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The effect of game based learning with math bingo in reducing math anxiety to improve students' mathematics learning outcomes in data presentation materials

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ABSTRACT

This study aims to examine the effects of game-based learning with Math Bingo in reducing math anxiety and improving student learning outcomes. The research method used is pre-experimental with a pre-post test design of one group. Math anxiety data was collected using questionnaires before and after the intervention, while math learning outcomes data were obtained through pre-test and post-test. results of data analysis obtained sig. (2-tailed) of $0.001 < 0.05$. Therefore, it can be concluded that game-based learning with Math Bingo is effective in reducing anxiety and improving students' math learning outcomes. This finding shows that game-based learning with Math Bingo is effective in reducing anxiety and improving students' math learning outcomes. The implication of this study is the importance of integrating game-based learning in mathematics learning to create a more interactive and interesting learning environment, as well as the need for support from curriculum developers and educational policies for the wider implementation of this method.

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INTRODUCTION

In this era of globalization, science and technology are growing rapidly. For the quality of human resources (HR) to be of better quality, this development needs to be developed by utilizing it as best as possible. By providing quality human resources that are able to compete in the ASEAN Economic Community (AEC), this is the right way to face the challenges of Indonesia's education system. The labor

market is more competitive as a result of this phenomenon. The MEA will be a good platform to showcase to other countries the capabilities and quality of Indonesia and its human resource base. The best approach to creating high quality human resources is through education (Ady Wahyuwan, 2020).

Education is one of the main factors that aim to produce quality, intelligent, skilled and competitive human resources in line with current developments. With

the continuous development of technology and science, education is one of the basic needs that must be met nowadays, because education is the determinant of the country's progress in the future, in order to improve the well-being of society. The education process can take place in the family, school and community. Formal education received at school.

The development of science and technology must be supported by the ability to harness, develop and manage technology. One of the efforts to improve the mastery of basic science is to increase the knowledge of mathematics, because mathematics is the basis for other sciences, especially in the development of science and technology (Handayani, 2019).

Increasing technological progress has encouraged the development of an increasingly advanced learning environment. Students can take advantage of technology as a learning tool to convey knowledge to students. Learning can create diverse learning activities and stimulate students to take advantage of the learning environment, so that the learning process becomes more interesting and interactive (Anik Sugiani, 2023).

Learning is a way to improve the abilities of quality students. Learning is also a process built by teachers to help students develop moral, intellectual and other skills and talents. Every student must have many skills in this digital age (Nuraini, 2023). Learning mathematics is an activity to gain knowledge that has been built by students themselves and must be carried out in order to give students the opportunity to rediscover mathematical concepts. Mathematics is the foundational knowledge that students need to support their learning success as they pursue higher education (Media Siska et al., 2023).

The importance of learning mathematics can be illustrated from its role in various aspects of life, for example information and ideas that have been translated or transmitted into mathematical language, and many information problems can be expressed in symbolic examples (Ikhsan, 2019).

Regarding the importance of mathematics, Indonesia has also made mathematics a compulsory skill that all citizens must have, it is the responsibility of every student, from primary school to secondary school, from generation to generation until now (Rizki et al., 2019)

In reality, Indonesian schools are still of poor quality, especially in terms of teaching mathematics. Indonesia's mathematics education ranks 34th out of 38 countries in the world according to UNESCO data. Additional evidence of the poor math skills of Indonesian students comes from a survey of the National Education Center in Statistics in 41 countries on math skills; Indonesia is ranked 39th, below Uruguay and Thailand.

This is probably because most students see mathematics as a challenging and even scary subject. Since mathematics is seen by them as a subject that requires complicated calculations to arrive at a final answer, this leads to a bored and anxious way of thinking. (Asmaka, 2019).

When studying mathematics, the adverse effects of students' dislike of the subject can cause anxiety. When presented with something unpleasant, math anxiety can be defined as a negative emotion caused by emotional instability and represented as fear, anxiety, worry, panic and other similar feelings (Ady Wahyudy et al., 2019).

As teachers continue to use traditional or conventional teaching methods, such as lectures, some problems with the learning process in the classroom include students' lack of interest in the material being discussed and their tendency to become passive learners. The

lecture method is the same as the traditional teaching method because it has been used as a verbal way of interaction between the teacher and the students. In addition, the lecture method has a greater influence on the level of teacher activity than the level of student activity (Muhtadillah, 2023). Other facts show that teachers rarely inspire students to learn and instead only provide topic content during teaching.

Another problem, based on the results of a preliminary study of class VII students of MTS GUPPI Pematangsiantar through interviews related to learning mathematics in the academic year 2023/2024, it was found that the results of students' learning mathematics are still relatively low. below the limit of the Ministry of Health. This can be seen from the results of the class VII mathematics exam. The low learning outcomes are caused by several factors, namely mathematics is considered difficult, so students tend to be passive in receiving learning and do not have the enthusiasm to follow the learning process, because some teachers still use the lecture method so that learning seems boring. This shows their boredom and the fact that they are never too old to stop playing.

In addition, the results of the researcher's observation during the class observation show that the students have a feeling of worry during the learning process. There are some students who look shaken, scared, and their facial expressions suddenly change when given a math problem, then asked by the teacher in front of the class to solve the math problem.

This is in line with previous studies. One element that is negatively correlated with math learning outcomes is anxiety (Artama et al., 2021). The results of the study show that math anxiety has a significant influence on students' math learning outcomes. High math anxiety tends to significantly reduce student

learning outcomes. Conversely, when math anxiety is low, students' learning outcomes also tend to be better. In addition, good math learning outcomes can contribute to reducing students' math anxiety levels.

Every student has unique qualities and approaches learning in a different way. Using appropriate teaching strategies to enhance student interest and learning outcomes can help address inequities in ability outcomes (Kurnia Bungsu et al., 2019).

Learning math needs to be delivered to students appropriately, and one way to reduce anxiety in learning math is to make learning math fun and something they will need for the future. And associate learning with their enjoyment, which is play. So learning that must be done is game-based learning. In this learning, students are required to learn, but with a play approach, so that learning does not bore students. In addition, they integrate their enjoyment of playing with what they learn. Then, learning through playing is what needs to be done. Students should learn this material, but they should do it in a fun way to ensure that they find the material interesting.

In this digital era, one of the information technologies that can be used as learning aids is Game-Based Learning (Adriyani et al., 2022). Game-Based Learning is a learning method that utilizes games created specifically to help students learn. Students are expected to learn using models, but do so in a fun way.

Using interesting learning resources and new approaches that are consistent with the content of the lesson is one way to overcome this problem. The Math Bingo game will be used in this investigation. In a math bingo game, players mark a randomly selected number on a bingo card. If multiple markers appear in the same row, column or diagonal, the game is declared a win. Students will be engaged and enthusiastic to participate in teaching

mathematics using this media. Additionally, math bingo is a learning resource designed to keep students from getting bored while learning math; Instead, students will find math bingo to be more challenging and fun as they learn while having fun.

Using the bingo game in the classroom as a tool for active learning can foster a fun learning climate where students take an active role in their education, improve their ability to collaborate with peers and help the class achieve its goals (Oktaviani et al., 2019).

Based on the explanation above, researchers are interested in conducting a recent study that may discuss in more depth the influence of game-based learning with math bingo on math anxiety and students' math learning outcomes.

METHOD

This research uses a quantitative study using a pre-experimental method. The design used in this research is One Group Pretest – Posttest Design, there are pretests and questionnaires before being given treatment so that the results of the treatment can be known more precisely because they can see the situation before being given treatment. In this study, the researcher gave questionnaires and pre-post tests to students to determine the level of math anxiety and student learning outcomes before and after being given treatment using a learning model in an experimental class. This design is a combination of post-test and pre-test by conducting tests on one group before being given treatment and after being given treatment.

This research was conducted at the MTSS GUPPI College located in Siantar Subdistrict Martoba Pematangsiantar. The population that was taken was all students in class VII MTSS GUPPI Pematangsiantar in the academic year 2023/2024 which consists of 2 classes with 25 students in each class. Sampling was carried out using

a purposive technique until class VII-A was obtained as the class in which the experiment would be conducted.

The test instrument in this research is a questionnaire and a test of learning outcomes which is a pre-post test. In this study, the researcher gave questionnaires and pre-post tests to students to determine the level of math anxiety and student learning outcomes before and after being given treatment using a learning model in an experimental class.

This research procedure is the planning stage; At this stage, prepare research instruments in the form of questionnaires and tests of learning outcomes, then verify the instruments with the help of experts. At the implementation stage, the researcher gave a questionnaire to measure learning anxiety before and after treatment. and provide pre-post tests to measure learning outcomes. Finally, data analysis was conducted with a paired t-test to see significant differences.

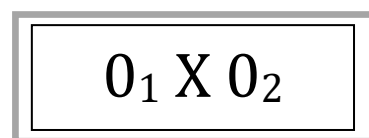


Figure 1. One Group pretest-posttest Design

Description :

X = Treatment of the experimental group, namely by applying the Game Based Learning learning model with Math Bingo
O₁ = Pretest (Before Treatment is Given)
O₂ = Posttest (After being given treatment)

In this research, a questionnaire was used with 25 questions and descriptive learning outcome test questions that have been tested for validity and reliability and declared valid and reliable. Tested with the help of IBM SPSS 25 software. The prerequisite test consisted of a normality test. If the prerequisite test is met then the

hypothesis test is conducted using a paired sample t-test.

The descriptive test results are presented in Table 1.

RESULTS AND DISCUSSION

Table 1. Descriptive Test Results of the Mathematics Anxiety Questionnaire

Variable	N	Min	Max	Mean	Std.Dev
Math Anxiety (Initial)	25	70	87	77,56	5.386
Math Anxiety (Final)	25	45	65	55,08	4,425

Based on Table 1, it can be seen that the math anxiety questionnaire test (initial) with 25 respondents obtained a mean value of 77.56 with a minimum value of 70 and a maximum value of 87, the standard deviation value is 5.386.

Meanwhile, Mathematical Anxiety (Final) as many as 25 respondents obtained a mean value of 55.08 with a minimum value of 45 and a maximum value of 65, the standard deviation is 4.425.

Table 2. Pretest-Posttest Descriptive Test Results

Variable	N	Min	Max	Mean	Std.Dev
Pretest	25	33	73	53,32	13,225
Posttest	25	60	100	79.48	13,305

Based on Table 2. it can be seen that the pre-test of the remaining learning outcomes with 25 respondents obtained a mean value of 53.32 with a minimum value of 33 and a maximum value of 73, the standard deviation value is 13.225. Meanwhile, the student learning results of the Post Test as many as 25 respondents obtained a mean score of 79.48 with a minimum score of 60 and a maximum score of 100, the standard deviation is 13.305.

Based on the requirements of the Paired sample t-test, before conducting the hypothesis test it is necessary to perform a prerequisite test. Prerequisite test results were calculated with the help of IBM SPSS Statistics 25.

From the calculation using the residual technique through Shapiro-Wilk significance with a sig level of 5% or 0.05. The data distribution is said to be normal if the sig value of the Shapiro-Wilk test is ≥ 0.05 . If the Shapiro-Wilk test significance value is ≤ 0.05 then the data is not normally distributed. And with the help of IBM SPSS Statistics 25, the following results were obtained:

Table 3. Pretest-Posttest Normality Test Results Learning Results

Shapiro-Wilk				
	Variable	Statistic	Df	Sig
Math Anxiety	Math Anxiety (Initial)	0,920	25	0,148
	Math Anxiety (Final)	0,950	25	0,255
Learning outcomes	Pretest	0,950	25	0,078
	Posttest	0,927	25	0,074

Based on Table 3, the results of the normality test show that sig. for math initial anxiety data was $0.148 > 0.05$ and final anxiety was $0.255 > 0.05$. Since $0.051 > 0.05$ and $0.255 > 0.05$, it is concluded that the distribution of the study data is a normal distribution.

Pretest results for statistical analysis showed that the data for Pretest Math Anxiety, Posttest Math Anxiety and Pretest-Posttest Math Learning Outcomes were normally distributed. The next step is to test the hypothesis using a paired sample t-test

To see the effect of Game-Based Learning with Math Bingo in reducing

math anxiety to improve students' math learning outcomes.

Hypothesis Test 1 (paired sample t – test)

$$H_0: \mu_1 = \mu_2$$

$$H_0: \mu_1 \neq \mu_2$$

H_0 = There is no significant difference between the game based learning model

and math bingo on students' mathematics anxiety

H_1 = There is a significant difference between the game based learning model and math bingo on students' mathematics anxiety

Table 4. Test Results Paired samples t -test Mathematics Anxiety

	Mean	N	Std. Devi	Paired Samples Statistics		t	df	Significance Two-Sided p
				Std.Error Mean	Mean			
Math Anxiety (Initial)	74.12	25	3.97199	.79440				
Math Anxiety (Final)	55.08	25	4.42455	.88491	19.04000	16.500	24	<,001

Because the value of sig. < 0.05, then H_0 is rejected. This means that there is a significant influence on the average questionnaire score before and after being given treatment. Based on the test above, it shows that there is an influence of the game-based learning model with math bingo in reducing students' math anxiety. Hypothesis Test 2 (paired sample t – test)

$$H_0: \mu_1 = \mu_2$$

$$H_0: \mu_1 \neq \mu_2$$

H_0 = There is no significant influence of the game based learning model with math bingo on students' mathematics learning outcomes

H_1 = There is a significant influence of the game based learning model with math bingo on students' mathematics learning outcomes

Table 5. Test Results Paired samples t - test student mathematics learning outcomes

	Mean	N	Std. Dev	Paired Samples Statistics		t	df	Significance Two-Sided p
				Std.Error Mean	Mean			
Pretest Math Learning Results	55.32	25	13.22472	2.64494				
Posttest Math Learning Results	79.48	25	13.30451	2.66090	-26.1600	-9.206	24	<,001

1. The influence of Game Based Learning with Math Bingo on mathematics anxiety.

Based on the table of statistical test results, the average questionnaire score before treatment was 74.12, while the average questionnaire score after

treatment was 55.08. The mean difference between initial and final math anxiety was 19.04000. This shows that math anxiety at the end of the measurement is an average of 19.04 points lower than math anxiety at the beginning of the measurement. The one-sided and two-sided significance p

values were both < 0.001 , indicating that this mean difference was highly statistically significant. This can be interpreted that game-based learning variables have a significant effect on reducing math anxiety in class VII MTS students at GUPPI Pematangsiantar College. This shows that game-based learning affects the ups and downs of students' math anxiety.

This study shows that game-based learning using Math Bingo is effective in reducing students' math anxiety. Through an interactive, fun and collaborative approach, Math Bingo not only increases student motivation and engagement but also provides immediate feedback and social support that helps reduce anxiety. This finding is in line with learning theory that emphasizes the importance of active involvement, positive reinforcement, and experience-based learning in achieving better learning outcomes. Using Math Bingo as a learning tool can be an effective strategy to overcome math anxiety and improve learning outcomes, making an important contribution to the quality of math education.

2. The influence of Game Based Learning with Math Bingo on mathematics learning outcomes.

Based on the table of statistical test results, the average questionnaire score before treatment was 53.32, while the average questionnaire score after treatment was 79.48. Students' mathematics learning outcomes increased significantly with an average difference of 26.16 points from the pre-test to the post-test. This shows that the result of learning mathematics on the post-test is on average 26.16 points higher than the result of learning mathematics on the pre-test. The t value (-9.206) shows a very significant difference between the results of learning mathematics before and after treatment. A very small P value ($< .001$) also shows that this increase did not happen by

chance and that the treatment given was effective in improving learning outcomes.

The results of this study have important implications for educational practices. This study suggests that game-based learning such as Math Bingo can be an effective tool in improving math learning outcomes and reducing anxiety. Therefore, educators and educational policy makers can consider incorporating game-based learning into their learning models. In addition to focusing on improving learning outcomes, it is important to pay attention to the emotional aspects of students such as anxiety. A holistic approach that includes game-based learning can help address anxiety issues while improving learning outcomes.

This result is consistent with the findings of several previous studies. For example, a study conducted by Winatha & Setiawan (2020) also found that there is a positive influence of game-based learning games on learning motivation and learning achievement. This is in line with a study conducted by (Fitri Peggy Iswani, 2020) explaining that the application of active learning Bingo game methods can improve student learning outcomes. This can be seen from the average student learning result in cycle I which is 70 while the average student learning result in cycle II is 90. Learning mathematics using the Bingo game method can create a fun learning atmosphere because learning mathematics is not boring but rather fun and challenging, where mathematics being a game, not a job or task, students are also more interested because with the game students can be motivated to compete healthily with their friends.

In addition, game-based learning increases student engagement and motivation by providing a fun and challenging learning environment. Students are more motivated to learn when they feel involved in fun and meaningful activities. The results of

another study by (Maulana et al., 2023) The use of game-based learning that uses spinning wheel media to support the learning process has been proven to have a positive effect on student learning and make the learning process more active. This is evident when students are enthusiastic and focused while studying. Active students respond positively to questions or interruptions from the teacher, ask thoughtful questions, share learning outcomes and insights, and work well in groups.

The similarity of this study with previous studies lies in the focus of the influence of Game-Based Learning on learning outcomes. Both used an experimental research design to compare the effectiveness of Game-Based Learning by using tests to measure students' math learning outcomes. Both use experimental research designs. However, this study makes an additional contribution by involving a different population of students and a different educational context, namely VII grade students of GUPPI Teachers' MTS, thus providing a richer and more diverse context to evaluate the effectiveness of Game-Based Learning. in this study using media with mathematical bingo.

Based on the results of hypothesis testing and data analysis, it is known that learning that is given treatment using Game Based Learning with Math bingo is able to reduce math anxiety and improve students' math learning results compared to before being given treatment. Game-based learning increases student engagement and motivation by providing a fun and challenging learning environment. Students are more motivated to learn when they feel involved in fun and meaningful activities. Math Bingo creates this condition by incorporating game elements into math learning.

CONCLUSIONS AND SUGGESTIONS

Based on the results of the study, it can be concluded that the use of game-based learning with Math Bingo can significantly reduce math anxiety and improve students' math learning outcomes. The study data shows the average difference before and after treatment. where there was a decrease in average math anxiety and an increase in students' math learning outcomes. Therefore, game-based learning has a significant positive effect on students' mathematics anxiety and mathematics learning outcomes, and its application can provide practical benefits and important theoretical contributions in the context of mathematics education at the junior high school level.

Further studies can compare the effectiveness of game-based learning with other alternative learning media, for example digital-based which can reduce math anxiety and improve student learning outcomes. This will help students to more easily understand the learning that is carried out with the game. This will help increase student engagement and motivation by providing a fun and challenging learning environment. Students are more motivated to learn when they feel involved in fun and meaningful activities.

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