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The effect of team games tournament model assisted by snakes and ladder on students' conceptual understanding in mathematics

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Abstract.
This study evaluates the efficacy of the Team Games Tournament (TGT) model, augmented with snakes and ladders game media, in enhancing the conceptual comprehension and learning motivation of Grade 5 students at SDN 88 Singkawang. Employing a quantitative approach employing a quasi-experimental posttest-only control group design, the research encompassed all Grade 5 students through a total sampling strategy. The control group consisted of 23 students from class 5-A, while the experimental group included 24 students from class 5-B. Data was collected utilizing both test and non-test instruments, and assumption testing was conducted via the Chi-Square normality test and homogeneity of variance test. Independent samples t-test, effect size calculation, and percentage analysis were employed to analyze the data. The findings revealed a substantial disparity in conceptual understanding between the two groups. The experimental group demonstrated superior scores, as evidenced by $t(45) = 5.61$, $p < 0.001$, surpassing the critical value of ttable = 2.01. The effect size of 1.4 confirmed the pronounced impact of the TGT model coupled with snakes and ladders game media. Furthermore, students' learning interest within the experimental group was categorized as high, with an average percentage of 82.1%. In summation, the integration of the TGT model with snakes and ladders game media significantly enhances both conceptual comprehension and learning motivation among Grade 5 students, particularly in the domain of mathematics, specifically fractions. These findings underscore the potential of combining cooperative learning models with game-based media to foster active engagement and profound understanding in elementary mathematics education.

Keywords:
Conceptual understanding; snakes and ladders game media; TGT model

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INTRODUCTION

Mathematics plays a pivotal role in education, being a mandatory subject at all school levels, from elementary to high school. As elucidated by Nahdi (2017), mathematics should be taught from the elementary level to equip students with essential cognitive abilities such as logical, analytical, systematic, critical, and creative thinking. Moreover, it is crucial to instill collaborative skills, enabling students to comprehend mathematical concepts and effectively solve real-world problems. In the Independent Curriculum, the primary objective of mathematics education is to cultivate a profound comprehension of mathematical concepts, develop proficient problem-

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solving skills, and empower students to apply mathematical knowledge in practical real-world scenarios (Solehah & Setiawan, 2023).

In their study Lestari and Surya (2017), the authors emphasized the significance of conceptual understanding as a fundamental skill for students to acquire in order to effectively master other essential competencies, such as problem-solving, mathematical communication, and representation. Similarly, Wicaksono and Artha (2022) defined conceptual understanding as a form of mastery of learning material, manifesting in students' capacity to identify, simplify, and accurately apply concepts. This understanding holds paramount importance because the rules and principles employed in learning are predicated upon these concepts, facilitating students' long-term knowledge retention without relying solely on memorization techniques.

Despite the Programme for International Student Assessment (PISA) data, Indonesia's mathematics achievement remains inadequate. In 2015, Indonesia scored 386, which declined to 379 in 2018 and further decreased to 366 in 2022. These scores significantly fall short of the international average of 489 points (OECD, 2023). Consequently, Indonesian students exhibit a lack of proficiency in solving non-routine problems and tend to prioritize questions similar to those presented in examples (Luritawaty, 2018).

In a study conducted by Aina and Pratiwi (2024), it was discovered that the average mathematics score of students in a particular school was only 51, significantly below the passing criterion of 70. Out of the 33 students, 30 were unable to achieve mastery due to suboptimal learning processes and inadequate conceptual understanding. Similarly, Mauliddina and Sari (2022) reported that students' mathematics achievement was categorized as low (14.7%), with an average score of 38.24. Aningsih and Asih (2017) further revealed that 66.67% of students were unable to present concepts in mathematical representation, primarily attributed to a lack of conceptual comprehension.

In the fifth grade of SDN 88 Singkawang, pre-research was conducted to assess five indicators of conceptual understanding. These indicators are as follows: (1) restating a concept, (2) classifying objects based on specific properties, (3) providing examples and non-examples, (4) presenting concepts in various mathematical representations, and (5) applying concepts or problem-solving algorithms. To evaluate students' conceptual understanding of fractions, several key indicators were utilized as references. The findings presented in Table 1 provide an overview of the specific indicators where students encounter difficulties.

Table 1. Results of the concept understanding test analysis

No	Concept Understanding Indicator	Students' Responses	Notes
1.	Restating a concept	11 partially correct, 13 incompletes	Most students have not fully understood fractions
2.	Classifying objects	11 unable, 10 incomplete, 3 complete	Only 12.5% classified correctly
3.	Providing examples and non-examples	6 unable, 21 partially correct	Most understand only partially
4.	Representing concepts mathematically	19 unable, 5 partially correct	High difficulty in visual or symbolic representation
5.	Applying concepts or algorithms	23 unable, 1	Nearly all struggled to apply concepts
Average score		48.6	Low category

Based on the data presented in Table 1, the average student score was 48.6, indicating that students' comprehension of the concept of fractions remains relatively limited. This finding concurs with the findings of Unaenah and Sumantri (2019), who observed that students frequently encountered difficulties with questions that deviated from the examples provided by the instructor. Furthermore, they reported that only a limited number of indicators were mastered by students,

with an average score of 29.28%. Pulungan et al. (2024) also reported that the concept understanding of fifth-grade students was predominantly low, with an average score of 36.42%. Additionally, they identified a significant portion of students with a very low level of understanding, reaching an average score of 34.01%.

Preliminary test results indicated that a significant number of students encountered difficulties in comprehending mathematical concepts, particularly fractions, due to confusion in executing operations such as addition, subtraction, multiplication, and division, as well as challenges in aligning denominators. These obstacles impede their ability to grasp more intricate mathematical concepts. Fitriya et al. (2024) characterized fractions as a fundamental yet challenging mathematical concept. Amir and Andong (2022) observed that among students with less than 50% proficiency in fractions, difficulties encompassed problem interpretation, calculation execution, and comprehension of explanations.

Furthermore, the researcher identified several factors contributing to students' low conceptual understanding. The learning process still relied on direct instruction, and instructional media that could stimulate students' interest were not utilized. Consequently, most students exhibited low engagement, paid minimal attention to the teacher's explanations, and tended to lose focus as the lesson progressed. Based on the interest questionnaire distributed to Grade 5 students, the average score was 10.2, or 51%, indicating that students' interest in learning mathematics remained low. Ziliwu et al. (2024) asserted that low interest is influenced by both internal and external factors. Internal factors include physical conditions and the perception of mathematics as difficult. External factors include monotonous teaching methods, unsupportive learning environments, limited facilities, and parental support. This is corroborated by the findings of Zuschaiya (2024), who identified two causes of low interest in learning: internal factors such as unhealthy physical conditions and the assumption that mathematics is difficult, and external factors such as monotonous teaching methods, unsupportive learning environments, limited school facilities, and parental support.

Research conducted by Adam (2023) underscores the significance of instructional media in enhancing students' learning interest. It also supports the development of more effective teaching strategies, improves concept comprehension, strengthens the teacher's role as a facilitator, and promotes engaging content. Consequently, these factors collectively foster a more motivating and effective learning environment. In alignment with Ningrum's (2021) perspective, it is evident that the quality of learning media employed directly correlates with the heightened level of student interest in learning.

To overcome these challenges, it is imperative to implement an interactive and engaging instructional model. As per the findings of Fadhillah et al. (2025), the Team Games Tournament model facilitates active student participation within heterogeneous groups through structured games and tournaments, thereby fostering a positive and enjoyable learning environment. Furthermore, Larasati et al. (2022) assert that the application of the Team Games Tournament model significantly contributes to enhancing students' learning interest. Additionally, Afandi (2015) suggests that the use of snakes and ladders as a learning medium can improve student learning outcomes by 45%, indicating its positive impact on both students' conceptual understanding and learning interest.

Previous research has demonstrated the positive effects of the Team Games Tournament (TGT) model (Fadhillah et al., 2025; Larasati et al., 2022) and snakes and ladders media (Afandi, 2015) on various subjects and grade levels. However, a significant research gap exists as no study has specifically investigated the combined impact of these two approaches to address the limited conceptual understanding of fractions among fifth-grade students. This study seeks to address this gap by examining the influence of the TGT model supplemented with snakes and ladders media in this specific, unexplored context.

In light of the aforementioned challenges, this study seeks to ascertain whether there exists a disparity in the level of conceptual comprehension between fifth-grade students enrolled in SDN

88 Singkawang who undergo instruction employing the Team Games Tournament model supplemented with snakes and ladders media, and those who receive direct instruction. Furthermore, it investigates whether the model significantly impacts students' mathematical concept understanding and whether their learning interest is categorized as high following treatment.

METHOD

The research methodology employed in this study is quantitative, employing a quasi-experimental design, specifically a posttest-only control group design. This design was selected to mitigate sensitization effects associated with pretesting and to ensure equivalence in academic characteristics between the two classes. This equivalence was corroborated through interviews with class instructors and by reviewing students' daily test scores.

The study was conducted at SDN 88 Singkawang, situated at Haji Bakar Street, Semelagi Kecil Subdistrict, North Singkawang District, Singkawang City, West Kalimantan, during the odd semester of the 2024/2025 academic year.

The population comprised all students enrolled in grades 5 at SDN 88 Singkawang, totaling 47 students. Sampling employed a total sampling technique, with class 5-A (23 students) designated as the control group and class 5-B (24 students) as the experimental group. The class selection was based on similar academic characteristics to ensure equivalence prior to treatment and due to the relatively small number of students, which permitted the inclusion of the entire population for more representative data and enhanced the validity of the findings.

Data collection techniques included a concept understanding ability test consisting of five essay questions and a non-test instrument, a mathematics learning interest questionnaire, administered after the learning process. The learning process utilized a previously developed and validated teaching module to ensure the material's appropriateness for students' needs. This module served as the foundation for both the instructional process and the assessment of students' concept understanding and learning interest.

Both the concept understanding test and teaching modules underwent validation by three experts, including lecturers and grade 5 teachers. Instrument trials were conducted on 21 students at SDN 91 Singkawang. The summary of the instrument analysis results is presented in Table 2.

Table 2. Summary of instrument analysis results

Aspect analyzed	Instrument	Result	Criteria
Content validity test	Post-test questions	4.0	Valid
	Experimental module	4.1	Valid
	Control module	4.0	Valid
Construct validity	Question 1	0.63	High
	Question 2	0.75	High
	Question 3	0.79	High
	Question 4	0.66	High
	Question 5	0.71	High
Reliability test		0.73	High
Difficulty level	Question 1	0.48	Medium
	Question 2	0.70	Medium
	Question 3	0.71	Medium
	Question 4	0.60	Medium
	Question 5	0.59	Medium
Discrimination power	Question 1	0.23	Fair
	Question 2	0.27	Fair
	Question 3	0.37	Fair
	Question 4	0.40	Fair
	Question 5	0.43	Good

Based on Table 2, the instruments are deemed feasible for measuring students' conceptual understanding. The categorization of validity, reliability, difficulty level, and discrimination power are guided by the guidelines outlined by Arikunto (2018). Furthermore, the non-test technique employed a student learning interest questionnaire consisting of 20 statements. This questionnaire has a validity score of 3.32, categorized as good, and a reliability coefficient of 0.840, also within the good category.

The collected data were systematically analyzed. Normality testing was conducted using the Chi-Square formula to ensure data were normally distributed. Homogeneity testing was performed using the F test to assess variance equality between groups. Differences between the experimental and control classes were analyzed using an independent samples t-test. The effect of the Team Games Tournament learning model supported by the snakes and ladders game media on students' conceptual understanding was measured using effect size calculation. Simultaneously, students' learning interest was analyzed using percentages to provide a clear depiction of response proportions. This analytical approach was designed to present valid and reliable research findings.

RESULTS AND DISCUSSION

Preliminary observations indicated that numerous Grade 5 students at SDN 88 Singkawang encountered difficulties in comprehending fraction concepts, particularly in the indicators of classification, representation, and application. Consequently, the selection of an instructional model and learning media capable of simultaneously enhancing engagement, collaboration, and conceptual clarity became imperative.

Post-test data were collected from 24 students in the experimental class, who received instruction employing the Team Games Tournament model supported by snakes-and-ladders media, and 23 students in the control class, who were instructed through direct instruction on the topic of fractions. The selection of the Team Games Tournament model was predicated on its ability to foster group collaboration through engaging and interactive competitive activities. This strategy aligns with the principles of cooperative learning, as elucidated by Nurhasanah and Rubiyanto (2018). Cooperative learning is a constructivist approach wherein students actively construct knowledge based on their prior experiences and engage positively in group interactions. Consequently, the TGT model emphasizes active student participation, social interaction, and positive interdependence among group members.

The utilization of the snakes-and-ladders medium was designed not only to stimulate students' interest in mathematics but also to enhance their focus on the content and facilitate the construction of concept understanding through concrete visualizations. This "learning by playing" approach is believed to foster a learning environment that is enjoyable, meaningful, and conducive to optimizing students' knowledge construction, consistent with Konstruktivisme constructivist theory. As proposed by Lev Vygotsky, constructivisme is a learning theory emphasizing that knowledge is constructed through social interaction and influenced by culture and the learner's social environment.

Despite the potential benefits of Team Games Tournament, its implementation presents several challenges. The game-based activities can generate noise that may interfere with other classes. Additionally, the formation of small-scale groups may limit cross-group interaction. Furthermore, adequate facilities and resources are necessary, and developing comprehensive competition questions can be intricate.

The snakes and ladders medium also carry the risk of inducing student fatigue if the game duration is excessive, the number of questions is excessive, or students wait for extended periods before their turn. Furthermore, insufficient teacher supervision can divert students' attention from the learning objectives toward the gameplay itself.

In contrast, the direct instruction approach employed in the control class tended to be teacher-centered, characterized by one-way communication patterns. The absence of student-teacher interaction negatively impacted learning engagement, leading to boredom, diminished

motivation to inquire, and difficulties in comprehending material aligned with the indicators of concept understanding.

The students' concept understanding ability in this study is assessed based on five indicators: restating a concept, classifying objects according to specific properties, providing examples and non-examples of the concept, presenting concepts in various forms of mathematical representation, and applying concepts or problem-solving algorithms. These five indicators serve as a reference for analyzing students' concept understanding ability on fraction material. The results of the analyzed data processing are presented in the following Table 3.

Table 3. Mean scores for each indicator

No	Indicator	Experimental	Control
1.	Restating concepts	2.5	1.3
2.	Classifying objects according to certain properties	2.8	2.5
3.	Giving examples and non-examples of the concept	2.5	2.5
4.	Presenting concepts in various forms of mathematical representation	2.4	1.7
5.	Applying concepts or problem-solving algorithms	2.0	1.1
	Mean	2.4	1.8

The analysis revealed that the most effective indicator in the experimental group was classifying objects, with a mean score of 2.8. This advantage can be attributed to the visual representations provided by the game-based medium, group discussions that facilitated concept clarification, and opportunities to test understanding through competition. In contrast, applying concepts or problem-solving algorithms yielded the lowest score mean score of 2.0, indicating that students still require additional practice in operations with fractions, particularly those with unlike denominators, as well as consistent training in formulating step-by-step problem-solving procedures.

The higher score in the classification indicator for the experimental group can be attributed to the structured peer discussions embedded in the TGT sessions, where students collaboratively sorted and compared fractions while progressing in the game. The visual cues provided by the snakes and ladders medium acted as cognitive anchors, facilitating the distinction between fractional and non-fractional numbers. This direct alignment between the game mechanics and the classification task explains why this indicator outperformed others. Conversely, the relatively lower score in the application indicator suggests that, while the game effectively supported conceptual clarity, it offered limited opportunities for repeated procedural practice, which is essential for mastering algorithmic problem-solving.

This study presents a divergence from the findings reported by Korkmaz Guler and Tarim (2024), which indicated that the classification indicator exhibited the lowest scores among sixth-grade students in comprehending fraction concepts, while application demonstrated relatively higher scores. This discrepancy can be attributed to variations in students' prior knowledge, the emphasis on learning activities, and the intensity of the exercises provided in both studies. Students from SDN 88 Singkawang appeared to possess a substantial understanding of distinguishing between fractions with uniform and non-uniform denominators, as well as differentiating between fractions and non-fractions—factors that support their classification abilities. Conversely, the quantity of procedural problem-solving exercises incorporated into the TGT sessions was restricted, resulting in an inadequate development of their conceptual application skills.

Furthermore, to examine the differences in students' concept understanding between the experimental and control classes in the mathematics subject on the topic of fractions for Grade V

students at SDN 88 Singkawang, a two-sample t-test was employed. Prior to the t-test, prerequisite tests, namely the normality test and homogeneity test, were conducted.

Next, a normality test was conducted to determine whether the data were normally distributed. The Chi-Square test at a significance level of 5% was used, where if the calculated χ^2value was less than the χ^2table, it could be concluded that the data were normally distributed.

Table 4. Presents the results of the post-test data normality test

Statistics	Experiment	Control
Significant level	5%	5%
X^2_{values}	3.204	2.876
X^2_{tables}	7.815	5.991
Number of students	*24*	*23*
Conclusion	Normal	

Based on the results of the normality test presented in Table 4, the calculated χ^2_{value} for the experimental class was 3.204, while the χ^2_{table} was 7.815. In the control class, the calculated χ^2_{value} was 2.876, compared to the χ^2_{table} of 5.991. Since the calculated $\chi^2_{value} < \chi^2_{table}$ in both classes, the post-test data were determined to be normally distributed. This indicates that the data from both classes meet the assumption of normality.

Subsequently, a homogeneity test was performed to examine whether the variances of the experimental and control classes were equal. The analysis employed the F-test, and the results of the calculations for both sample groups are presented in Table 5.

Table 5. Results of post-test data homogeneity test calculations

Statistics	Experiment	Control
Significant level	5%	5%
Variance	119.389	205.087
N	24	23
F_{value}	0.58	
F_{table}	**2.04**	
Conclusion	Homogeneous	

Analyzing Table 3, the F-test conducted with a significance level of $\alpha = 5\%$ and degrees of freedom for the experimental group ($df_1 = 23$) and the control group ($df_2 = 22$) yields an F_{table} of 0.58 and a p-value of 0.897. Since the calculated F_{value} (0.58) is less than or equal to the F_{table} (2.04), it can be concluded that the variances of the two groups are equal, indicating homogeneity. Additionally, the results of both the normality and homogeneity tests confirm that the data from both groups are normally distributed and homogeneous. Consequently, the analysis proceeded with a two-sample t-test to compare the mean scores of the two groups. The t-test results are presented in the following Table 6.

Table 6. Results of the t-test calculation of post-test data

Class	Sig. Level	T_{value}	T_{table}	Conclusion
Experiment & Control	5%	5.61	2.014103	There are differences in abilities

Based on the results presented in Table 6, a t-test was conducted to determine the statistical significance of the concept understanding between students taught using the Team Games Tournament learning model assisted by snakes and ladders game media and those taught using direct instruction in Grade 5 at SDN 88 Singkawang. The experimental class yielded a T(45) value of 5.61, while the control class yielded a T(45) value of 0.001.

Since the calculated T-value (5.61) exceeded the critical value (2.01) from the with a significance level of 5% T-table, it can be concluded that there is a statistically significant difference in concept understanding between the two groups. This finding aligns with the hypothesis testing criteria, as it indicates a statistically significant difference in ability between the experimental and control classes.

These findings are consistent with previous research conducted by Penggabean et al. (2021), which reported that students' concept understanding is higher when learning through the Team Games Tournament cooperative model compared to the direct instruction model. Additionally, Rahayu and Suryani (2022) demonstrated that the use of the Team Games Tournament learning model can enhance students' concept understanding of learning materials, facilitate engaging and interactive learning, and aid in comprehending complex concepts.

Following the identification of a statistically significant difference between the two class samples, the next step involves measuring the effect size using Cohen's formula. Effect size is employed to quantify the influence of the Team Games Tournament model assisted by the snakes and ladders game media on the concept understanding ability of fifth-grade students regarding fraction material. The results of the analysis are presented in Table 7.

Table 7. Effect size calculation results

Calculation	Result
Average	70.4
Standard deviation (Sc)	14.32086
Effect Size	1.4
Criteria	High

Based on the data presented in Table 7, the Effect Size (ES) value is 1.4, which falls within the high category. This indicates that the application of the Team Games Tournament learning model, coupled with the use of snakes and ladders game media, has a substantial impact on the mathematical concept comprehension of Grade 5 students enrolled at SDN 88 Singkawang. This finding aligns with the research conducted by Rahayu and Suryani (2022), who reported that the utilization of the TGT model, augmented by snakes and ladders game media, also exhibited a high level of influence on students' conceptual understanding.

In this study, the experimental class achieved an average score of 80.68, while the control class averaged 62.50. Consequently, it can be concluded that there exists a significant disparity in concept understanding between the experimental and control classes, with the experimental class demonstrating superior performance compared to the control class, which received direct instruction.

This result is corroborated by the findings of Zailani and Tawarni (2023), who assert that the Team Games Tournament method is highly effective in enhancing students' interest in learning and conceptual understanding. This is achieved by creating an active and engaging classroom environment while fostering a sense of responsibility and cooperation among students. Furthermore, the research conducted by Aulia and Handayani (2018) indicates that implementing the Team Games Tournament learning model in Grade 5 significantly enhanced students' mathematical concept comprehension. This is evident from the average posttest score of 60.25 for the experimental class, in contrast to 23.75 for the control class. These findings are consistent with the present study, demonstrating that the TGT model, when combined with snakes and ladders game media, positively influences students' conceptual understanding.

In the subsequent phase of the research, the researcher investigated whether the percentage of student learning interest after the implementation of the Team Games Tournament model, augmented by the snakes and ladder game media, would fall within the high category. The observation of students in this study was conducted across four distinct categories: (1) Happy Feeling, (2) Interest in Learning, (3) Attention while Studying, and (4) Involvement in Learning.

These four categories served as the foundation for the development of a student learning interest questionnaire.

The questionnaire employed the Guttman scale, presented in a checklist format (√) where students responded to statements based on their opinions in the designated spaces. Students were required to select only one answer from two alternatives: "Yes" or "No." The Guttman scale was chosen due to its suitability for class 5, as it comprises simple dichotomous questions that are readily comprehensible and facilitate a precise measurement of learning interest. The analysis of students' learning interest based on these indicators is presented in Table 8.

Table 8. Analysis of student learning interests based on indicators

Indicator	Amount	Percentage	Category
Happy Feeling	67	93.1%	Very high
Interest in learning	96	80%	High
Attention while studying	113	78.5%	High
Involvement in learning	118	81.9%	High

Based on the analysis presented in Table 8, the indicator of Happy Feeling toward learning mathematics is categorized as very high, with a score of 67 and a percentage of 93.1%. Similarly, the indicator of interest in learning mathematics is also categorized as high, with a score of 96 and a percentage of 80%. The indicator of Attention while studying is categorized as high, with a score of 113 and a percentage of 78.5%. Finally, the indicator of involvement in learning is categorized as high, with a score of 118 and a percentage of 81.9%.

The indicator of Happy Feeling toward learning mathematics achieved the highest percentage, indicating that the use of games in learning made students feel more engaged, entertained, and happy in participating in mathematics lessons. Additionally, the distribution of students' learning interest is visually presented in Figure 1.

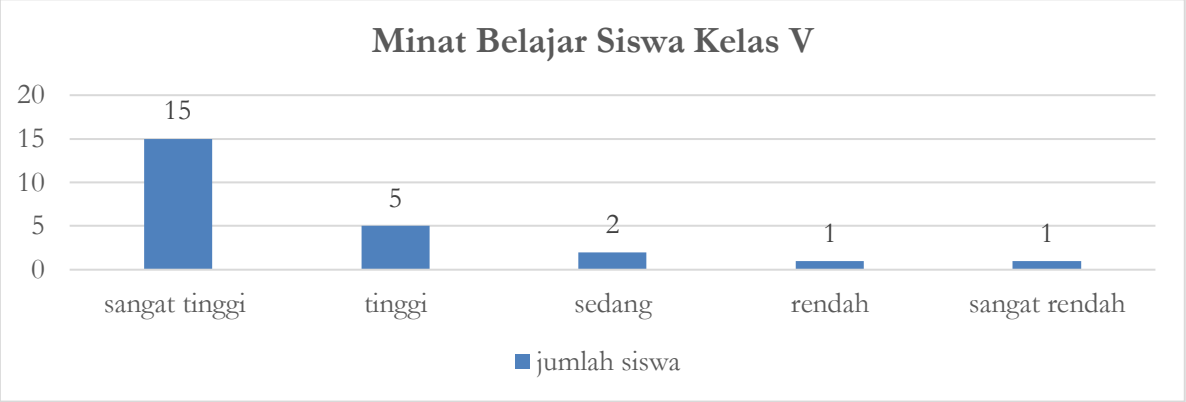

Figure 1. Distribution of learning interests

Based on Figure 1, students' interest in learning mathematics was categorized into the high category (15 students, 62.5%), very high category (5 students, 20.8%), moderate category (2 students, 8.3%), low category (1 student, 4.2%), and very low category (1 student, 4.2%). The overall questionnaire score was 394, representing a total percentage of 1.970 and an average score of 82.1%. This indicates that overall student interest in learning was high after the implementation of the Team Games Tournament model, aided by the snakes and ladders game media.

According to Mauliddina and Sari (2022), students' interest in the material significantly impacts the learning process. As interest increases, understanding of the material, particularly in mathematics, also enhances. This finding is corroborated by Octariani and Panjaitan (2020), who reported that the Team Games Tournament learning model effectively increased interest, resulting in a rise from 5.71% to 82.86% in the high-interest category. Therefore, the use of the Team

Games Tournament model, assisted by the snakes and ladders game media, successfully fostered a high level of student interest in learning mathematics in Grade V at SDN 88 Singkawang.

In this study, the researcher measured only the high percentage of student interest following the implementation of the Team Games Tournament model, aided by the snakes and ladders game media. The findings revealed a positive correlation between students' learning interest and their concept understanding in mathematics. The average score of students' concepts understanding using this model was 80.6, while their average learning interest score reached 82.1. These results demonstrate that higher learning interest correlates with greater concept understanding.

CONCLUSIONS

Based on the data analysis, it can be concluded that there is a difference in conceptual understanding between fifth-grade students of SDN 88 Singkawang who received instruction using the Team Games Tournament model assisted by snakes and ladders media and those who received direct instruction. This intervention also demonstrated a significant effect on students' mathematical concept understanding, as indicated by a t-test revealing a statistically significant difference between the experimental and control groups, with an effect size of 1.4, reflecting a strong impact. Furthermore, the combined model and media successfully fostered a high level of learning interest, with an average percentage of 82.1%. These findings highlight that interactive and engaging approaches can serve as effective solutions for enhancing both content mastery and student engagement.

However, this study has certain limitations. It focused solely on the topic of fractions in a single elementary school with a limited sample size, which may restrict the generalizability of the results to other subjects or educational levels. Furthermore, the short research duration did not allow for the observation of the model's long-term impact.

The implications of this study suggest that educators may consider adopting the TGT model combined with interactive game-based media as an effective instructional strategy, particularly for subjects perceived as challenging. Such an approach can make the learning process more enjoyable and meaningful. Future research is recommended to apply this model in different contexts, such as other subjects or higher grade levels, and to conduct longer-term observations to assess students' knowledge retention.

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