Kognitif
Jurnal Riset HOTS Pendidikan Matematika
Volume - 6 No - 3 2026 Page 952 – 964
ISSN 2776-9704 P-ISSN 2776-9984
https://doi.org/10.51574/kognitif.v6i3.5363

Implementation of Discovery Learning Model Assisted by Mathigon on Mathematics Learning Outcomes

Luqyana Jasmine Lathifah, Edwin Musdi, Mirna, Suherman

How to cite: Lathifah, L. J., Musdi , E., Mirna, M., & Suherman, S. (2026). Implementation of Discovery Learning Model Assisted by Mathigon on Mathematics Learning Outcomes. *Kognitif: Jurnal Riset HOTS Pendidikan Matematika*, *6*(3), 952–964. https://doi.org/10.51574/kognitif.v6i3.5363

To link to this artcle: https://doi.org/10.51574/kognitif.v6i3.5363

Opened Access Article

Published Online on 16 July 2026

Submit your paper to this journal

Kognitif: Jurnal Riset HOTS Pendidikan Matematika
https://doi.org/10.51574/kognitif.v6i3.5363 Volume 6, No 3, July - September 2026, pp. 952 –964

Implementation of Discovery Learning Model Assisted by Mathigon on Mathematics Learning Outcomes

Luqyana Jasmine Lathifah[1], Edwin Musdi[1*], Mirna[1], Suherman[1]

[1]Mathematics Education Study Program, Faculty of Mathematics and Natural Sciences, Universitas Negeri Padang

Article Info

Article history:

Received Jun 10, 2026
Accepted Jul 14, 2026
Published Online Jul 16, 2026

Keywords:

Discovery Learning Model
Learning Outcomes
Mathigon
Mathigon-assisted Discovery Learning

ABSTRACT

This research was motivated by the low mathematics learning outcomes resulting from students' low activeness and the not yet optimal use of technology-based learning media. One alternative that can be applied is the Mathigon-assisted Discovery Learning model. This study aims to determine whether the mathematics learning outcomes of students taught using the Mathigon-assisted Discovery Learning model are better than those of students taught using conventional learning. This study used a quasi-experimental method with a Non-equivalent Posttest-Only Control Group Design. The population of this study was all eighth-grade students of SMP Negeri 1 Hiliran Gumanti in the 2025/2026 Academic Year. The sample was selected using a cluster random sampling technique, namely class VIII.2 (26 students) as the experimental class and class VIII.3 (25 students) as the control class. The equivalence of the initial abilities of the two classes was based on the Odd Semester Examination scores in mathematics. The experimental class received instruction using the Mathigon-assisted Discovery Learning model, while the control class received conventional instruction. The research instrument was an essay test that had met the criteria of validity and reliability. The data were analyzed using descriptive statistics, normality tests, homogeneity tests, and t-tests with the assistance of Minitab 18. The results showed that the mathematics learning outcomes of students taught using the Mathigon-assisted Discovery Learning model were better than those of students taught using conventional learning, with a mean score of 79.74 for the experimental class and a p-value = 0.004 < 0.05. The effect size analysis using Cohen's d of 0.79 indicated a medium effect, which suggests that the implementation of this model made a fairly significant contribution to the mathematics learning outcomes of eighth-grade students at SMP Negeri 1 Hiliran Gumanti.

Corresponding Author:

Edwin Musdi,
Mathematics Education Study Program,
Faculty of Mathematics and Natural Sciences,
Universitas Negeri Padang,
Jl. Prof. Dr. Hamka, Air Tawar, Padang, West Sumatera, 25131, Indonesia,
edwinmusdi@fmipa.unp.ac.id.

Introduction

Mathematics is one of the subjects that plays a strategic role in various aspects of life, particularly in developing students' logical, critical, creative, and systematic thinking skills (Sumartini, 2016). Based on Government Regulation Number 4 of 2022, mathematics is established as a compulsory subject for students at the basic and secondary education levels. Furthermore, Minister of Education and Culture Regulation Number 22 of 2016 states that the objectives of mathematics education are to enable students to understand and apply mathematical concepts, reason, solve problems, and communicate mathematical ideas. To determine the extent to which these objectives have been achieved, an indicator that can describe the success of the learning process is needed, namely learning outcomes. Learning outcomes are one of the main indicators for assessing the level of students' success in understanding learning material (Saputri et al., 2025). Learning outcomes reflect changes in students' abilities after undergoing the learning process, encompassing cognitive, affective, and psychomotor aspects (Salsabila et al., 2023). Thus, the more optimal students' learning efforts are, the better the learning outcomes achieved will be.

However, students' mathematics learning outcomes in Indonesia remain relatively low. This condition is reflected in the results of the Program for International Student Assessment (PISA) survey, which showed that Indonesia's average mathematics score in 2022 only reached 366 points, far below the global average of 472 points. Moreover, only 18% of Indonesian students reached level 2 of mathematics proficiency, which is the minimum standard that all students at the secondary education level should achieve (OECD, 2023). This low level of student learning outcomes is further supported by several relevant studies. Patri & Purniyanti (2024) found that only 30.77% of students achieved mastery in mathematics learning, while Syafii et al. (2023) reported that more than half of the students did not meet the minimum passing criterion of 75. This finding is also supported by classroom observations in Grade VIII at SMP Negeri 1 Hiliran Gumanti during the 2024/2025 academic year, where students' mathematics learning outcomes remained below the school's minimum mastery criterion of 78. This can be seen in Table 1, showing the average scores and percentage of mastery during the odd semester final assessment of class VIII at SMP Negeri 1 Hiliran Gumanti.

Table 1. Average Scores and Percentage of Mastery in the Odd Semester Final Assessment of Mathematics for Class VIII at SMPN 1 Hiliran Gumanti

Class	Number of Students	Average	Student Meeting the MMC (n)	Percentage
VIII 1	26	58.38	2	7.69%
VIII 2	26	59.35	4	15.38%
VIII 3	25	58.44	2	8%

Source: Mathematics Teacher of Grade VIII SMPN 1 Hiliran Gumanti

Based on Table 1, the mathematics learning outcomes of eighth-grade students at SMP N 1 Hiliran Gumanti are still relatively low. Class VIII.1 obtained a mean score of 58.38, with only 2 students achieving the Minimum Mastery Criterion (MMC). Class VIII.2 obtained a mean score of 59.35, with 4 students achieving the MMC, while class VIII.3 obtained a mean score of 58.44, with only 2 students achieving the MMC. Out of a total of 77 students, only 8 achieved the MMC set by the school. These data indicate that most students have not yet reached the MMC, suggesting that mathematics learning outcomes still need to be improved.

The results of observations and interviews with the mathematics teacher indicated that students tended to be passive during the learning process. This passivity was reflected in the students' lack of participation in learning activities, such as only a few students asking questions, answering the teacher's questions, or expressing opinions during class discussions.

Kognitif: Jurnal Riset HOTS Pendidikan Matematika
https://doi.org/10.51574/kognitif.v6i3.5363 Volume 6, No 3, July - September 2026, pp. 952 –964

Furthermore, when the teacher explained the material, some students appeared to prefer engaging in other activities, such as drawing on the back of their books, daydreaming, or talking with their deskmates. Based on the interview results, the teacher also stated that most students believed that mathematics was a difficult and intimidating subject. This condition led to a lack of interest and motivation to learn, as well as a lack of confidence in expressing opinions, asking questions, or solving the given problems. Low learning motivation and interest, along with a negative perception of mathematics, affect students' learning effectiveness, which in turn contributes to low learning outcomes (Oktavia & Hidayati, 2022). In addition, the learning process still relies on textbooks and whiteboards as the main media for delivering material. The limited use of technology-based learning media has resulted in less varied learning and has failed to encourage students' active engagement.

Based on these conditions, efforts are needed to improve students' mathematics learning outcomes through the implementation of a learning model that encourages students' active engagement in exploring and constructing their own understanding. The selection of a learning model must be adjusted to students' characteristics, the material, learning objectives, and time allocation, so as to create a more engaging learning experience, increase motivation, and activate students' participation so that learning objectives can be achieved (Metzvioleta, 2025). One learning model that can be used to improve students' mathematics learning outcomes is the Discovery Learning model. This model requires students to actively discover concepts through activities such as exploration, observation, categorization, formulating conjectures, explaining, and drawing conclusions, while the teacher acts as a facilitator (Kodirun et al., 2016; Ramli, 2020). Discovery Learning has also been proven to enhance students' active engagement and develop independent learning skills (Artanti & Lestari, 2017; Darmawan & Suparman, 2019), thereby making learning student-centered (Rahmawati et al., 2025).

Several previous studies have shown that the Discovery Learning model has a positive effect on students' mathematics learning outcomes. Ardianto et al. (2019) found that the average mathematics learning outcomes of students taught using Discovery Learning (80.31) were higher than those taught using conventional learning (73.73). A similar finding was reported by Syafitri & Dwina (2025), showing that the average learning outcomes of students taught using Discovery Learning (70.1) were higher than those of students taught using the conventional model (55.8). Thus, previous research findings indicate that the Discovery Learning model can produce better mathematics learning outcomes compared to conventional learning. In implementing the Discovery Learning model, technology-based learning media are used to support the learning process. In this modern era, the use of technology in learning has become essential to improve quality and create a more engaging and motivating learning atmosphere for students (Damopolii et al., 2019). One digital platform that can be used in mathematics learning is Mathigon. Mathigon is an interactive mathematics learning platform that provides visualizations, digital manipulatives, educational games, and exploration activities that support discovery-based learning (Ihsan et al., 2024; Wardani & Amidi, 2025). Mathigon offers several features that can support mathematics learning, namely: (1) Polypad, a digital manipulative tool that allows students to arrange, transform, and combine mathematical objects to understand the relationships between concepts more concretely; (2) Course, which provides learning material in the form of interactive modules with illustrations, concept explanations, and activities that support understanding of the material; and (3) Simulation, which presents animations and simulations so that students can observe how a mathematical concept works and understand the relationships between concepts more clearly (Nufninu & Wijaya, 2025).

Based on these various features, this study utilized Polypad because it aligns with the characteristics of the flat-sided solid figures material and supports the implementation of the

Discovery Learning model. Through this feature, students can explore flat-sided solid figures by manipulating three-dimensional shape models, observing their nets, and identifying the elements of the shapes. This helps students understand the relationships between the elements of solid figures, surface area, and volume of flat-sided solid figures (Mulyaningsih et al., 2025). In implementing the Discovery Learning model, the Polypad feature was utilized in the stimulation, data collection, and data processing syntax stages. In the stimulation stage, the teacher used Polypad to present visualizations of flat-sided solid figures as an initial stimulus for learning. Next, in the data collection and data processing stages, students used the geometric tools in Polypad, which allow them to rotate, arrange, unfold (nets), and explore three-dimensional shape models to discover the concepts of surface area and volume interactively. The results of this exploration were then discussed in the verification stage together with the teacher and group members, before students drew conclusions in the generalization stage. Thus, the use of Polypad helped visualize the concept of flat-sided solid figures and supported the concept-discovery process in the Discovery Learning model, making learning more interactive and meaningful. Accordingly, Mathigon can help students construct knowledge independently through the process of exploration and concept discovery.

Various previous studies have shown that the Discovery Learning model and digital media can improve students' mathematics learning outcomes. However, most studies have examined these two aspects separately, while research integrating the Mathigon digital medium—particularly the Polypad feature—into the implementation of Discovery Learning syntax remains limited. In fact, the Polypad feature allows students to explore, manipulate, and analyze mathematical objects, thereby supporting the concept-discovery process. Therefore, this study aims to determine whether the mathematics learning outcomes of students taught using the Mathigon-assisted Discovery Learning model are better than those of students taught using the conventional learning model on the topic of flat-sided solid figures.

Method

Type of Research

This study used a quasi-experimental method with a Non-equivalent Posttest-Only Control Group Design. This method was chosen to determine whether the mathematics learning outcomes of students taught using the Mathigon-assisted Discovery Learning model were better than those of students taught using the conventional learning model. This design was used because the researcher was unable to randomly assign students into groups, and instead used pre-existing classes. In this study, the experimental class was taught using the Mathigon-assisted Discovery Learning model, while the control class was taught using the conventional learning model, namely the direct instruction model. After the entire learning process was completed, both classes were given a final test to examine the differences in the learning outcomes obtained. This design is appropriate for analyzing differences in learning outcomes between the experimental and control classes under naturally occurring learning conditions in schools.

Population and Sample

The population of this study consisted of 77 eighth-grade students at SMPN 1 Hiliran Gumanti, comprising three classes, namely class VIII.1, VIII.2, and VIII.3. Class VIII.1 consisted of 26 students, class VIII.2 consisted of 26 students, and class VIII.3 consisted of 25 students. The research sample was selected using a cluster random sampling technique, as the population had already been grouped into intact classes with relatively homogeneous

Kognitif: Jurnal Riset HOTS Pendidikan Matematika
https://doi.org/10.51574/kognitif.v6i3.5363 Volume 6, No 3, July - September 2026, pp. 952 –964

characteristics. Sampling was carried out through a random drawing to determine the experimental and control classes. Based on the results of this drawing, class VIII.2 was designated as the experimental class, which received instruction using the Mathigon-assisted Discovery Learning model, while class VIII.3 was designated as the control class, which received instruction using the direct instruction model.

Research Implementation

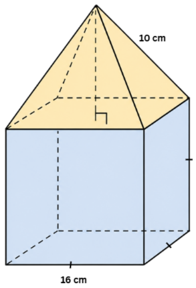
At the implementation stage, the researcher applied the treatment to the experimental and control classes in accordance with the learning design that had been prepared. The experimental class received instruction using the Mathigon-assisted Discovery Learning model, which was carried out through six stages, namely stimulation, problem statement, data collection, data processing, verification, and generalization. The use of Mathigon was integrated to support the visualization, exploration, and manipulation of geometric objects during the learning process. Meanwhile, the control class was taught using the direct instruction model through four stages, namely Demonstrating Knowledge, Providing Guided Practice, Checking for Understanding and Providing Feedback, and Independent Practice. Learning in both classes covered the same material. The final test was conducted in the seventh meeting.

Instrument

The instrument used to collect data in this study was a final test. The test administered consisted of three essay questions. The questions were developed based on the learning outcome indicators for the flat-sided solid figures material studied during the research. These questions were designed to measure students' abilities at the applying (C3) and analyzing (C4) cognitive levels. Through the essay questions, students were required to identify the information given and asked, select and apply appropriate formulas, analyze the relationships between the elements of solid figures, and present the solution steps and conclusions systematically. Thus, the test instrument measured not only the final results but also students' abilities in applying and analyzing. The items of the final test are presented in Table 2.

Table 2. Final Test Questions

Questions	Question Characteristics
Question #1. In preparation for the ninth-grade farewell event, the school plans to beautify the hall by repainting all of the interior walls. The school hall is in the shape of a cuboid with a length of 10 meters, a width of 8 meters, and a height of 4 meters. If the painting cost is Rp20,000.00 per m², determine the total cost required to paint all of the interior walls of the hall!	This question measures students' ability to apply the concept of the surface area of a cuboid to a contextual problem. Students are expected to be able to identify the information given and asked, determine which parts of the cuboid need to be calculated, apply the appropriate formula to determine the surface area of the hall's walls, and relate the calculation results to the painting cost to obtain the total cost required.
Question #2. An aquarium in the shape of a cuboid has a length of 72 cm, a width of 45 cm, and a height of 55 cm. The aquarium will be filled with water to its full capacity. Determine the maximum volume of water that the aquarium can hold, in liters!	This question measures students' ability to apply the concept of the volume of a cuboid to a contextual problem. Students are expected to be able to identify the information given and asked, apply the volume formula for a cuboid to determine the aquarium's capacity, and convert the calculation results from cubic centimeters to liters to obtain the maximum volume of water that can be held.
Question #3. Look at the following image of a combination of a cube and a square pyramid!	This question measures students' ability to analyze the surface area of a combined solid figure consisting of a cube and a square pyramid. Students are expected to

Questions	Question Characteristics
 Analyze which surface parts of the figure are included and which are not included in calculating the surface area of the combined shape. Then, calculate the total surface area of the solid figure and provide your reasoning!	be able to identify the information given and asked, determine which surface parts of the figure are included and which are not included in calculating the total surface area, apply the appropriate formulas to calculate the area of each part, and provide reasoning for the solution steps taken to obtain the total surface area of the combined figure.

Before being used in the research, the test instrument was first validated by two mathematics education lecturers at Universitas Negeri Padang. The instrument validation covered the aspects of content, construction, and language. Based on the results of the validation by the two validators, all test items were declared consistent with the specified learning indicators and cognitive levels, and suitable for use with several revisions. The revisions included refining the narrative and wording of the questions to make them clearer and more contextual, improving the visualization of the solid figure images, and refining the sentence structure of each item before the instrument was used in the research. Subsequently, the instrument was analyzed based on discriminating power, difficulty index, and reliability. The analysis results showed a reliability coefficient of 0.79, which falls into the high category. Thus, the test instrument was declared appropriate for measuring students' mathematics learning outcomes.

Data Collection

Research data were collected through a mathematics learning achievement test administered after the entire series of learning activities had been completed. Prior to the test, students in the experimental class were taught using the Mathigon-assisted Discovery Learning model, while students in the control class were taught using the conventional learning model, namely the direct instruction model. The final test results from both classes were then used as research data to compare students' mathematics learning outcomes and to determine the effect of the Mathigon-assisted Discovery Learning model on mathematics learning outcomes.

Data Analysis

The analysis began by calculating the test scores based on the established scoring rubric. Next, the scores from the mathematical problem-solving ability test were converted into values on a scale of 0 to 100 using the following formula:

$$score = \frac{Obtained\ Score}{Maximum\ Possible\ Score} \times 100$$

Descriptive analysis was then conducted to obtain the mean, maximum, minimum, and standard deviation values for each class. Before hypothesis testing, prerequisite analyses were first carried out. The prerequisite analyses in this study included normality and homogeneity tests. The normality test was conducted using the Anderson-Darling test to determine whether

Kognitif: Jurnal Riset HOTS Pendidikan Matematika
https://doi.org/10.51574/kognitif.v6i3.5363 Volume 6, No 3, July - September 2026, pp. 952 –964

the data were normally distributed or not. Meanwhile, the homogeneity test was conducted using the F-test to determine whether the variances of the two sample classes were homogeneous or not. If the prerequisite tests were satisfied, the data were then processed using a parametric test, namely the t-test at a 5% significance level, to determine whether the mathematics learning outcomes of students taught using the Mathigon-assisted Discovery Learning model were better than those of students taught using the conventional learning model. This testing process was assisted by Minitab software to ensure the accuracy of the results.

Research Findings
Data Description

The analysis of the final test aimed to compare the mathematics learning outcomes of students in the experimental and control classes. The descriptive analysis used included the mean, maximum score, minimum score, and standard deviation. A summary of the descriptive analysis is presented in Table 3.

Table 3. Posttest Result Data for Sample Class

Class	Mean	Max	Min	Standard Deviation
Experiment	79.74	100	55.56	12.67
Control	68.53	95.56	40	15.71

Based on Table 3, the experimental class obtained a mean score of 79.74, higher than the control class, which obtained a mean score of 68.53. This indicates that the mathematics learning outcomes of students in the experimental class were better than those in the control class. The difference between the mean scores of the experimental and control classes was 11.22. The analysis results also showed that the standard deviation of the experimental class was smaller than that of the control class, indicating that the students' learning outcomes in the experimental class were more homogeneous, with scores distributed more evenly around the mean, whereas in the control class the distribution of scores was wider and the learning outcomes more varied. A more detailed picture of students' mathematics learning outcomes for each item is presented through the mean score of each question in Table 4.

Table 4. Mean Scores of the Sample Groups in Answering the Learning Outcome Test Questions

Question	Mean Score of the Experimental Class	Mean Score of the Control Class	Maximum Score
1	12.88	11.60	15
2	9.04	8.48	10
3	13.96	10.76	20

Based on Table 4, it can be seen that the mean scores of students' mathematics learning outcomes for all three questions in the experimental class, which was taught using the Mathigon-assisted Discovery Learning model, were higher than those in the control class, which was taught using the conventional model. A comparison of the mean test scores for students' mathematics learning outcomes is presented in Figure 1.

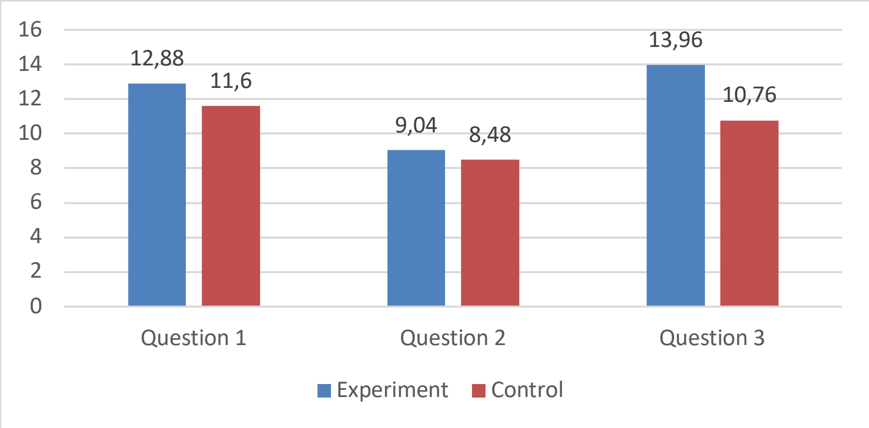


Figure 1. Graph of Mean Scores of the Sample Groups in Answering the Learning Outcome Test Questions

Analysis of Mathematics Learning Outcomes Test Data

This analysis aims to determine whether the formulated hypothesis can be accepted or rejected. It includes the results of the prerequisite tests, comprising the normality test and the homogeneity of variance test, as well as the results of the hypothesis test on the mathematics learning outcome data. The data processing analysis was carried out using Minitab software. The results of the analysis are presented in Table 5.

Table 5. Results of the Prereuisite Test and Hypothesis Test

Analysis Stage	Test Type	*P - value*	Criterion	Decision
PrereuisiteTest	Normality Test (Anderson–Darling) - Experimental Class	0.153	$P - value > \alpha$	H_0 accepted
	Normality Test (Anderson–Darling) - Control Class	0.269		
	Homogeneity Test (F-test)	0.292		
Hypothesis Test	Independent Samples t-Test	0.004	$P - value < \alpha$	H_0 rejected

Based on Table 5, the data from both classes were normally distributed and homogeneous. Therefore, the hypothesis was tested using an independent samples t-test. The results of the hypothesis test showed a $P - value$ of 0.004, which was less than 0.05. Thus, H_0 was rejected. Meaning that the mathematics learning outcomes of students taught using the Mathigon-assisted Discovery Learning model were better than the mathematics learning outcomes of students taught using the conventional learning model.

To further strengthen these findings, an additional analysis was conducted by calculating the effect size (Cohen's d). This analysis aims to determine the magnitude of the effect of implementing the Mathigon-assisted Discovery Learning model on students' mathematics learning outcomes. The results of the effect size calculation are presented in Table 6.

Table 6. Effect Size Test Result (*Cohen's d*)

Parameter	Value
Effect Size (*Cohen's d*)	0.79
Category	Medium

Based on the effect size calculation using Cohen's d, a value of 0.79 was obtained, which falls into the medium category. This result indicates that the implementation of the Mathigon-assisted Discovery Learning model had a medium effect on students' mathematics learning

Kognitif: Jurnal Riset HOTS Pendidikan Matematika
https://doi.org/10.51574/kognitif.v6i3.5363 Volume 6, No 3, July - September 2026, pp. 952 –964

outcomes. Thus, in addition to producing a statistically significant difference, the learning model also had a meaningful effect on improving students' mathematics learning outcomes.

Discussion

Based on the description and analysis of the data, the mathematics learning outcomes of the experimental class were superior to those of the control class. The mean score obtained by the experimental class was 79.74, while the control class obtained 68.53. The difference between the mean scores of the two sample classes was also supported by the results of the hypothesis test using the t-test, which showed a p-value < 0.05, so H_0 was rejected. In addition, the effect size calculation using Cohen's d of 0.79 indicated a medium category. These findings show that the implementation of the Mathigon-assisted Discovery Learning model had a significant effect on the mathematics learning outcomes of eighth-grade students. The results of this study are also consistent with those of Moko et al. (2022) and Okwina (2020) who stated that the implementation of the Discovery Learning model improves students' mathematics learning outcomes.

Viewed in terms of the achievement on each test item, students in the experimental class demonstrated better ability at the applying (C3) and analyzing (C4) cognitive levels. In question number 1, which measured the applying (C3) ability, students were required to identify the information given and asked in the problem. Next, students had to select the appropriate formula, namely the surface area formula for a cuboid, to determine the total surface area of the hall's walls, then relate it to the painting cost per square meter, and arrange the calculation steps systematically to arrive at the final answer. This ability shows that students were not merely recalling the formula but were able to apply the concept of surface area in solving a contextual problem. The better achievement in the experimental class indicates that the stages in the Discovery Learning model helped students understand the relationship between the concept of surface area and its application in everyday life.

Question number 2 also measured the applying (C3) ability, in which students were required to identify the information given and asked in the problem. Next, students determined the aquarium's volume using the appropriate cuboid volume formula, converted the calculation results from cubic centimeters to liters, and arranged the calculation steps systematically to obtain the final result. The better achievement in the experimental class shows that the discovery-based learning process helped students connect the concepts acquired during learning with their application in real situations. Through exploratory activities, students not only memorized the formula but also understood the underlying origin of the concept, making it easier for them to determine the appropriate solution procedure.

Question number 3, which measured the analyzing (C4) ability, required students to analyze which surface parts of the combined solid figure were included and which were not included in determining the total surface area of the shape. Students were then expected to identify the information given and asked. Next, after determining the surface parts to be calculated, students calculated the area of each part using the formulas for the area of a square and the area of a triangle, then summed them correctly to obtain the total surface area of the combined figure. The better achievement in the experimental class indicates that learning which provides students with opportunities to explore and verify concepts independently can support the development of analytical skills. During the learning process, students became accustomed to observing the relationships between the elements of solid figures, discussing their findings, and providing reasoning for the solutions obtained, so that their analytical skills developed more optimally.

This is influenced by the characteristics of learning in the experimental class, which implemented the Mathigon-assisted Discovery Learning model. The Discovery Learning model places students as active subjects in constructing knowledge through the stages of stimulation, problem statement, data collection, data processing, verification, and generalization. At each of these stages, students are encouraged to observe, explore, analyze, verify, and draw conclusions about concepts independently under the teacher's guidance. This kind of learning process provides students with the opportunity to build a deeper conceptual understanding compared to learning dominated by direct delivery of material (Prasetyo & Abduh, 2021).

The advantage of learning in the experimental class was also supported by the use of the Polypad feature in Mathigon. The three-dimensional object rotation feature allowed students to observe solid figures from various viewpoints, making it easier for them to identify faces, edges, and vertices. In addition, the nets feature allowed students to unfold and fold the nets of solid figures so that the relationship between each constituent face and the surface area could be observed directly. In the volume material, students also explored the relationship between the base dimensions, height, and volume of solid figures through the manipulation of digital models. These activities helped students visualize abstract concepts more concretely, thereby supporting the concept-discovery process in line with the characteristics of Discovery Learning (Nufninu & Wijaya, 2025).

In contrast, learning in the control class used the conventional, teacher-centered learning model. In the learning process, the teacher explained the material, provided example problems, and continued with practice exercises (Yanuar & Pius, 2023). Although this approach helped students understand solution procedures, students' involvement in discovering concepts, analyzing problems, and independently constructing understanding was more limited. As a result, the mathematics learning outcomes of students in the control class developed less optimally compared to those of students in the experimental class. Overall, the research results indicate that the implementation of the Mathigon-assisted Discovery Learning model made a positive contribution to mathematics learning outcomes on the topic of flat-sided solid figures. This contribution is presumed to stem from students' active involvement in the concept-discovery process, as well as the use of Mathigon, which supports the visualization, manipulation, and exploration of geometric objects, thereby helping students understand concepts more meaningfully.

Conclusion

Based on the research results, it can be concluded that the mathematics learning outcomes of students taught using the Mathigon-assisted Discovery Learning model on the topic of flat-sided solid figures were better than those of students taught using the conventional learning model in class VIII of SMP N 1 Hiliran Gumanti in the 2025/2026 Academic Year. This is shown by the mean final test scores of 79.74 for the experimental class and 68.53 for the control class, as well as the hypothesis test results showing $p - value = 0{,}004 < 0.05$. In addition, the effect size analysis using Cohen's d showed a medium effect size (Cohen's d = 0.79), indicating that the implementation of the Mathigon-assisted Discovery Learning model made a fairly meaningful contribution to students' mathematics learning outcomes. This study is limited to the use of the Non-equivalent Posttest-Only Control Group Design and the topic of flat-sided solid figures. Therefore, future research is recommended to use a design involving both pretest and posttest, and to apply it to a more diverse range of mathematics topics.

https://doi.org/10.51574/kognitif.v6i3.5363 Volume 6, No 3, July - September 2026, pp. 952 –964

Conflict of Interest

The researchers states that there is no conflict of interest in this research.

Auhor Contributions

L.J.L. contributed to the development of the research concept, data collection, data analysis, conducting the research, and writing the article. E.M contributed to research supervision, providing guidance on research methodology, as well as refining the content and language of the article. M. and S. contributed to instrument validation and manuscript revision. All authors have read and approved the final version of this article for publication. The distribution of contributions in the conceptualization, writing, and revision of this research is as follows: L.J.L.: 45%, E.M.: 25%, M.: 15%, and S.: 15%.

Data Availability Statement

The authors state that the data supporting the findings of this study will be made available by the corresponding author, [E.M.], upon reasonable request

References

Ardianto, A., Mulyono, D., & Handayani, S. (2019). Pengaruh Model Discovery Learning Terhadap Hasil Belajar Matematika Siswa Kelas VII SMP. *Jurnal Inovasi Matematika (Inomatika)*, *1*(1), 31–37. https://doi.org/10.35438/inomatika.v1i1.136

Artanti, F., & Lestari, T. K. (2017). Upaya Meningkatkan Kemandirian Belajar Matematika Siswa dengan Menggunakan Model Discovery Learning di MAN 3 Yogyakarta. *Prosiding Konferensi Nasional Penelitian Matematika Dan Pembelajarannya II (KNPMP II)*, 290–300. https://proceedings.ums.ac.id/knpmp/article/view/2247/2202

Damopolii, V., Bito, N., & Resmawan. (2019). Efektivitas Media Pembelajaran Berbasis Multimedia Pada Materi Segiempat. *Algoritma Journal of Mathematics Education (AJME)*, *1*(2), 74–85. https://doi.org/10.15408/ajme.v1i2.14069

Ihsan, A., Mailizar, & Elizar. (2024). Enhancing students problem-solving skills and engagement through inquiry- based mathematics education with Mathigon: A study on Cartesian coordinates. *Beta: Jurnal Tadris Matematika*, *17*(2), 135–158. https://doi.org/10.20414/betajtm.v17i2.662

Kodirun, Busnawir, & Viktor, E. beliana. (2016). Penerapan Model Pembelajaran Discovery Learning Berbasis Lesson Study Dalam Upaya Peningkatan Kemampuan Komunikasi Matematik Siswa Kelas X Mipa-3 Sma Negeri 5 Kendari. *Jurnal Pendidikan Matematika*, *7*(2). https://doi.org/jpm.v7i2.3085

Metzvioleta. (2025). Pengaruh Penggunaan Model Pembelajaran Untuk Meningkatkan Hasil Belajar Siswa Sekolah Dasar. *Jurnal Pendidikan Indonesia*, *6*(5), 1–9. https://doi.org/10.59141/japendi.v6i5.7833

Moko, V. T. H., Chamdani, M., & Moh.Salimi. (2022). Penerapan Model Discovery Learning untuk Meningkatkan Hasil Belajar Matematika. *Inovasi Kurikulum*, *19*(2), 131–142. https://doi.org/10.17509/jik.v19i2.44974

Mulyaningsih, A. P., Gusti, C. A., Noorahmah, A. Y., Permatasari, S., Putri, H. E., & Wulan, N. S. (2025). Penerapan Model Pembelajaran Stem Berbantuan Polypad Untuk Meningkatkan Pemahaman Konsep Jaring-Jaring Bangun Ruang Pada Siswa Sekolah

Dasar. Jurnal Kolaboratif Sains, 8(12), 8169–8181. https://doi.org/10.56338/jks.v8i12.9599

Nufninu, Y., & Wijaya, A. (2025). The Effec t of RME Approach Assisted by Mathigon on Students ' Mathematical Literacy and Mathematical Resilience. *International Journal of Multicultural and Multireligious Understanding*, *12*(9), 246–254. http://dx.doi.org/10.18415/ijmmu.v12i9.7053

OECD. (2023). *PISA 2022 Assessment and Analytical Framework*. https://doi.org/10.1787/dfe0bf9c-en

Oktavia, R. K., & Hidayati, fina H. (2022). Dampak Persepsi Siswa Terhadap Pelajaran Matematika Pada Jenjang SMA. *Cendekia*, *16*(2), 27–37. https://doi.org/10.30957/cendekia.v16i2.666

Okwina, D. (2020). Discovery Learning Effect on Mathemathic Learning. *Journal of Asian Multicultural Research for Educational Study*, *1*(1), 21–27. https://doi.org/10.47616/jamres.v1i1.12

Patri, S. F. D., & Purniyanti, I. (2024). Peningkatan Hasil Belajar Matematika Dengan Model Problem Based Learning (PBL) Pada Materi Pengukuran Waktu, Jarak Dan Kecepatan. *Jurnal Edu Research*, *5*(2), 156–164. https://doi.org/10.47827/jer.v5i2.184

Prasetyo, A. D., & Abduh, M. (2021). Peningkatan Keaktifan Belajar Melalui Model Discovery Learning Di Sekolah Dasar. *Jurnal Basicedu*, *5*(4), 1717–1724. https://doi.org/10.31004/basicedu.v5i4.991

Rahmawati, A., Fauzan, A., & Khairi, A. U. (2025). Meningkatkan Pemahaman Konsep Matematis Melalui Model Discovery Learning pada Materi Teorema Pythagoras Kelas VIII SMP. *Jurnal Polinomial*, *4*(1), 42–50. https://doi.org/10.56916/jp.v4i1.1297

Ramli, H. (2020). Model Discovery Learning Dalam Pembelajaran Matematika. *Paradigma: Jurnal Ilmu Pendidikan Dan Humaniora*, *6*, 12–24. https://doi.org/10.62176/paradigma.v6i1.125

Salsabila, Y., Harahap, A. A. S., Fitria, N., & Harahap, N. darussakinah. (2023). Pengaruh Perkembangan Kemampuan Pada Aspek Kognitif, Afektif, dan Psikomotorik Terhadap Hasil Belajar. *Algebra: Jurnal Pendidikan, Sosial Dan Sains*, *3*(1). https://doi.org/10.58432/algebra.v3i1.741

Saputri, F. J., Sowiyah, Hermawan, J. S., & Rapani. (2025). Pengaruh Model Discovery Learning Berbantuan Video Animasi Terhadap Hasil Belajar. *Al-Irsyad: Journal of Mathematics Education*, *4*(2), 144–159. https://doi.org/10.58917/ijme.v4i2.172

Sumartini, T. S. (2016). Kemampuan Pemecahan Masalah Matematika dalam Menyelesaikan Soal Cerita Berdasarkan Langkah Polya. *Mosharafa: Jurnal Pendidikan Matematika*, *5*(2), 1–7. https://doi.org/10.31980/mosharafa.v5i2.391

Syafii, M., Putra, E. D., & Sujiwo, D. A. C. (2023). Pengaruh Discovery Learning Terhadap Hasil Belajar Matematika Siswa MA Al-Falah Dempo Barat. *Tematik: Jurnal Konten Pendidikan Matematika*, *1*(1), 14–18. https://doi.org/10.55210/jkpm

Syafitri, C., & Dwina, F. (2025). Penerapan Model Pembelajaran Discovery Learning Pada Hasil Belajar Matematika Peserta Didik Fase E Sman 1 Batang Anai. *Jurnal Edukasi Dan Penelitian Matematika*, *14*(3), 130–135. https://doi.org/10.24036/ksvaq011

Wardani, R. K., & Amidi. (2025). Kemampuan Penalaran Matematis Ditinjau dari Minat Belajar Siswa dengan Model Problem Based Learning Berbantuan Mathigon. *Jurnal Ilmiah Literasi Indonesia*, *1*(1), 183–193. https://doi.org/10.63822/s0amny98

Yanuar, A., & Pius, I. (2023). Upaya Meningkatkan Keaktifan dan Hasil Belajar Siswa Kelas 4 SDK Wignya Mandala Melalui Pembelajaran Kooperatif. *Sapa: Jurnal Kateketik Dan Pastoral*, *8*(1), 1–10. https://doi.org/10.53544/sapa.v8i1.327

Kognitif: Jurnal Riset HOTS Pendidikan Matematika
https://doi.org/10.51574/kognitif.v6i3.5363 Volume 6, No 3, July - September 2026, pp. 952 –964

Authors Biography

	**Luqyana Jasmine Lathifah** was born in Bengkulu on March 19, 2004. He started his education at SDIT Alhasanah in 2010 and graduated in 2016. He then continued his education at MTsN 1 Kota Bengkulu in 2016 and graduated in 2019. He then continued his education at SMAN 2 Sumatera Barat in 2019 and graduated in 2022. He is currently studying at the Universitas Negeri Padang, majoring in Mathematics education. ✉ luqyanajasminel19@gmail.com
	**Edwin Musdi** is a lecturer and researcher at the department of mathematics education, faculty of mathematics and natural science, Universitas Negeri Padang, West Sumatera, Indonesia. His research interest is Mathematics Learning Strategies. ✉ edwinmusdi@fmipa.unp.ac.id
	**Mirna** is a lecturer and researcher at the department of mathematics education, faculty of mathematics and natural science, Universitas Negeri Padang, West Sumatera, Indonesia. Her research interest is mathematics education and learning. ✉ mirnabahar@fmipa.unp.ac.id
	**Suherman,** is a lecturer and researcher at the department of mathematics education, faculty of mathematics and natural science, Universitas Negeri Padang, West Sumatera, Indonesia. His research interest is Mathematics Learning Strategies. ✉ suherman@fmipa.unp.ac.id