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COMPARISON OF STUDENTS' MATHEMATICAL CONCEPT UNDERSTANDING ABILITY IN POLYHEDRON MATERIAL USING THE DISCOVERY LEARNING AND CORE LEARNING MODEL WITH THE ASSISTANCE OF POP-UP BOOK MEDIA

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ABSTRACT

This research was motivated by the low ability of class VIII students at MTs N 1 Purbalingga to understand mathematical concepts. This research aims to compare students' ability to understand mathematical concepts in flat-sided geometric material using two different learning models, namely discovery learning and Connecting, Organizing, Reflecting, And Extending (CORE) with the help of pop-up book media. The research method used is quantitative with a quasi-experimental type of research. The population in this study were class VIII students at MTs N 1 Purbalingga for the 2022/2023 academic year. The sampling technique used simple random sampling, and the sample in this study were students in classes VIII D and VIII E, totaling 76 students. In experimental class I, I received teaching using the discovery learning model assisted by pop-up books. For experimental class II, I received teaching using the CORE model assisted by pop-up books. The data collection method uses tests in the form of pretest and posttest. The data analysis technique uses the n-gain and two independent samples t-tests. The research results showed that the average n-gain score in experimental class I was 0.656; in experimental class II, it was 0.366, which was in the medium category. Judging from the n-gain interpretation, the average percentage value obtained by experimental class I, namely 65.5%, is interpreted as quite effective. It is interpreted as ineffective in experimental class II, namely 36.6%. Based on analysis using the t-test for two independent samples, the significance value was $0.000 < \alpha=0.05$, so it can be concluded that there is a significant difference between the ability to understand mathematical concepts of students who use the pop-up book-assisted discovery learning model and the CORE assisted learning model on flat-sided building materials.

Keywords: CORE Learning Model, Discovery Learning Model, Mathematical Concept Understanding, Pop-up Book

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INTRODUCTION

Education is the most important thing in human life because with education, every human being can learn various sciences and with that knowledge, humans can change their mindset. In the world of education, there are various fields of learning, one of which is

mathematics. Learning mathematics has a role that cannot be separated from the definition of mathematics itself. By the definition contained in the Appendix to the Minister of Education and Culture Number 58 of 2014, "Mathematics is a universal science, useful for human life, underlies the development of modern technology, plays a role in various sciences, and advances human thinking." Based on this role, it appears that mathematics is an important lesson for students, especially to achieve various existing learning objectives.

One of the objectives of learning mathematics listed in the Appendix to the Minister of Education and Culture Number 58 of 2014 concerning the junior high school curriculum is that students have an understanding of mathematical concepts, which are competencies in explaining the relationship between concepts and applying concepts or algorithms, efficiently, accurately, flexibly, and precisely in problem-solving. This ability is called the ability to understand mathematical concepts. The ability to understand mathematical concepts is an ability to master material and students' abilities to understand, absorb, master, and apply it in learning mathematics. This ability is a basic ability that is very important to have because students who have good conceptual understanding skills can help students master other mathematical concepts, such as communication, reasoning, problem-solving, and so on.(Ningsih et al., 2019).

Even though the ability to understand mathematical concepts is important, in reality in learning polyhedron the strategy used by the teacher to convey geometric material is to paint geometric shapes and work on practice questions (Yanti et al., 2019), so there are still many students who experience difficulty in reasoning a geometric figure. This causes students difficulties in translating pictorial questions, so that problem-solving becomes constrained. Thus the right strategy is needed to improve students' understanding of mathematical concepts.

Based on the results of the preliminary test that was given to class VIII D students of MTs N 1 Purbalingga with a total of 38 students, it was found that the students' ability to understand mathematical concepts was still low. This can be seen from the average percentage of correct answers from the 38 students, which is 47%. In addition, the researchers conducted interviews with the eighth grade mathematics teacher at MTs N 1 Purbalingga, obtained information that many students considered mathematics a difficult subject. Most students still use memorization skills, and many students still do not understand mathematical concepts. In the learning process there are students who are interested, quite interested, and even not interested in learning mathematics.

In addition to interviews, researchers also made observations when teaching and learning activities took place and it was seen that learning in the classroom still tended to be teacher-centered or conventional using only textbooks. As a result, students experience difficulties in understanding the material and questions related to the material because students are only fixated on what is explained by the teacher, students are passive, and cannot explore their own knowledge, so that learning only occurs in one-way communication and understanding of the concepts received. students become less than optimal. Even when the teacher gave a different problem than the previous example problem, many students found it difficult, even though the question only changed numbers or just flipped questions back and forth. This reinforces that students' ability to understand mathematical concepts is still low.

According to Aunurrahman (Ningsih et al., 2019) one of the factors that influence the ability to understand students' mathematical concepts is the learning model used by the teacher. One effort to improve it is through the discovery learning and Connecting, Organizing, Reflecting, and Extending (CORE) learning models with the help of pop-up book media. Discovery learning is a learning model in which the teacher does not immediately provide the final results or conclusions from the material presented, but students have the opportunity to search and find themselves, so that the learning process will be easy to

remember and not easy to forget (Cahyo, 2013). While CORE is a learning model that expects students to be able to find their own knowledge by connecting and organizing new knowledge with old knowledge then thinking about the concept being studied (reflecting) and it is hoped that students can broaden their knowledge during the learning process (extending) (Kusrianto, 2016). Thus, it is possible that discovery learning and CORE learning models can be used to improve students' understanding of mathematical concepts.

Discovery learning and CORE learning models are learning models that involve students, so that students are actively involved in the learning process, students will investigate on their own, and discover their own learning concepts from the media provided. Therefore, the existence of media is considered necessary as a support in learning activities. In this case the researcher uses pop-up book media on polyhedron material. Pop-up books are books that can display images with a three-dimensional effect that appear when opened and give a unique image display effect inside (Sari, 2019).

In addition, according to Maharani, et al (Maharani et al., 2018) pop-up books can be used to explain abstract concepts and require concrete objects. Pop-up books can be designed according to the needs of the material to be taught and of course by paying attention to how the learning steps are (Yuliani et al., 2018). The advantage of pop-up books is that they can visualize images more realistically and become more interesting, thus helping students to communicate these images in the language of mathematics. This is suitable for use on polyhedron material because the study of the material is still abstract and difficult for students to understand. In addition, this polyhedron requires a high level of reasoning because it is a three-dimensional shape. Therefore, in learning about polyhedron, it is necessary to use a pop-up book that is used during learning.

Based on the description above, the researcher conducted a study entitled "Comparison of Students' Ability to Understand Mathematical Concepts in Polyhedron Material Using the Learning Model of Discovery Learning and Connecting, Organizing, Reflecting, and Extending (CORE) Assisted by Pop-Up Books Class VIII MTs N 1 Purbalingga."

Based on the introduction that has been presented, the formulation of the problem in this study is "How are the differences in the ability to understand mathematical concepts of students who use the discovery learning model assisted by the pop-up book with CORE learning model assisted by a pop-up book on polyhedron material for class VIII MTs N 1 Purbalingga ?"

By the formulation of the problem above, the purpose of this study was to find out how the differences in the ability to understand mathematical concepts of students using the discovery learning model assisted by the pop-up book and CORE learning model assisted by a pop-up book on polyhedron material for class VIII MTs N 1 Purbalingga.

METHOD

The research method used in this study is quantitative, while the type of research is quasi-experimental with a nonequivalent control group design. In this design before treatment, both classes are given a pretest to find out the initial state of the class. Furthermore, both classes were given treatment. The experimental class I was given treatment using the discovery learning model assisted by pop-up books. While the experimental class II was given treatment using the CORE learning model assisted by pop-up books. At the end of the study, the two experimental classes were given a posttest to see the results (Majid et al., 2020).

The population in this study were students of class VIII MTs N 1 Purbalingga for the 2022/2023 academic year. The sampling technique uses simple random sampling where the sampling process is taken randomly by drawing lots. Based on the lottery, it was found that

there were 38 students in class VIII D who used the discovery learning model assisted by pop-up books and class VIII E as many as 38 students who used the CORE learning model assisted by pop-up books.

The data collection method uses tests in the form of pretest and posttest which have been adjusted to indicators of the ability to understand mathematical concepts in the polyhedron material. The purpose of this test is to find out whether there are differences in the ability to understand students' mathematical concepts regarding the polyhedron material given two different treatments. The research instruments, both pretest and posttest questions, were tested for validity and reliability before being given to the experimental class. The data analysis technique used a hypothesis test in the form of an *n-gain test* and *independent sample t-test*, using SPSS Statistics 23. The n-gain test was used to determine the increase in the ability to understand mathematical concepts among students using the discovery learning model assisted by pop-up books with students who use the CORE learning model assisted by a pop-up book. Meanwhile, the independent sample t-test was used to determine differences in the increase in the ability to understand students' mathematical concepts in the two experimental classes.

RESULT AND DISCUSSION

This research was conducted in five meetings in experimental class I and experiment II. The first meeting is giving a pretest, then the next three meetings are used for learning activities, and the last meeting is giving a posttest. The implementation of this study used two classes as research samples, namely class VIII D as the experimental class I which used the discovery learning model assisted by the pop-up book, and class VIII E as the experimental class II which used the CORE learning model assisted by a pop-up book. The following is the treatment with the discovery learning model assisted by the CORE learning model assisted by a pop-up book on polyhedron material:

1. Discovery Learning Model

The discovery learning model is discovery-based. In the context of using pop-up book media on polyhedrons, the characteristics of this learning model are that students can find elements, volumes, and surface areas of cubes, blocks, prisms, and also pyramids.

Figure 1. The discovery learning model assisted by the pop-up book for Experiment Class I

The steps for the discovery learning model assisted by the pop-up book on polyhedron material are as follows: (1) the teacher groups students into 4 groups consisting of 5-10 students, (2) stimulation, the teacher gives a pop-up book and student worksheets (LKPD which contains instructions for analyzing polyhedron (cubes, blocks, prisms, and pyramids), (3) problem statements, students are asked to conduct experiments with the help of paper and sticks contained in the pop-up book , Students must record the results that have been obtained

in the LKPD that has been provided, (4) data collection, students in groups use available materials (can be from textbooks, worksheets, printed books, etc.) perform verification according to the instructions in the LKPD, (5) data processing, the teacher carries out guidance when students do data processing, (6) verification, students check carefully to prove whether or not the proof of the discovery polyhedron (cubes, blocks, prisms, and pyramids) with the results of data that has been processed, (7) generalization, after the discussion is over, some group representatives present in writing or orally the results of learning or what has been learned and discussed.

2. CORE Learning Model

The CORE learning model is a student experience-based learning model. In the context of using pop-up book media on polyhedron material, the characteristics of this learning model are that students can find elements, volumes, and surface areas of cubes, beams, prisms, and pyramids. Through students' own experiences/through independent learning that has been done before. These findings depend on the material under discussion.

Figure 2. The CORE learning model assisted by a pop-up book for Experiment Class II

The steps for the CORE learning model assisted by pop-up books on polyhedron material are as follows: (1) connecting, the teacher invites students to connect old concepts that students already have with new concepts that will be learned (associating geometric shapes with polyhedron). The teacher also orders students to study the material independently, according to a predetermined time, (2) the teacher groups students into 4 groups consisting of 5-10 students, (3) organizes, the teacher gives pop-up books and LKPD (contains instructions for analyze the polyhedron (cubes, blocks, prisms, and pyramids) and allow students to organize the information that has been obtained previously. At this stage each group is given a task with a note that, students are not allowed to open any reading sources because, previously they have studied independently and now is the time to apply this knowledge, but students are allowed to ask the teacher if they experience difficulties, (4) reflecting, after students have completed the LKPD, the teacher invites students to repeat what they have obtained in group discussions by representing several members of each group to present it in front of the class and other students to correct, (5) extending, the teacher directs students to work on questions or make generalizations from the knowledge that has been obtained during the learning process.

In this study, to measure students' ability to understand mathematical concepts using a test instrument. The test used was in the form of a pretest which was carried out before being given treatment and the posttest was carried out after being given treatment by the researcher. The pretest was given to the experimental class I and experiment II to find out the initial

ability to understand students' mathematical concepts before the learning process was carried out.

Before the pretest and posttest are used in the experimental class, they must be tested first using the validity test and reliability test. In the validity test, the first step that needs to be done is expert validation. This expert validation was carried out by two validators who were experts in the field of mathematics education, namely UIN Mathematics lecturer Saifuddin Zuhri and Mathematics Teacher MTs N 1 Purbalingga. After expert validation, the researcher tested the tests in the form of pretest and posttest to class IX A students with a total of 32 respondents. This is because class IX students have homogeneous (same) variants and students have previously received polyhedron material. After obtaining the value of working on the pretest posttest questions, then tested using validity and reliability tests and obtained 5 pretest questions and 5 posttest questions categorized as valid and reliable to be used as research instruments.

Based on the pretest results of the experimental class I and experiment II, it shows that students' ability to understand mathematical concepts is relatively the same. This can be seen from the average pretest score for experimental class I of 31.45 and for experimental class II of 30.66, both classes are in the very low category. This shows that students' mastery of concepts between experimental class I and experiment II before participating in learning was very low. This is a reasonable condition considering that the material has never been delivered to students before.

In contrast to the results of the pretest, students' understanding of mathematical concepts after participating in learning increased. This can be seen from the results of the posttest experimental class I and experiment II, each of which got an average value of 75.39 and 55.39, both of which are in the medium category. These results indicate that the experimental class I average value is higher than the experimental class II, namely 75.39> 55.39. This shows that the mastery of polyhedron material in both classes after being given treatment with the discovery learning model and CORE assisted by pop-up books get different average values.

Table 1. Class I N-Gain Results Summary

Normalized N-Gain Value	Interpretation	Frequency	Percentage %
0,70 ≤ N-Gain ≤ 1,00	Tall	13	34%
0,30 ≤ N-Gain < 0,70	Currently	25	66%
0,00 < N-Gain < 0,30	Low	0	0%
N-Gain = 0,00	No upgrade	0	0%
-1,00 ≤ N-Gain < 0,00	There was a decline	0	0%

Table 2. Class II N-Gain Results Summary

Normalized N-Gain Value	Interpretation	Frequency	Percentage %
0,70 ≤ N-Gain ≤ 1,00	Tall	3	8%
0,30 ≤ N-Gain < 0,70	Currently	25	66%
0,00 < N-Gain < 0,30	Low	10	26%
N-Gain = 0,00	No upgrade	0	0%
-1,00 ≤ N-Gain < 0,00	There was a decline	0	0%

The results of the pretest and posttest obtained from both classes were used in the n-gain test to determine the increase in students' understanding of mathematical concepts. This

is in accordance with Hake's theory, the n-gain test uses both pretest and posttest scores (Allen Marga Retta, Nila Kesumawati, 2018). Furthermore, the results of the n-gain score were used in the independent sample t-test to find out the differences in the increase in students' understanding of mathematical concepts between the two experimental classes.

From the recapitulation of pretest and posttest scores, it can be concluded that the average n-gain score of both classes before and after the treatment has increased. It can be seen that the average n-gain score in the experimental class I during learning was 0.656 with the specification that 13 students had an increase in the high category (34%) and 25 students had an increase in the medium category (25%). While the average n-gain score in the experimental class II during learning was 0.366 with specifications 3 students having an increase in the high category (8%) and 25 students having an increase in the medium category (66%), and 10 students in the low category (26 %). The following table recapitulates the results of n-gain calculations for experimental classes I and II:

The results show that the discovery learning model with pop-up book support is more effective than the CORE model with the same assistance in improving students' understanding of mathematical concepts. Experimental class I, which used the discovery learning model, achieved an average effectiveness score of 65.6%, indicating a moderate level of effectiveness. In contrast, the CORE model scored an average of 36.6%, which is considered ineffective. Therefore, the discovery learning model with pop-up books was more effective for enhancing the mathematical concept comprehension of eighth-grade students. An independent sample t-test was conducted on the average n-gain scores of both classes. Before this test, normality and homogeneity tests were performed as prerequisites. The results of the Kolmogorov-Smirnov normality test are shown in Table 3 below.

Table 3. Normality Test Results with N-Gain Score

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Class	Statistic	Df	Sig.	Statistic	df	Sig.
N-Gain Score	Experiment I	,131	38	,099	,965	38	,279
	Experiment II	,117	38	,200*	,942	38	,047

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

Based on Table 3 it can be seen that the significance value of the Kolmogorov Smirnov test in experimental classes I and II obtained values of 0.099 and 0.200, this indicates that the two experimental classes are above the significance level of 0.05. Therefore it can be concluded that the n-gain scores for experimental class I and II are normally distributed. Furthermore, the results of the homogeneity of variance test using the Levene test can be seen in table 4 below:

Table 4. Homogeneity Test Results with the N-Gain Score

		Levene Statistic	df1	df2	Sig.
N-Gain Score	Based on Mean	,295	1	74	,589
	Based on Median	,359	1	74	,551
	Based on Median and with adjusted df	,359	1	64,148	,551
	Based on trimmed mean	,310	1	74	,579

Table 4 indicates a significance value of 0.589 in the "Based on Mean" section, which exceeds 0.05, confirming the homogeneity of the n-gain scores between the two classes. With this prerequisite met, an independent sample t-test was conducted to compare the mean scores, aiming to evaluate differences in students' understanding of mathematical concepts

when using different learning models in the two experimental classes (Lestari & Yudhanegara, 2015). A 5% significance level was applied, where a test result below 0.05 would lead to rejecting H0 and accepting H1.

Table 5 shows two significance values (both 0.000) under the sections for equal variances assumed and not assumed. Since the data variances are homogeneous, the equal variances assumed value is used. With a significance value of 0.000, which is less than 0.05, H0 is rejected and H1 is accepted. This result indicates a significant difference in the mathematical concept understanding of students using the discovery learning model with pop-up book assistance compared to those using the CORE model with pop-up book assistance for polyhedron material.

Table 5. Independent Samples t-Test Result

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% C. I. of the difference	
		F	Sig.	t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
N-Gain Score	Equal variances assumed	,295	,589	7,884	74	,000	,29053	,03685	,21710	,36396
	Equal variances not assumed			7,884	69,378	,000	,29053	,03685	,21702	,36404

Data analysis shows improvement in students' understanding of mathematical concepts in classes VIII D and VIII E at MTs N 1 Purbalingga. This improvement was observed after implementing the discovery learning and CORE models with pop-up book assistance. The average n-gain score for students in the discovery learning class was 0.656, while the CORE class had a lower average score of 0.366. These scores reveal that the discovery learning model achieved moderate effectiveness, with a score of 65.6%. Meanwhile, the CORE model was rated as less effective, with a score of 36.6%.

An independent sample t-test was used to verify the effectiveness difference between the two models. The test, conducted using SPSS, returned a significance value of 0.000, which is below the 0.05 threshold. This result allowed researchers to reject H0 and accept H1, establishing a significant difference between the models. The conclusion drawn is that students using the discovery learning model with pop-up books showed a stronger grasp of polyhedron concepts. This performance was notably better than that of students using the CORE model with pop-up book assistance.

The discovery learning model outperformed CORE because it encouraged active exploration and engagement. Through the pop-up books, students could directly build knowledge rather than relying solely on memorization. This method allowed them to work independently, making learning more meaningful and personalized. Conversely, the CORE model limited students' learning to recall, offering less depth. Additionally, individual learning needs and time restrictions in class further constrained the CORE model's effectiveness.

The findings of this study align with previous research that supports the benefits of discovery learning. Risa Mulyanto's research indicated that students using the CORE model scored lower in problem-solving than those using discovery learning (Putri & Eliarti, 2017). Additionally, Weni Martucillia found that discovery learning led to higher scores in

polyhedron topics for class VIII students at SMP Negeri 3 Bengkulu City (Martucilia et al., 2022). This study's findings are also consistent with Nurul Nadia Adha's research, which found differences between the CORE and reciprocal teaching models. Specifically, Adha's study highlighted improvements in reasoning and connection skills for class VII students at SMPN 1 Tanjung Morawa (Adha, 2019).

CONCLUSION AND SUGGESTIONS

Based on the results of the research and discussion that has been carried out, it can be concluded that there is a significant difference between the ability to understand mathematical concepts of students who use the discovery learning model assisted by the pop-up book and the CORE learning model assisted by a pop-up book on polyhedron material. This can be seen from calculations using the SPSS Statistics 23 application, the results of the independent sample t-test les get a significance of 0.000 which is smaller than the significant limit of 0.05, then H_0 is rejected and H_1 is accepted. In addition, the discovery learning model assisted by pop-up books is superior to CORE, because in the discovery learning process students can explore much more knowledge, because students find out for themselves through reading material that students have when using pop-up books. Whereas in the CORE model, their knowledge is limited to relying only on students' memories, while the ability to understand the material for each student is different, and also the time for independent study in class is limited.

Future research could explore using discovery learning models with different types of learning media or integrating digital technology. This approach may create opportunities for more innovative and effective strategies to improve students' understanding of mathematical concepts. Researchers continuing with this learning model are advised to carefully consider the limitations encountered in this study. By doing so, future studies may yield more comprehensive and impactful results. This attention to detail could enhance the quality and relevance of findings for educators and curriculum designers.

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