimental class was 36.77, while that of the control class was 36.91, indicating that the students' initial abilities were relatively comparable before the treatment was administered. After the learning process, the mean posttest score in the experimental class increased to 84.71, whereas the control class reached 79.56. These data indicate that the improvement in learning outcomes was greater in the experimental class than in the control class. To assess the degree of improvement more objectively, a Normalized Gain (N-Gain) analysis was conducted. The results of the N-Gain analysis are presented in Table 5.

**Table 5.** Mean N-Gain scores in both classes

| Class        | N-Gain | Category |
|--------------|--------|----------|
| Experimental | 0.75   | High     |
| Control      | 0.67   | Moderate |

Based on Table 5, the experimental class obtained a mean N-Gain score of 0.75, which falls into the high category, whereas the control class obtained a score of 0.67, categorized as moderate. These findings indicate that the improvement in learning outcomes in the experimental class was higher than that in the control class. The substantial increase in learning achievement in the experimental class suggests that the implementation of the TGT learning model was more effective in improving students' conceptual understanding of virus-related material. This improvement occurred because the TGT model provided students with opportunities to learn through group collaboration and academic competition, both of which encouraged active engagement throughout the learning process.

This increase in learning outcomes can be attributed to the fact that the TGT learning model integrates the principles of cooperative learning, which emphasize social interaction among students during the learning process. According to constructivist theory, knowledge is actively constructed through discussion and the exchange of ideas among individuals, enabling students to develop a deeper conceptual understanding (Dimiyati & Mudjiono, 2015). In the TGT learning model, group discussions and academic tournaments allow students to re-explain concepts to their teammates and test their understanding through academic games. This process promotes stronger conceptual elaboration, which in turn contributes to improved learning outcomes (Slavin, 2015).

These findings are consistent with the study by Parhusip et al. (2023), which reported that game-based cooperative learning significantly enhances students' learning motivation and conceptual understanding because students are directly involved in the learning process. Hafizah et al. (2024) also found that the implementation of the TGT learning model improved student learning outcomes because students actively processed information during classroom activities. Similarly, Lestari et al. (2023) showed that game-based cooperative learning can improve conceptual understanding through students' direct involvement in learning activities.

In addition to improving the average learning achievement scores, the implementation of the TGT learning model also enhanced students' cognitive ability at the C3 level (applying concepts). The percentages of students who correctly answered C3-level questions on the pretest and posttest in the experimental and control classes are presented in Table 6.

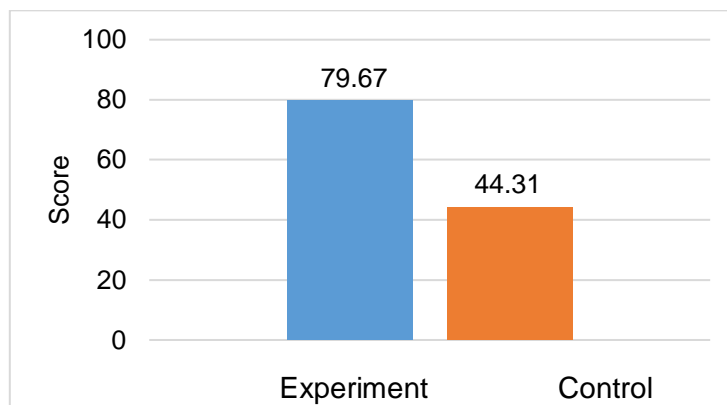
**Table 6.** Percentage of achievement in C3-level cognitive ability

| Class        | Pretest | Posttest |
|--------------|---------|----------|
| Experimental | 39.41%  | 70.58%   |
| Control      | 38.23%  | 50.00%   |

As presented in Table 6, the percentage of achievement in C3-level cognitive ability in the experimental class increased from 39.41% on the pretest to 70.58% on the posttest, whereas in the control class it increased from 38.23% to 50.00%. These results indicate that students in the experimental class demonstrated a better ability to apply virus-related concepts than those in the control class.

The improvement in C3 ability in the experimental class occurred because students did not merely receive material from the teacher, but also applied concepts during discussions and academic competitions. In the games and tournament phases, students were required to answer concept-based questions, which promoted deeper understanding. This finding is in line with Warouw et al. (2025), who stated that learning difficulties in virus-related material range from high to very high, thereby requiring active learning strategies. In addition, Lorika and Syamsurizal (2022) found that most students experience difficulty understanding virus concepts due to the large number of complex scientific terms involved. The successful improvement in concept application ability (C3) in this study indicates that the TGT learning model can foster students' thinking skills more optimally. Academic game-based learning has been shown to help students connect concepts with problem-solving situations, thereby making learning more meaningful.

The observation results showed that student learning activity in the experimental class taught using the TGT learning model was higher than that in the control class taught using the Direct Instruction model. A comparison of the mean learning activity scores between the experimental and control classes is shown in Figure 1.



**Figure 1.** Comparison of the mean student learning activity scores in both classes

Based on Figure 1, the mean student learning activity score in the experimental class was 79.67, which falls into the very active category, whereas the control class obtained a score of 44.31, categorized as moderately active. These results indicate that students in the experimental class exhibited a higher level of learning activity than those in the control class. The high level of learning activity in the experimental class occurred because the TGT learning model provided students with opportunities to engage directly in the learning process through group cooperation and academic competition. During the team phase, students actively exchanged ideas and completed tasks collaboratively, whereas during the games and tournament phases, they were encouraged to understand the material more deeply so that they could contribute to their group. This finding is consistent with Astriana (2021), who stated that the TGT learning model can increase student activeness through social interaction and healthy competition. Buhari (2023) also showed that academic game activities in the TGT learning model can enhance student participation because learning becomes more engaging and less monotonous.

Further analysis indicated that the increase in learning activity occurred not only in general, but also significantly across each activity indicator. A comparison of student learning activity indicators in both classes is presented in Table 7.

**Table 7.** Comparison of student learning activity scores for each indicator

| Indicator | Experimental Class (%) | Control Class (%) |
|-----------|------------------------|-------------------|
| Visual    | 87.67                  | 70.00             |
| Oral      | 66.00                  | 16.67             |
| Listening | 85.33                  | 72.33             |
| Motor     | 83.67                  | 41.33             |
| Emotional | 83.67                  | 25.67             |

Based on Table 7, most indicators in the experimental class were classified as very active, namely visual, listening, motor, and emotional activities, all of which had percentages above 80%. Meanwhile, the oral activity indicator was classified as active, with a percentage of 66.00%. In contrast, several indicators in the control class remained in the moderately active to less active categories, particularly oral and emotional activities. In the experimental class, improvements in visual and listening activities were observed when students paid attention to the explanation of the material that served as the basis for the game implementation. Meanwhile, motor and oral activities developed during group discussions and the execution of games in the tournament phase. Emotional activity also increased due to the presence of healthy competition among groups. These data indicate that student learning activity in the experimental class developed more significantly than in the control class.

The increase in activity across these indicators suggests that TGT learning can simultaneously accommodate diverse student learning styles. According to Dimiyati and Mudjiono (2015), learning activities that involve both physical and mental aspects can improve the quality of the learning process. This finding is further supported by Octavia et al. (2021), who stated that the use of educational game media such as domino cards can enhance student interaction and strengthen active engagement in learning. The findings of Wiratni et al. (2021) also showed that game-based activities can train students' rapid responses and cooperation during the learning process. The consistency of these results indicates that game media such as domino cards make an important contribution to supporting the effectiveness of the TGT learning model. This strategy may therefore serve as a practical instructional approach for biology teachers to improve students' overall learning activity.

Before hypothesis testing was conducted, the research data were first examined through prerequisite tests, including tests of normality and homogeneity. The normality test was performed using the Shapiro–Wilk test at a significance level of  $\alpha = 0.05$ . Data are considered normally distributed when the significance value (Sig.) is greater than 0.05. The results of the normality test for student learning activity and learning outcomes are presented in Table 8.

**Table 8.** Results of the normality test for student learning activity and learning outcomes

| Class        |          | Sig. Learning Outcomes | Sig. Learning Activity | $\alpha$ | Description          |
|--------------|----------|------------------------|------------------------|----------|----------------------|
| Experimental | Pretest  | 0,157                  | 0,192                  | 0,05     | Normally distributed |
|              | Posttest | 0,146                  |                        | 0,05     | Normally distributed |
| Control      | Pretest  | 0,161                  | 0,213                  | 0,05     | Normally distributed |
|              | Posttest | 0,190                  |                        | 0,05     | Normally distributed |

Table 8 shows that the significance values for both classes were greater than 0.05. Therefore, it can be concluded that the data on student learning activity and learning outcomes were normally distributed.

The homogeneity test was conducted at a significance level of  $\alpha = 0.05$ . Data are considered homogeneous when the Sig. value is greater than 0.05. The results of the homogeneity test for student learning activity and learning outcomes are presented in Table 9.

**Table 9.** Results of the homogeneity test for the research data

| Data Type                         | Sig.  | $\alpha$ | Description |
|-----------------------------------|-------|----------|-------------|
| Experimental and control pretest  | 0.641 | 0.05     | Homogeneous |
| Experimental and control posttest | 0.889 | 0.05     | Homogeneous |
| Experimental and control activity | 0.188 | 0.05     | Homogeneous |

Table 9 shows that the significance values for both classes were greater than 0.05, indicating that the research data were homogeneous. After the prerequisite assumptions had been satisfied, hypothesis testing was conducted using the Independent Sample t-Test. The results are presented in Table 10.

**Table 10.** Results of the independent sample t-test for student learning activity and learning outcomes

| Data                              | Sig. (2-tailed) | Sig. (1-tailed) | Description   |
|-----------------------------------|-----------------|-----------------|---|
| Experimental and control activity | 0.000           | 0.000           | H <sub>0</sub> rejected and H <sub>a</sub> accepted |
| Experimental and control posttest | 0.009           | 0.0045          | H <sub>0</sub> rejected and H <sub>a</sub> accepted |

Based on Table 10, the results of the Independent Sample t-Test show that the significance value (1-tailed) for learning activity was 0.000 and that for learning outcomes was 0.0045, both of which were smaller than 0.05. This indicates that H<sub>0</sub> was rejected and H<sub>a</sub> was accepted, meaning that there was a significant difference between the experimental and control classes. These findings demonstrate that the learning activity and learning outcomes of students taught using the TGT learning model were higher than those of students taught using the Direct Instruction model on virus-related material.

The findings of this study also have practical implications for biology instruction at the secondary school level, particularly for virus-related material, which is abstract and microscopic in nature. The implementation of the TGT learning model combined with domino card media can help students visualize concepts and increase active engagement through educational game activities. This strategy may serve as an alternative instructional method for biology teachers to create a more interactive learning environment and help students understand difficult biological concepts more effectively.

## CONCLUSION

Based on the findings of this study, it can be concluded that the implementation of the Teams Games Tournament (TGT) learning model had a significant effect on both students' learning activities and learning outcomes in the topic of viruses among tenth-grade students at Budisatrya Private Senior High School, Medan. Statistical analysis showed that student learning activities in the experimental class were significantly higher than those in the control class, with a significance value of  $0.000 < 0.05$ . Similarly, student learning outcomes in the experimental class were also significantly higher than those in the control class, with a significance value of  $0.0045 < 0.05$ . These findings indicate that the TGT learning model can serve as an effective

alternative strategy in biology instruction to improve both student engagement and learning outcomes on virus-related material.

## RECOMMENDATION

Based on the results obtained, teachers and pre-service teachers are encouraged to apply the TGT learning model as an innovative alternative instructional strategy to enhance students' learning activities and outcomes, particularly in biology education. The use of instructional media that support academic game-based activities, such as domino cards, should also be further developed to make the learning process more engaging, interactive, and capable of maximizing student participation. School support, in the form of adequate learning facilities and training in the implementation of active learning models, is also an important factor in ensuring the successful application of this model in the classroom.

This study remains limited in terms of its scope, as it focused on a single learning topic and was conducted over a relatively short period. Therefore, future research is recommended to apply the TGT learning model to other biology topics or at different educational levels by incorporating additional variables, such as learning motivation, learning interest, and students' critical thinking skills. Further studies involving larger sample sizes and longer instructional durations are expected to strengthen the generalizability of the findings and provide a more comprehensive contribution to the development of innovation in biology education.

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