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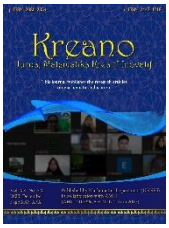

The Effect of Gamification Approach and Teams Games Tournament in Term of Learning Interest on Students' Understanding of Mathematical Concepts

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Abstract

Understanding mathematical concepts in mathematics learning is a crucial skill that students must possess to support the smooth running of teaching and learning activities. Pre-research results at an elementary school in East Jakarta indicate that students' understanding of mathematical concepts is still relatively low, as reflected in their suboptimal daily test scores. Therefore, researchers are interested to use a learning approach that can improve students' mathematical reasoning ability, namely the Gamification and Teams Games Tournament (TGT) learning approach in terms of learning interest with the aim of knowing: 1) the effect of gamification and TGT approaches on students' understanding of mathematical concepts; 2) the effect of learning interest on students' understanding of mathematical concepts; 3) the interaction between gamification and TGT approaches and students' learning interest. This study was a Quasy Experimental study with a 2-design factorial. The population and sample in this study were all students of class V at one of the elementary schools in East Jakarta, the control class is VA grade and the experimental class is VB grade. Data from questionnaires and understanding of mathematical concepts were analyzed using twoway ANOVA. Based on data analysis, the following results were found: (1) there is the effect of gamification and TGT approaches on students' understanding of mathematical concepts; (2) there is an effect of learning interest on students' understanding of mathematical concepts; and (3) there is an interaction between gamification and TGT approaches and students' learning interests. The results of the study showed that the gamification approach was more effective than the TGT model in improving students' understanding of mathematical concepts, especially for students with high learning interests. Therefore, teachers are advised to apply the gamification approach as an innovative learning strategy that can accommodate differences in students' learning interests in the classroom.

Keywords: Gamification Approach; TGT; Learning Interest; Understanding of Mathematical Concept.

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Abstrak

Pemahaman konsep matematis dalam pembelajaran matematika merupakan kemampuan penting yang harus dimiliki peserta didik untuk mendukung kelancaran kegiatan belajar mengajar. Hasil pra-penelitian di sebuah SD di wilayah Jakarta Timur menunjukkan bahwa tingkat pemahaman peserta didik terhadap konsep matematis masih tergolong rendah, yang tercermin dari nilai ulangan harian yang belum optimal. Oleh karena itu, peneliti terdorong untuk menggunakan pendekatan pembelajaran yang dapat meningkatkan kemampuan penalaran matematis peserta didik, yaitu pendekatan pembelajaran Gamifikasi dan Teams Games Turnament (TGT) ditinjau dari minat belajar dengan tujuan untuk mengetahui: 1) pengaruh pendekatan gamifikasi dan TGT terhadap pemahaman konsep matematis peserta didik; 2) pengaruh minat belajar terhadap pemahaman konsep matematis peserta didik; 3) interaksi antara pendekatan gamifikasi dan TGT dengan minat belajar peserta didik. Penelitian ini merupakan penelitian Quasy Eksperimental dengan desain 2 faktorial. Populasi dan sampel dalam penelitian ini yaitu seluruh peserta didik kelas V di salah satu sekolah dasar di Jakarta Timur, sebagai kelas kontrol yaitu kelas VA dan sebagai kelas eksperimen yaitu kelas VB. Data hasil angket dan pemahaman konsep matematis dianalisis menggunakan uji anava 2 jalur. Berdasarkan analisis data, ditemukan hasil-hasil sebagai berikut: (1) terdapat pengaruh pendekatan gamifikasi dan TGT terhadap pemahaman konsep matematis peserta didik; (2) terdapat pengaruh minat belajar terhadap pemahaman konsep matematis peserta didik; dan (3) terdapat interaksi antara pendekatan gamifikasi dan TGT dengan minat belajar peserta didik. Hasil penelitian menunjukkan bahwa pendekatan gamifikasi lebih efektif daripada model TGT dalam meningkatkan pemahaman konsep matematis peserta didik, terutama bagi peserta didik dengan minat belajar tinggi. Oleh karena itu, guru disarankan untuk menerapkan pendekatan gamifikasi sebagai strategi pembelajaran inovatif yang mampu mengakomodasi perbedaan minat belajar peserta didik di kelas.

INTRODUCTION

Math is a required topic in the national education system, and students must take it from kindergarten through elementary school, junior high school (JHS), senior high school (SHS), and further education. Since mathematics has an impact on daily life, it is a required topic taught from a young age till maturity. In actual life, mathematics plays a crucial part.

The quality of mathematics instruction in Indonesian elementary schools still does not meet ideal standards. Valero et al. (2002), observed that traditional methods such as lecturing remain dominant, with teachers often leading the process and students passively following instructions, a situation comparable to learning conditions in several African countries. This was confirmed by a grade V teacher when the researcher conducted an observation at an elementary school in East Jakarta. From the results of the observation, it was found that teachers tend to be more comfortable with conventional learning where the proportion of teacher activity is very dominant compared to students.

Not finished with the education problems in Indonesia, another disaster came without compromise, namely the Covid-19 pandemic. The situation in all sectors changed drastically, including education. All educational institutions have been temporarily shuttered due to limited human encounters and gatherings and the deployment of social distance. Distance learning, which has been implemented for around two years, has resulted in learning loss for students. According to the Education and Development Forum (2020) All educational institutions have been temporarily shuttered due to limited human encounters and gatherings and the deployment of social distance. Distance learning, which has been implemented for around two years, has resulted in learning loss for students. Learning loss occurs when students experience a general or particular loss of information and abilities, or when they experience an academic setback as a result of circumstances like extended pauses in their education or the discontinuity of the educational process.

Lack of concentration and focus, lack of enthusiasm in learning, and low student absorption of different learning ideas are among the learning losses that are expected to occur. Learning motivation suffers by the lack of in-person instruction (Cerelia et al., 2021). During traditional classroom instruction, students tend to maintain greater focus because they feel they are being directly monitored. Although schools have resumed face-to-face activities, the residual effects of prolonged home-based learning are still evident in classrooms today, as perceived by many educators.

According to the findings of interviews with a number of instructors, pupils' motivation in learning has decreased, and their conceptual thinking skills—particularly in mathematics—are quite poor. According to Theresia (2022), pupils' comprehension of mathematical ideas suffered while they learned at home during the COVID-19 epidemic. A fundamental skill that all students should possess is the capacity to comprehend mathematical ideas, since this enables them to solve problems that teachers present and provide very gratifying outcomes.

Therefore, understanding mathematical concepts must always be honed and trained so that students become accustomed to solving problems that will be faced so that they get satisfactory results. According to Audria's (2021) research, during the Covid-19 epidemic, instructors' adoption of tactics to spark students' enthusiasm in learning through the network learning system increased. By implementing learning strategies, students are more interested and happy in participating in learning.

According to the findings of the researchers' interviews with grade V teacher class, every child has different skills for solving problems. Previously, teachers had instilled concepts in problem solving, but not a few students had an understanding of mathematical concepts. When a child has high logic, the child will study the questions given easily so that they can solve them. But when a child has low logic, the child will have difficulty in studying the questions so that the child cannot solve them.

Many educators tend to favor the lecture-based method due to its simplicity and immediate implementation, even though it often leads to limited student engagement and deeper learning. And usually at the end of the learning process, teachers get evaluation results that are not in accordance with what is expected. That is the reality of classroom instruction on a daily basis, not to mention that pupils rapidly get disinterested in the lessons that are presented in front of the class.

Traditional education is thought to be less applicable to today's kids. In order to increase students' comprehension of mathematical concepts and interest in learning, the classroom learning process needs to be improved. This can be achieved by implementing a teaching strategy that engages and delights students in the process and encourages them to participate actively in their education.

One approach that can be used is the gamification approach. According to Jusuf (2016), gamification is a approach of teaching that uses elements of a game or video game to encourage pupils to learn. A learning approach known as "gamification" uses gaming aspects to encourage pupils, foster emotions of enjoyment, and increase their involvement in the learning process. There are several gamification elements that can be applied in learning such as awards, points, role-playing, challenges, levels in each game, scoreboards and others. The concept of gamification can

attract students' interest to continue learning mathematics by capturing interesting things (Jusuf, 2016). Meanwhile, according to Meyhart (Takdir, 2017), there are several things about game aspects, namely points, badges, levels, progression, feedback, task lists, avatars and social graphs by studying video games.

From the report, it can be interpreted that children's interest in games is indeed very high compared to children's interest in books or even the learning process. This is a challenge as well as an opportunity for teachers to be able to integrate elements in the game into learning so that children feel interested in the learning process in class.

Figure 1 below shows the thinking framework in this research.

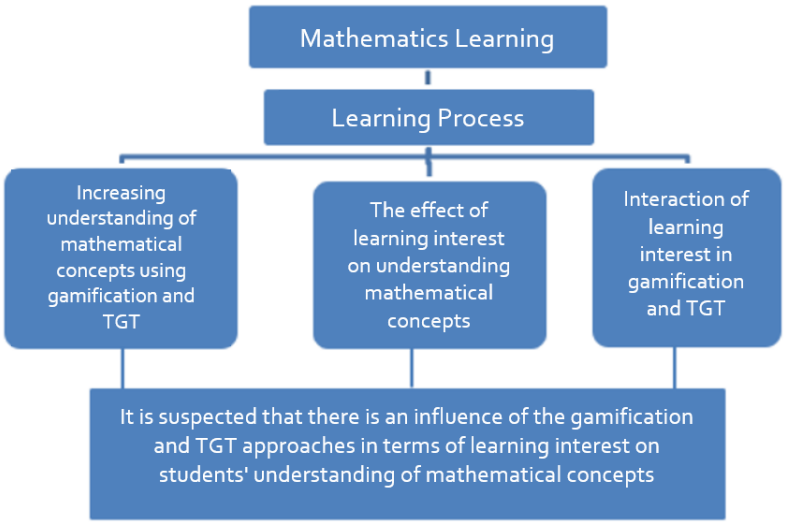

Figure 1. Thinking Framework Design

METHOD

In this study, learning interest is separated in this study into two groups: those with high learning interest and those with low learning interest. To fulfill the study's objectives, both descriptive and quasi-experimental methods were utilized, employing a 2x2 factorial design (Factorial Design Two Factor Experiment). The type of experiment that will be used is quasi-experimental design, in this study, individuals who are the subjects of research in certain groups have certain goals, students are the subjects in this study.

The study assigned participants into two categories: an experimental group that received instruction through a gamification approach, and a control group that was instructed using the TGT model. A pretest (initial test) will be given to students prior to the learning process, and a posttest (final test) will be given after the learning process to assess how well students have improved their understanding of mathematical concepts and their interest in learning. This is the research design that will be employed.

The study's population consisted of 60 individuals from two classes of fifth graders at an East Jakartan elementary school. Two classes were used in this study: class VB, which had 30 students as the experimental class, received the learning process treatment using the gamification approach, and class VA, which had 30 students as the control class, received the learning process treatment using the Teams Games Tournament

(TGT) learning model.

The stages to be taken in this research are presented in Figure 2 below.

Figure 2. Research Stages

The preparation stage included identifying classroom issues, observing teaching practices, reviewing literature, designing instruments for measuring conceptual understanding, and developing lesson plans based on the gamification strategy.

The implementation phase consisted of several key activities, including administering a pretest to both the experimental and control groups to assess students' initial understanding of mathematical concepts. Instruction was then delivered using a gamification approach in the experimental group and the Teams Games Tournament (TGT) model in the control group. Following the instructional period, a posttest was conducted to evaluate students' mathematical abilities after the treatment. The results of the pretest and posttest were then processed, and the test instruments were analyzed. Finally, a comparative analysis was carried out between the two groups to examine the extent of improvement in students' conceptual understanding of mathematics.

Data collection techniques are recording events/objects or information or characteristics of all or part of the population that will support the research (Subagjo, 2011). The data collection technique referred to here is the method used by researchers to collect the required data. This study uses a Likert scale questionnaire instrument consisting of positive and negative statements. The scoring criteria for each item, determined by the chosen responses, are presented in the table below.

Table 1. Likert Scale Categories

Rating	Score	
	(+)	(-)
SS (Very Agree)	5	1
S (Agree)	4	2
KS (Less Agree)	3	3
TS (Disagree)	2	4
STS (Very Disagree)	1	5

Table 2. Questionnaire Grid About Learning Interest

No	Indicators	Number of Items	Item	
			(+)	(-)
1.	Feeling of liking or pleasure	8	17, 20, 21, 29	3, 8, 14, 25
2.	Learning interest activities	8	5, 11, 18, 22	2, 10, 26, 29
3.	Attention	7	7, 12, 23	4, 15, 19, 27
4.	Students' enthusiasm in following lessons	7	1, 6, 9, 24	13, 16, 28
Total		30		

Table 3. Categorization

Range	Score
$X < (\bar{x} - 1{,}0SD)$	Low
$(\bar{x} - 1{,}0SD) \leq X$	High

If all items are completed, the maximum achievable score is 125. Since the collected data is currently in score format, it will be transformed into values using the formula below (Wahab, 2016):

$$N = \frac{Score\ obtained}{Maximum\ score} \times 100\%$$

The 21 test questions were arranged based on 7 indicators of mathematical concept understanding and then tested by experts to find out the deficiencies in the questions and what improvements should be made. After the construct test was carried out, it was continued with limited testing on 2 students who had high and low characteristics. After that, a comprehensive trial was carried out on students who had the same characteristics as the sample that would be used for the study.

This study employed both test and non-test methods for data collection. The non-test method was utilized to gather information on students' learning interest through questionnaires completed by the respondents. The collected data were quantitative in nature, derived from the pretest and posttest results, which were subsequently analyzed using statistical methods.

RESULT AND DISCUSSION

Posttest Results of Experimental Class and Control Class

To provide a clearer picture of student performance after the intervention, the posttest scores of both the experimental and control groups are summarized in the descriptive statistics shown in Table 4.

Table 4. Descriptive Statistics of Posttest Results

Descriptive Statistics								
	N	Range	Minimum	Maximum	Mean		Std. Deviation	Variance
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
Control	30	42.00	45.00	87.00	68.5000	1.90688	10.44443	109.086
Experiment	30	33.00	45.00	78.00	66.1333	1.51599	8.30344	68.947
Valid N (listwise)	30							

The data indicates a marginal difference in the performance of the experimental and control groups. The experimental group achieved a mean score of 66.13 with a standard deviation of 8.303 and variance of 68.947. In contrast, the control group obtained a slightly higher average score of 68.5, with a standard deviation of 10.44 and variance of 109.086, resulting in a score gap of 2.4

points in favor of the control group.

The Effect of Gamification and TGT Approaches on Students' Understanding of Mathematical Concepts

Initial assessments in the experimental group revealed that students' conceptual understanding in mathematics was relatively low. From several questions from students raised regarding the test questions, it was as if they had just found a problem as stated on the question sheet. This indicates that spatial problems are rarely presented in class and students are not used to such problems. Based on the results of the Gain test in the experimental class, almost all students showed significant development in their ability to understand mathematical concepts. An average N-Gain score of 0.33 was recorded in the experimental class, placing it within the moderate range. This suggests that the Gamification approach contributed significantly to enhancing students' comprehension of mathematical concepts.

The application of the gamification model in learning accustoms students to being like someone who is playing a game. In learning, the material is divided into several levels, so that students can measure their own abilities. If at a level the student has not reached the minimum value that has been determined, then he can repeat it again until he succeeds. Through a series of activities carried out repeatedly in geometry material, the students' conceptual understanding ability will also develop. In addition, this game-based learning will increase students' learning interest materials. This increase is caused by the material presented in various fun activities such as treasure hunts, and various rewards that are obtained if students succeed in reaching a certain level.

According to the gain score analysis for the control class, students' improvement in understanding mathematical concepts was measured at 0.29. This value falls within the category of IG ≤ 0.3, indicating a low level of gain. Thus, the enhancement in students' conceptual understanding following instruction with the TGT model was relatively minimal. These results are very different from the experimental class because the learning carried out is indeed different. Learning in the control class is carried out in a less varied manner, activities in each learning end with a competition or tournament. Unlike the gamification model, the material presented is not classified into several levels so that all students are treated equally in the game. The impact is that some students have difficulty with certain questions because the prerequisites for the previous material have not been mastered.

From the researcher's observations, the learning carried out in the control class is less conducive, many students do not concentrate on the material being presented. In addition, some students look noisy when the teacher is explaining the material. When writing the material, it can be seen that not all students take complete notes. The question and answer process does not take place thoroughly. Only a few students play an active role in learning. Not all students get media, only teachers show media in front of the class, so some students find it difficult to understand the material. During the evaluation, many students complained that they did not understand what was meant in the question sheet, even though there were pictures as explanations. It is not uncommon for students to forget the material they have previously learned, this is because the learning process does not provide an opportunity for students to

play an active role in obtaining information. Students tend to be passive, the information obtained is not stored in their memory for long.

Based on the two-way ANOVA results, the significance value for the learning model was found to be 0.026. Therefore, it can be concluded that there is a difference in the improvement of students' understanding of mathematical concepts between those taught using the gamification model and those taught using the TGT model. The gain test data further supports this finding, with the experimental class showing a 33% increase in mathematical concept understanding, compared to 29% in the control class. These results indicate that the gamification model is more effective than the TGT model when teaching geometry to fifth-grade students. Therefore, it can be concluded that there is a difference in the improvement of conceptual understanding between students experiencing gamification-based instruction and those taught using the TGT approach. This is in line with Iis Lutfiani (2015) who stated that one of the advantages of gamification is that it helps students focus more and understand the material being studied.

The Effect of Learning Interest on Students' Understanding of Mathematical Concepts

According to the results of the two-way ANOVA analysis, the significance value for learning interest was 0.001. Given that the obtained p-value is lower than the significance threshold of 0.05, the null hypothesis (H_0) is rejected, supporting the acceptance of the alternative hypothesis (H_1). This indicates a statistically significant difference in students' conceptual understanding based on their level of learning interest. The data suggest that learning interest substantially influences students' mathematical understanding. In the control group, students with low interest did not demonstrate a meaningful improvement, while in the experimental group, those with low learning interest showed relatively better outcomes. Additionally, students with high learning interest in the experimental group exhibited a considerable increase in conceptual mastery when taught using the gamification approach. These findings align with Noer Rahmah (2012), who emphasized that both internal and external factors shape one's interest, which in turn impacts intelligence, motivation, talent, and cognitive skills.

Interaction of Learning Models and Learning Interests on Improving Mathematical Concept Understanding Ability

The two-way ANOVA results revealed a significance value of 0.010 for the interaction between the learning model and students' learning interest. Given that the obtained p-value is lower than the significance threshold of 0.05, the null hypothesis (H_0) is rejected, supporting the acceptance of the alternative hypothesis (H_1). This finding suggests that the interaction between the type of instructional model and students' learning interest has a statistically significant influence on enhancing their understanding of mathematical concepts. This outcome aligns with Slavin (2010), who asserts that student engagement in completing tasks can lead to improved classroom behavior, greater enjoyment of school and class activities, and stronger social interactions among peers.

Implication of Research

This research offers valuable insights for enhancing mathematics instruction at the elementary level. Incorporating a gamification approach has demonstrated a significant positive effect on students' conceptual understanding, particularly among learners with high interest levels. Consequently, it is recommended that educators integrate game-based elements into math lessons to foster a more engaging, interactive, and motivating classroom environment. Furthermore, cultivating students' interest in learning should also become a strategic focus, as it plays a vital role in supporting improved academic achievement

Limitation

Several limitations must be considered in interpreting the results of this study. First, the research was limited to a single elementary school in East Jakarta with only 60 fifth-grade participants, which may restrict the generalizability of the results. Second, the duration of the study was relatively short, possibly insufficient to observe the long-term effects of the gamification and TGT approaches on students' conceptual understanding. Third, learning interest was measured using self-reported questionnaires, which may introduce response bias due to students' subjective perceptions

CONCLUSION

Based on the research findings and analysis, it can be concluded that both the experimental and control groups experienced improvements in their understanding of mathematical concepts. However, the improvement was more notable in the experimental group, with an N-Gain score of 0.33, categorized as moderate, compared to the control group which showed a lower level of gain. This indicates that the gamification approach was more effective than the TGT model in enhancing conceptual understanding. Furthermore, the two-way ANOVA results confirm that there are significant differences in understanding based on both the learning model used and the level of students' learning interest. Students with higher learning interest showed better outcomes, and there was a statistically significant interaction between the type of learning model and learning interest in influencing students' conceptual mastery.

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