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IMPLEMENTATION OF MARBLES GAME TO IMPROVE JUNIOR HIGH SCHOOL STUDENT'S UNDERSTANDING OF OPPORTUNITY MATERIAL CONCEPTS

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ABSTRACT
This study was motivated by the low understanding of students' mathematical concepts. This study aims to determine the differences and improvements in the understanding of mathematical concepts of junior high school students whose learning implements marble games with students who do not implement marble games. This study uses quantitative research with a quasi-experimental method (Quasy Experimental) and a sampling technique through the Purposive Sampling technique. The population in this study were students of class VIII of SMPN 13 Kota Cirebon in the 2024/2025 Academic Year and samples in classes VIII D and VIII E as many as 24 students. The test analysis in this study used non-parametric statistical data analysis using the U-Test. The results of the study: (1) The understanding of mathematical concepts of students whose learning implements marble games is higher than students who receive conventional learning; (2) The increase in understanding of mathematical concepts of students whose learning implements marble games is higher than students who receive conventional learning.
Keywords: mables; opportunity; understanding of concepts

ABSTRAK
Penelitian ini dilatar belakangi oleh pemahaman konsep matematika siswa yang masih rendah. Penelitian ini bertujuan untuk mengetahui perbedaan dan peningkatan pemahaman konsep matematis siswa SMP yang pembelajarannya mengimplementasikan permainan kelereng dengan siswa yang tidak mengimplementasikan permainan kelereng. Penelitian ini menggunakan penelitian kuantitatif dengan metode eksperimen semu (Quasy Experimental) dan teknik pengambilan sampel melalui teknik Purposive Sampling. Populasi dalam penelitian ini adalah siswa kelas VIII SMPN 13 Kota Cirebon Tahun Ajaran 2024/2025 dan sampel pada kelas VIII D dan VIII E sebanyak 24 siswa. Analisis pengujian dalam penelitian ini menggunakan analisis data statistik non-parametrik menggunakan Uji-U. Hasil penelitian: (1) Pemahaman konsep matematis siswa yang pembelajarannya mengimplementasikan permainan kelereng lebih tinggi daripada siswa yang memperoleh pembelajaran konvensional; (2) Peningkatan pemahaman konsep matematis siswa yang pembelajarannya mengimplementasikan permainan kelereng lebih tinggi daripada siswa yang memperoleh pembelajaran konvensional.
Kata kunci*: kelereng; peluang; pemahaman konsep.*

Introduction

National education has a national cultural system that is sensitive and adaptive to the needs of changing times and is based on Pancasila and the 1945 Constitution

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as the noble values and ideals of the Indonesian people. If children use digital technology only to play gadgets, it is feared that traditional games will disappear and only digital games will remain (Riyantini & Teguh, 2021). This is a challenge for all groups, including teachers, parents, society, and the government to continue to instill a love for Indonesian culture in students in the face of rapid digital developments (Riyantini & Teguh, 2021). Games that require a lot of physical activity are very beneficial for children's motor development. In addition, traditional games are also very useful for training social interactions between children and their friends or with their environment (Damayanti *et al*., 2023). According to Khosasi *et al*. (2018), playing marbles can provide moral, social emotional, and motor benefits.

Marbles are a classic game that has entertained children and adults for generations. The description of the marble game also highlights the educational and social values contained in it. Several studies have shown that traditional games have a major role in the mathematics learning process (Risdiyanti & Prahmana, 2018). This game encourages students to think critically, apply logic, and learn through direct experience, which makes learning more interesting and inclusive. The social skills that emerge in this game are that children become more skilled in performing fine motor movements in the form of holding marbles and snapping their fingers in playing marbles (Firnanda & Sari, 2024).

The ability to understand is one of the important goals in learning mathematics. The materials taught to students are not only for memorization, but also to be understood so that students can better understand the concept of the material given (Novitasari, 2016). Based on the 2018 PISA Results (Schleicher, 2018), in mathematics, students' abilities are still relatively low, ranked 72 out of 78 countries and still at level 1 with a score of 379. The low learning outcomes of Indonesian students in mathematics are because students are not used to solving problems by understanding them and following the problem-solving process (Wardhani & Rumiati, 2014). Since participation in the PISA study began in 2000-2022, there has been no significant increase in quality, as evidenced by the results achieved in 2000-2022. In this problem, only 18% of students reached at least level 2 in mathematics. However, there is no information available for the remaining 82%. Almost no 15-year-olds are successful in mathematics, reaching level 5 or 6 on a mathematics test (OECD average: 9%) (Schleicher, 2018).

Students who have contextual thinking skills will find it easier to connect various information, so that they are able to understand the concepts used by Brinus *et al* (2019). Students who understand mathematical concepts can solve problems using appropriate mathematical steps and concepts. According to Effendi (2017), the characteristics of students who have good conceptual understanding skills are if the student can show indicators of conceptual understanding in the test. According to Ngalimun (2018), there are 5 indicators of mathematical conceptual understanding, namely: explaining the meaning of the concept; giving examples and non-examples of concepts; developing necessary and sufficient conditions for concepts; using models, diagrams, or symbols to present concepts; and applying concepts to problem solving. To understand mathematics, we need to understand the concepts in the material (Arcat, 2017).

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Based on the results of an interview with one of the teachers of SMPN 13 Kota Cirebon, namely Mr. Ichwan, S.Pd., students' understanding of mathematical concepts is currently still low. The cause is that some students have not mastered basic arithmetic concepts (multiplication and division) and students generally do not like mathematics because they only consider it a difficult and boring subject, even though as explained above, the ability to understand mathematical concepts is an important thing. It would be better if children were introduced to mathematics from an early age, as a simple and entertaining learning (Arindiono & Ramadhani, 2014). One solution to overcome the low understanding of student concepts is to apply interactive and contextual learning methods, such as the use of games in the learning process. The world of children is a world of play because most of the children's activities are playing. So indirectly, playing can have a very big influence (Harahap *et al*., 2023).

The novelty of this study is the application of marble games outside the classroom (field), the target of the study was grade VIII students at SMPN 13 Kota Cirebon, and focused on improving understanding of the concept of probability material. Previous studies tend to improve general abilities, not understanding specific concepts. This is in line with research conducted by Himmatul (2017) which states that with traditional games as a medium for learning mathematics, it can provide variations in learning so that it is not monotonous and not boring. This can be useful for improving mathematical abilities and optimizing student learning achievement (Himmatul, 2017).

The implementation of marble games for learning will bring a fun learning atmosphere and can improve the understanding of mathematical concepts. A fun learning atmosphere while playing can be one of the determining factors for students' success in achieving good learning achievements. The implementation of marble games in mathematics learning is expected not only to improve students' understanding of mathematical concepts in learning activities, but students can also apply the character and social values contained in mathematics learning in everyday life. In previous research conducted by Supriyadi *et al*. (2016), studying mathematics based on Banten culture has great advantages in the results of data processing carried out using the t-test and a significance value of <5%.

Research Methods

This study uses a quantitative research method. This type of research is a quasi-experimental study, which is a study that aims to see the increase in conceptual understanding in the implementation of marble games. The population used was all students of grade VIII with samples in class VIII D as the experimental class and VIII E as the control class, each class consisting of 24 students. In this study, a pre-test and post-test were conducted to compare the learning outcomes of the two groups, namely the experimental group that implemented the game and the control group that did not implement the game.

According to Ramdhan (2021), the experimental research method aims to examine the effect of a particular treatment on the symptoms of a particular group on the symptoms of a particular group compared to other groups that use different treatments. The design used in this study is a nonequivalent control group design. Here is the design:

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Table 1. Research Design

Group	Pretest	Treatment	Posttest
Experimental	01	X	02
Control	03		04

Description:
O_1 & O_3 = *Pre-test* value
O_2 & O_4 = *Post-test* value
X = *Treatment in the form of a marble game*

Based on Table 1, two groups with pre-test, treatment, and post-test samples were used in this study. The first group was a class that was given the implementation of the marble game. While the second group was a control class that received an expository learning model. The existence of this control class allows researchers to compare the magnitude of changes that occur after being given treatment to the experimental class.

The data collection technique for this study was by giving students a test of understanding the concept of probability material. The concept understanding test given to students was in the form of an essay test consisting of 7 questions as a measuring tool for understanding mathematical concepts, therefore the test was compiled based on indicators of understanding the mathematical concept of probability material. The data analysis technique used was a prerequisite test, namely a normality test using the Kolmogorov-Smirnov test at a significance level of a = 0.05, and a homogeneity test using the F test or Levene's test. If the data distribution is not normal, the homogeneity test is not used to test the equality of two independent means (Independent Sample T-Test) but directly using the non-parametric statistical test Mann Withney-U or U-test.

Results and Discussion

The research was conducted at SMPN 13 Kota Cirebon using two classes as research samples. Class VIII D was designated as the experimental group consisting of 24 students, with the implementation of marbles game implementation on the material of probability. On the other hand, class VIII E was designated as the control group consisting of 24 students, where the learning implementation method did not implement the implementation of marbles game on the material of probability.

Prerequisite tests were carried out, namely the normality test and the homogeneity test (if the data is normal) before comparing the differences in the average data values of the two groups, aiming to determine whether there is a difference in the understanding of mathematical concepts of students in the experimental group and the control group. According to Sugiyono (Lokat *et al*., 2022) the normality test is a test carried out to determine the distribution of data related to the variables to be analyzed, whether the distribution of the data is normally distributed or not. The data analysis was processed using SPSS for Windows software. The following are the results of the normality test data are presented in Table 2.

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Table 2. Normality Test Results

Data	Group		Conclusion
	Experiment (sig. value.)	Control (sig. value.)	
Pretest	0,001	0,000	Data is not normal
Posttest	0,057	0,005	Data is not normal
N-Gain	0,200	0,016	Data is not normal

Based on Table 2, it can be said that the data is normally distributed if the significance value is > 0.05. It can be seen that the pre-test data of both groups have sig. < 0.05, meaning the data is not normally distributed. In the post-test data, there is one group, namely the control group, which has sig. (0.005) < 0.05, which means the data is not normally distributed. And for the N-Gain data in both groups, it has sig. < 0.05, meaning the data is not normally distributed. Furthermore, to test the equality of the means before testing, the Mann - Whitney U test was used with a significance level of a = 0.05.

Before the start of the learning process, a pre-test containing seven descriptive questions was given to students in the experimental class and the control class. The pre-test was carried out to assess students' initial abilities in terms of understanding mathematical concepts. The pre-test mean equality test was carried out using the Mann-Whitney U test because the results of the pre-test data were not normally distributed. Here are the results are presented in Table 3.

Table 3. Pre-test Results

Group	Number of Students	Mean	Standard Deviation	U-test
Experiment	24	6,25	6,797	0,356
control	24	6,88	4,121	

Based on Table 3, the average pre-test in the experimental group is lower than the control group and it is also seen that the U-test results are 0.356 > 0.05, so the conclusion is that there is no difference in pre-test scores between the two groups. After the learning process is complete, students in the experimental class and the control class are given post-test questions.

Based on the requirements for analyzing test data, it is known that students' post-test scores are not normally distributed. Therefore, the post-test average difference test used is the Mann-Whitney U test using SPSS software version 25 for Windows. Here are the results are presented in Table 4.

Table 4. Hasil Post-test

Group	Number of Students	Mean	Standard Deviation	U-test
Experiment	24	88,58	20,383	0,000
Control	24	77,00	16,281	

Based on Table 4, the post-test results show a significant increase in scores in the experimental class which obtained an average of 88.58 compared to the

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control class which obtained an average of 77.00. Students in the experimental class who were involved in game-based learning showed a better increase in understanding, which was seen from the higher increase in post-test scores. It can also be seen from the U-test results of 0.000 <0.05, so the conclusion is that there is a difference in the post-test results of the two groups.

Measuring the effectiveness of learning, pre-test, and post-test data were analyzed using the N-Gain calculation. N-Gain is a measure used to determine the increase in student's conceptual understanding after participating in learning. Here are the results are presented in Table 5.

Table 5. N-Gain Results

Group	Number of Students	Mean	Standard Deviation	U-test
Experiment	24	0,8787	0,06496	0,000
Control	24	0,7533	0,08575	

Based on Table 5, the average N-Gain of the experimental group was 0.8787 higher than the control group of 0.7533. Meanwhile, the U-test results showed a sig. (2-tailed) value of 0.000 <0.05, which means that there is a significant difference between the two groups in increasing understanding of mathematical concepts. Therefore, the implementation of this game has been proven to be effective in improving students' understanding of mathematical concepts. Hasanah & Pratiwi (2017) explained that traditional games are useful for introducing basic concepts such as numbers.

Based on the results of implementation in the field, the implementation of marble games as a media tool for learning mathematics is effective in improving students' understanding of mathematical concepts. Based on the findings of previous researchers, conducted by Ashanti & Fitroh (2022) traditional games and their ethnomathematics elements can be used as a learning approach to improve children's understanding of mathematics, this also applies to this. Sari & Switania (2022) explain that the use of traditional games allows students to see the application of mathematics in real life, rather than seeing it as something abstract. Sarah *et al*. (2022) explained that the marble game has a mathematical concept consisting of plane geometry, space geometry, trigonometry, distance, and probability. Pratiwi & Pujiastuti (2020) showed that mathematics teachers need to explain the relationship between mathematics and traditional games in more detail to explain the motivation and benefits of learning mathematics. Therefore, there is a need to develop more effective learning methods in integrating ethnomathematics into mathematics learning so that it can improve students' mathematical understanding. The results of Mawaddah & Maryanti's (2016) research show that students' ability to understand mathematical concepts on the first test, second test, and final test is in a good category. Studying mathematics with a deep and wise understanding will give students a sense of the benefits of mathematics in their daily lives (Agustina, 2016).

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Conclusion and Suggestion

The implementation of marble games in mathematics learning has proven effective in improving students' understanding of mathematical concepts, especially in the material of probability. Through playing while learning, students are more active in learning and can build good understanding. The results of the Mann-Whitney U test showed that the average post-test score of the experimental group (88.58) was higher than the control group (77.00). In addition, the increase in understanding (N-Gain) in the experimental group was higher than the control group.

Based on the results of the conclusion, it is recommended that teachers use marble games as a medium for learning mathematics to improve students' understanding of mathematical concepts. This study can also be a guideline for further studies with other traditional games such as gobag sodor or engklek, and also using measurements of other cognitive aspects such as mathematical reasoning, numeracy literacy, or mathematical connections.

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