

Play and Learn: Using the "Dampu Bulan" Game to Improve Conceptual Understanding of Probability

Chiga Remadhania^{1*}, Risky Dwiprabowo², Eva Oktaviana³
^{1, 2, 3}Primary School Teacher Education Study Program, STKIP Kusuma Negara, Jakarta, Indonesia
[*chigaremadhania@stkipkusumanegara.ac.id](mailto:chigaremadhania@stkipkusumanegara.ac.id)

Abstract

This study investigates the effectiveness of the Dampu Bulan game in enhancing students' conceptual understanding of probability in mathematics learning. Conducted in May 2025 with 79 sixth-grade students, the experiment compared Class VI-A, which used the Dampu Bulan game, and Class VI-B, which received conventional instruction. Results showed that the experimental group achieved higher average scores (71.41) than the control group (56.10), with a t-test result of $4.27 > 1.996$, indicating a significant difference. Observations revealed high student engagement (average score = 0.86), particularly in enthusiasm, cooperation, and honesty. These findings demonstrate that integrating the Dampu Bulan game into mathematics lessons effectively improves conceptual understanding and student participation in learning probability at SDN Jati Rahayu VIII, Bekasi City.

Keywords: conceptual understanding, dampu bulan game, mathematics learning, probability, student engagement

1 INTRODUCTION

The mathematical ability of Indonesian students remains a serious concern. The results of the Programme for International Student Assessment (PISA) 2022 show that Indonesia's average mathematics score was only 366, far below the OECD average of 472, placing Indonesia 77th out of 81 countries (OECD, 2023). More than 43% of students fall within the lowest socio-economic quintile, with an average score of 354, and there is a 34-point gap between high- and low-performing students. This condition indicates that students' mastery of mathematical concepts remains low, particularly in higher-order thinking skills (Fauzi & Widjajanti, 2021).

Innovative learning strategies need to be directed toward approaches that are interactive, enjoyable, and relevant to students' learning experiences. One such approach is game-based learning, which has been widely recognized for its potential to enhance students' motivation and engagement in mathematics classrooms. Research on game-based instructional strategies indicates that integrating game elements into learning activities can foster active participation and positive learning attitudes among elementary school students.

Mathematics is a subject disliked by many students because they tend to perceive it as difficult and hard to understand. This perception is a form of emotional response that affects both intellectual and emotional intelligence, consequently leading to low achievement in mathematics (Fiqia et al., 2021). In alignment with the findings of (Aifah, Yudha, and Oktaviana, 2020), mathematical concepts are most effectively internalized by

students when delivered through diverse, concrete representations that bridge the gap between abstract theory and tangible application."

One of the mathematics topics often considered difficult is probability. Many students still struggle to understand its fundamental concepts, such as sample space, probability scale, and comparisons of event likelihoods. These difficulties are exacerbated by teaching methods that rely heavily on lectures and routine exercises, which limit students' active engagement in the learning process (Rahmawati & Susanti, 2022). Yet, active engagement is one of the key factors in developing a deeper conceptual understanding (Zubaedi, 2021).

Innovative teaching efforts should therefore focus on interactive, enjoyable, and contextually relevant strategies. One promising approach is through educational games. Traditional games can be adapted for mathematics instruction to encourage active participation, cooperation, and contextual concept understanding (Pratama & Sari, 2022). The Dampu Bulan game is one such medium that effectively combines elements of entertainment and education, helping students become more enthusiastic, motivated, and able to grasp probability concepts more effectively (Marlina & Putri, 2023).

The integration of games in mathematics instruction not only supports cognitive development but also positively influences affective aspects such as enthusiasm, cooperation, and active participation (Fiqriah, Suntari, & Yudha, 2025). Therefore, the use of traditional games such as the Dampu Bulan game is considered relevant and promising for improving students' conceptual understanding of probability in mathematics learning.

Based on these considerations, this study aims to examine the effectiveness of the Dampu Bulan game in improving students' conceptual understanding of probability in mathematics learning. Specifically, the study seeks to compare the learning outcomes of students who learn through the Dampu Bulan game and those who receive conventional instruction, as well as to analyze student engagement throughout the learning process.

2 RESEARCH METHODS

The mathematical ability of Indonesian students remains a major concern in national and international educational assessments. According to the Programme for International Student Assessment (PISA) 2022, Indonesia's average mathematics score was 366, far below the OECD average of 472, ranking the country 77th out of 81 participating nations (OECD, 2023). Furthermore, over 43% of students belong to the lowest socio-economic quintile with an average score of 354, and there exists a 34-point gap between high- and low-achieving students. These findings indicate that Indonesian students still struggle with mastering mathematical concepts, especially in terms of higher-order thinking skills (Fauzi & Widjajanti, 2021).

Mathematics is often perceived as a difficult and intimidating subject. Many students develop a negative emotional response toward mathematics, believing it to be complex and inaccessible. This perception affects both their intellectual and emotional intelligence, resulting in low achievement levels (Fiquia et al., 2021). One of the mathematical topics that students frequently find challenging is probability. Misunderstandings often arise in basic concepts such as sample space, probability scale, and comparative likelihoods of events. These conceptual difficulties are often exacerbated by traditional teaching methods that rely heavily on lectures, memorization, and routine exercises, leaving little room for student interaction or exploration (Rahmawati & Susanti, 2022).

Active engagement is a critical component in helping students build meaningful and lasting understanding of mathematical concepts. When students participate actively, they are more likely to connect abstract mathematical ideas to real-world contexts, thereby developing stronger conceptual frameworks (Zubaedi, 2021). Consequently, mathematics instruction must shift from teacher-centered approaches to interactive, student-centered learning models that emphasize collaboration, discovery, and enjoyment.

One promising approach to achieving this goal is through the integration of educational games. Games, particularly traditional ones, can serve as effective learning media that combine entertainment and education. When appropriately adapted, traditional games encourage students to participate actively, cooperate with peers, and understand concepts in a more contextual and meaningful manner (Pratama & Sari, 2022). The Dampu Bulan game, a traditional Indonesian hopping game, has the potential to merge cognitive learning with affective and social interaction. By incorporating the Dampu Bulan game into mathematics instruction, students can experience an enjoyable learning environment that fosters enthusiasm, motivation, and a deeper understanding of probability (Marlina & Putri, 2023).

Based on these considerations, this study was conducted to examine the effectiveness of the Dampu Bulan game in improving students’ conceptual understanding of probability in mathematics learning. Specifically, it aims to compare students’ learning outcomes between those taught using the Dampu Bulan game and those taught using conventional methods, as well as to analyze students’ engagement levels during the learning process.

3 RESULT AND DISCUSSION

3.1 Data Description

After implementing different learning approaches in the experimental and control classes—where the experimental class received instruction using the Dampu Bulan game as a learning medium, while the control class did not—students were given a post-test at the end of the learning sessions. The purpose of the post-test was to determine the students’ level of conceptual understanding of probability after experiencing the two different learning treatments. A summary of the calculated data results is presented in the following table.

Table 1. Post-Test Data on Students’ Conceptual Understanding of Probability

Statistics	Experimental Class	Control Class
Number Of Students	34	35
Total Score	2428	1963,5
Mean	71,41	56,10
Standard Deviation	17,67	11,56
Variance	312,25	133,61
Maximum Score	100	75
Minimum Score	36,67	35

Table 2. Data from Student Engagement Observations During the Learning Process Based on the Dampu Bulan Game.

Number Of Students	Average Score
34	0,86

3.1.1 Research Data of the Experimental Class

Based on the data obtained from the assessment of students’ conceptual understanding of probability through learning with the Dampu Bulan game, which involved 34 students in total, the results can be described as follows: the mean score = 71.41; median (Me) = 77.5; mode (Mo) = 62.39; standard deviation = 17.67; variance = 312.25; maximum score = 100; and minimum score = 36.67.

Table 3. Distribution of Test Results on Students’ Conceptual Understanding of Probability in the Experimental Class

Class Interval	Tally	Frequency	Class Boundaries
36-46	III	3	35,5-46,5
47-57	HHI	5	46,5-57,5
58-68	HHI IIII	9	57,5-68,5
69-79	IIII	4	68,5-79,5
80-90	HHI I	6	79,5-90,5
91-101	HHI II	7	90,5-101,5

The frequency distribution can be seen in the form of a histogram and polygon graph in Figure 1.

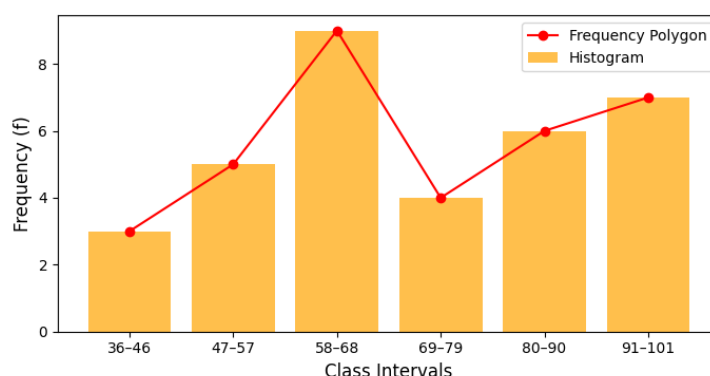


Figure 1. Histogram and Frequency Polygon of the Test Results on Students' Conceptual Understanding of Probability in the Experimental Class

Based on observations of students' activities during the mathematics learning process in the experimental class that used the Dampu Bulan game, the average observation score was 0.86 out of a maximum score of 1.00. This value was obtained from observations of five indicators of attitude and engagement: enthusiasm, cooperation, discipline, honesty, and activeness in discussions.

The average score indicates that students were in the high engagement category. This finding confirms that the use of the Dampu Bulan game had a positive impact on student participation, as reflected in their enthusiasm, activeness in discussions, honesty, and cooperation. This category was determined based on proportional score conversion (≥ 0.80), consistent with the rubric-based affective assessment theory, which states that scores above 80% represent a strong mastery of affective behaviors.

3.1.2 Research Data of the Control Class

Based on the data obtained from the assessment of students' conceptual understanding of probability through learning without using the Dampu Bulan game, which involved a total of 35 students, the results can be described as follows: the mean score = 56.10; median (Me) = 56.67; mode (Mo) = 56; standard deviation = 11.56; variance = 133.26; maximum score = 75; and minimum score = 35.

Table 4. Distribution of Test Results on Students' Conceptual Understanding of Probability in the Control Class

Class Interval	Tally	Frequency	Class Boundaries
35-42	IIII	4	35,5-46,5
42-49	HHI	5	46,5-57,5
49-56	HHI III	8	57,5-68,5
56-63	HHI III	8	68,5-79,5
63-70	HHI II	7	79,5-90,5
70-77	III	3	90,5-101,5

The frequency distribution can be seen in the form of a histogram and polygon graph in Figure 2.

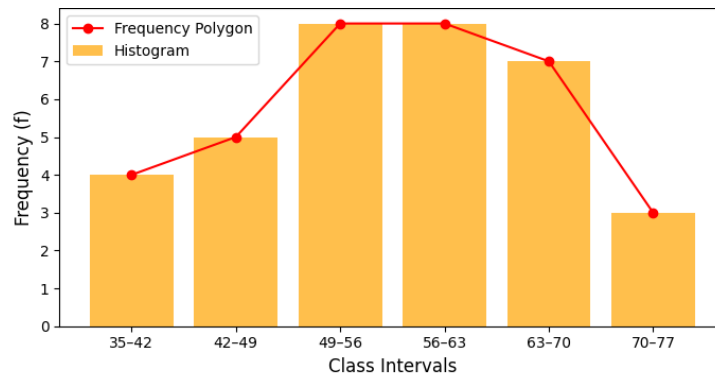


Figure 2. Histogram and Frequency Polygon of the Test Results on Students' Conceptual Understanding of Probability in the Control Class

3.2 Analysis Requirement Test

3.2.1 Normality Test

The normality test used in this study was the Chi-Square test. The criterion for this test is that the data are considered normally distributed if $X^2_{count} < X^2_{table}$.

Table 5. Summary of Data Normality Test Results

Value	N	Significance Level			Description
		α	X^2_{count}	X^2_{table}	
Experimental	34	0,05	7,26	7,815	Normally Distributed
Control	35	0,05	0,15	7,815	

Based on the table above, the Chi-Square calculation for the experimental class shows a calculated value (X^2_{count}) of 7.26 and a table value (X^2_{table}) of 7.815 at a significance level of $\alpha = 0.05$. Since $X^2_{count} < X^2_{table}$, the data are normally distributed. In the normality test results for the control class, the calculated value (X^2_{count}) is 0.15 and the table value (X^2_{table}) is 7.815 at a significance level of $\alpha = 0.05$. Because $X^2_{count} < X^2_{table}$, the data are also normally distributed.

3.2.2 Homogeneity Test

In this homogeneity test, the researcher used the Fisher test. A summary of the calculation results can be seen in the following table.

Table 6. Summary of Data Homogeneity Test Results

Characteristics	Experimental and Control	Decision	Description
F_{count}	2,337	H_0 Accepted	Homogeneous
F_{table}	2,883		

Based on the table above, the Fisher test calculation for the experimental and control classes shows that $F_{count} = 2.337$ and $F_{table} = 2.883$ at a significance level of $\alpha = 0.05$. Since $F_{count} < F_{table}$, it can be concluded that the samples come from a homogeneous population.

3.3 Hypothesis Testing Results

The hypothesis testing was carried out using the t-test, with the requirement that the data for both variables must be normally distributed and homogeneous. This ensures that the results obtained are purely based on the similarity of data between the two variables.

The calculation results show that $t_{count} = 4.27$, which is greater than the t_{table} value of 1.996 at a significance level of $\alpha = 0.05$ with 67 degrees of freedom.

Thus, it can be concluded that $t_{count} = 4.27 > t_{table} = 1.996$, which means that H_0 is rejected and H_1 is accepted. This indicates that mathematics learning using the Dampu Bulan game is more effective than mathematics learning without the Dampu Bulan medium in improving students' conceptual understanding of probability among sixth-grade students at SDN Jati Rahayu VIII, Bekasi City, in the 2024/2025 academic year.

3.4 Discussion of Research Findings

To identify the difference in students' test results on conceptual understanding of probability between learning with the Dampu Bulan game and learning without it, the comparison can be seen from the average final scores presented in the table below.

Table 7. Test Results on Students' Conceptual Understanding of Probability in the Experimental and Control Classes

Characteristics	Final Test Results		Result	Interpretation
	VI-A	VI-B		
Mean	71,41	56,10		
X^2_{count}	7,26	0,15	$X^2_{count} < X^2_{table}$	Normally Distributed
X^2_{table}		7,815		
F_{count}		2,337	$F_{count} < F_{table}$	Homogeneous
F_{table}		2,883		
t_{count}		4,27	$t_{count} > t_{table}$	H_1 Accepted
t_{table}		1,996		

Based on the results obtained, mathematics learning using the Dampu Bulan game was found to be more effective than mathematics learning without the use of the Dampu Bulan medium. This effectiveness is evident from the improvement in students' conceptual understanding of probability topics, such as probability scales and comparison of event likelihoods, enabling sixth-grade students at SDN Jati Rahayu VIII, Bekasi City, in the 2024/2025 academic year, to determine the probability of an event more accurately.

4 CONCLUSION

Based on the final results of the study, it was found that the average score of the experimental class was 71.41, while the average score of the control class was 56.10. The normality test using the Chi-Square test for the experimental class showed that $X^2_{count} < X^2_{table}$ ($7.26 < 7.815$), and for the control class, $X^2_{count} = 0.15$, indicating that both classes were normally distributed. The homogeneity test using the Fisher test for both classes showed that $F_{count} < F_{table}$ ($2.337 < 2.883$), indicating that the data were homogeneous. The final t-test showed that $t_{count} > t_{table}$ ($4.227 > 1.996$), leading to the conclusion that H_1 was accepted.

Observations of students' activities during the mathematics learning process in the experimental class that used the Dampu Bulan game showed an average observation score of 0.86 out of a maximum score of 1.00, which falls into the high engagement category. The highest indicators were enthusiasm, cooperation, and honesty (average score = 3.5), while discipline had the lowest score (3.3), though it was still categorized as good. This indicates that the use of the Dampu Bulan game has a positive impact on increasing students' participation and engagement during the learning process.

Thus, it can be concluded that mathematics learning using the Dampu Bulan game is more effective than mathematics learning without the use of the Dampu Bulan game. This

conclusion is supported by the improvement in students’ conceptual understanding of probability among sixth-grade students at SDN Jati Rahayu VIII, Bekasi City.

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