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 study of investigation was motivated due to the limited proficiency of class VIII students at MTs N 1 Purbalingga to comprehend mathematical principles. This research seeks to assess student's comprehension of mathematical principles in flat-sided geometric material utilizing two distinct learning frameworks, specifically discovery learning and Connecting, Organizing, Reflecting, And Extending (CORE) with the help of pop-up book media. The method that utilized is quantitative with a quasi-experimental type of research. The study focused on the population of VIII-grade students at MTs N 1 Purbalingga for the 2022/2023 academic year. The sample method employed was basic random sampling, and the study's sample consisted of 76 students from classes VIII D and VIII E. In class I participated in an experimental teaching approach that utilized the discovery learning paradigm with the assistance of pop-up books. For experimental class II, I acquired instruction applying CORE model assisted by pop-up books. The data collection strategy utilizes pretest and posttest assessments. The analysis of the data method involves utilizing n-gain and conducting t-tests for two separate samples. The research outcomes showed that in experimental class I, the mean amount n-gain score was 0.656; in experimental class II, it was 0.366, it belonged to the mid-range group. Bsed on the n-gain analysis, the mean proportion of the total achieved by experimental class I, is 65.5%, is interpreted as quite efficient. It is interpreted as ineffective in experimental class II, namely 36.6%. According to examination using the t-test for two separate samples, the significance value was $0.000 < \alpha=0.05$, It could be inferred that there is a notable disparity in the comprehension of mathematical topics amongst students who utilize pop-up books 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

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 represents a ubiquitous and indispensable scientific discipline that has practical applications in every aspect of human existence. It forms the foundation of contemporary technology, contributes to different scientific fields, and promotes intellectual progress." 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 studying mathematics outlined in the Appendix Regarding the junior high school curriculum, Minister of Education and Culture Number 58 of 2014 states that students possess a grasp of fundamental matematics, which are competencies in describing the connection among conceptions and implementing them through algorithms efficiently, accurately, flexibly, and particulary in addressing issues. This ability is called mathematical comprehension. The comprehension of mathematical concepts is a cognitive skill to master material and students' abilities to understand, absorb, master, and apply it in learning mathematics. This ability is a fundamental skill that is crucial to have because students who are having 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 understanding mathematical ideas is crucial., 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, 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 enhance pupils' comprehension of mathematical subject matter.

According to the findings 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 diminished. This is evident 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 an issue distinct from the one in the preceding case, numerous students found it difficult, even though the question only changed numbers or just flipped questions back and forth. This reinforces that students' comprehension of mathematical ideas is inadequate.

According to Aunurrahman (Ningsih et al., 2019) one aspect that affects the capacity to comprehend students' mathematical skills 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 an educational approach where the teacher withholds the eventual outcomes or conclusions of the content initially delivered, but students have the chance to explore and discover by themselves, to facilitate memorization during the learning process and it will be not easy to forget (Cahyo, 2013). While CORE is an educational approach that requires students to independently acquire knowledge through linking and structuring new

information to existing knowledge. then contemplating the concept under examination (reflecting) and it is hoped that students able to broaden their expertise as they learn (extending) (Kusrianto, 2016). Thus, it is possible that discovery learning and CORE learning models enhances students' comprehension of mathematically topics.

Discovery learning and CORE learning models are learning models that involve students, to ensure students areactively engaged in their educational experience, 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 capable of showing visuals featuring a three-dimensional illusion that become visible while 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. 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.

Given the description provided, the examiner carried out an inquiry 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 issue that requires statement in this investigation 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 framing of the issue above, this investigation's goal was to determine how variations exist 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

This study's research methodology was quantitative, while the kind of inquiry that is being conducted is quasi-experimental with a nonequivalent design of the control group. In this design before treatment, both classes are given a preliminary examination to determine the starting state of the class. Furthermore, The treatment was administered to both classes. 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 groups that participated were each given a posttest at the conclusion of the research project in order to determine the outcomes. (Majid & Nur, 2020).

Individuals who participated in the current research were students of class VIII MTs N 1 Purbalingga for the 2022/2023 academic year. A method of sampling known as simple random sampling is utilized, in which the sample procedure is carried out in a random way 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.

Pre- and post-tests are the types of examinations that are utilized in the procedure of gathering data which have been adjusted to signs of the ability to comprehend mathematical principles utilized in the polyhedron material. One of the goals during this examination is to figure out the possibility that there are differences within the capacity to comprehend the mathematical principles students are learning regarding the polyhedron material given two different treatments. The research instruments, both pretest and postest the accuracy as well as the dependability of the tests were examined before being given to the experimental class. The method of analyzing the data included an examination of hypothesis that was carried out in the form of an *n-gain test* and *independent sample t-test*, using SPSS Statistics 23. The n-gain test was utilized in order to ascertain the extent to how students increased their capacity to comprehend math-related subjects through the utilization of the discovery learning approach with the assistance of pop-up books with learners whose utilize to the CORE learning model assisted by a pop-up book. Meanwhile, the independent sample t-test utilized in order to figure out differences in the increase in the ability to understand students' mathematical concepts in the two experimental classes.

RESULT

This inquiry was carried out over the course of a total of five meets in the 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 were taken from a pair of different classes, with class VIII D standing for 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 that was administered using the discovery education model, which was helped by the CORE learning model, and a pop-up book on polyhedron material:

1. Discovery Learning Model

The discovery learning model is discovery-based. Through context by 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.

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

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

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

For instance of a student-centered, experiential educational paradigm is the CORE 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.

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.

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

For the purpose of this investigation, a test instrument will be utilized to evaluate the pupils' capacity to comprehend mathematical concepts. The researcher administered this

examination as a pre-test, which It occurred earlier to administration of therapy, and a post-test, which took place after the treatment had been administered by the researcher. Both the experimental class I and the experimental Class II had a pretest to establish the beginning level of students' capacity to comprehend mathematical ideas prior to the implementation of the learning process.

Prior to the actual execution of the pre-and post-tests in the experimental class, they need to undergo validity and reliability tests before being used. In the validity test, the first step that needs to be done is expert validation. This expert validation was conducted by two validators who were specialists in the subject matter 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 circumstances of both 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.

The pretest findings of experimental class I and experiment II indicate that student's understanding of math-related subjects is similar. This is evident from the mean value 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 involvement in the educational process was limited. This is a reasonable situaation considering that the material has never been delivered to students before.

In contrast to the results of the pretest, student's comprehension of mathematical ideas after participating in learning increased. This can be seen based on the posttest experimental class outcomes 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 study outcome 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.

The outcomes 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 final stages of the n-gain score were used in the independent sample t-test to find out the differences in the enhancement in students' comprehension of the fundamentals of mathematics between the two experimental classes.

From the recapitulation of pretest and posttest scores, it can be concluded that it's average n-gain score of both classes before and after the treatment has increased. As may be observed, the experimental class's average n-gain score I during learning was 0.656 with the specification that 13 students experienced a rise in the upper range (34%) and 25 students had an increase classified as moderate category (25%). Despite the fact that the median n-gain score in the experimental class II before and after learning was 0.366 with specifications 3 students experiencing a growth in the high category (8%) and 25 students having an increase categorized as medium category (66%), and 10 students within the lower echelons (26 %). Here is following table recapitulates the results of n-gain calculations for experimental classes I and II:

Table 1. Class I N-Gain Results Summary

Normalized N-gain Value	Interpretation	Frequency	Percentage %
$0{,}70 \leq$ N-gain $\leq 1{,}00$	Tall	13	34%

$0,30 \leq$ N-gain $< 0,70$	Currently	25	66%
$0,00 <$ N-gain $< 0,30$	Low	0	0%
N-gain $= 0,00$	No upgrade	0	0%
$-1,00 \leq$ 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 %
$0,70 \leq$ N-gain $\leq 1,00$	Tall	3	8%
$0,30 \leq$ N-gain $< 0,70$	Currently	25	66%
$0,00 <$ N-gain $< 0,30$	Low	10	26%
N-gain $= 0,00$	No upgrade	0	0%
$-1,00 \leq$ N-gain $< 0,00$	There was a decline	0	0%

Furthermore, through the analysis of an n-gain effectiveness with regard to experimental class I and experiment II, it shows that the idea of learning by exploration, which is supported by pop-up book model is more effective to use than the CORE model assisted by a pop-up book. The discovery learning model assisted by pop-up books is more able to improve students' capability of comprehending mathematical ideas and concepts because such model has higher effectiveness value, with an average value of percentages that was attained by this preliminary experimental class I, which is 65.6% when interpreted, it is at a moderate interpretation. effective. Whereas the results of the CORE model assisted by the pop-up book get an average percentage value of 36.6% if interpreted too, it is in an ineffective interpretation. So, it can be concluded that the discovery learning model assisted by the pop-up book carried out in experimental class I was more effective in increasing the ability to understand mathematical concepts of class VIII students compared to the CORE learning model assisted by a pop-up book.

Furthermore, the median n-gain results from each of the two classes were utilized to provide the independent sample t-test. Before the procedure of a t-test with an independent sample has been carried away, the normality and homogeneity of variance tests were first carried out as prerequisite tests. The finding of the outcome regarding the normality of the test conducted with the Kolmogorov-Smirnov method are displayed in table 3:

Table 3. Normality Test Results with N-Gain Score

Tests of Normality

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

*. It represents the minimum value that reflects actual significance.

a. A Revision Regarding Lilliefors' significance

Table 3 presents 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 a conclusion that may be drawn is that n-gain scores in both classes I and II of the test results follow a normal distribution. Furthermore, The outputs regarding the homogeneity of variable test, which was performed using a Levene examination, are presented in table 4 next to it:

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

Test of Homogeneity of Variance

		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

Taking a look at Table 4, it is clear that the "Based on Mean" section the significant value was 0.589 where ≥ 0.05 therefore, it may be inferred in which the n-gain scores of the two classes are homogeneous.

After fulfilling the prerequisite test, then a t-test of two free samples was carried out. The individual experiment t-test is used to ascertain the disparity between both mean values of the independent sample t-test (Karunia Eka Lestari, 2015). The present research aims to figure out comparison of students' proficiency in comprehending concepts related to mathematics using different learning models in the two experimental classes. The significance level limit uses 5% with the assumption that if the test results are <0.005. Therefore, H0 gets disapproved while H1 is approved. The findings based on the independent sample t-test are as follows:

Table 1. **Independent Samples t-Test**

		Levene's Test for Equality of Variances		t-test for Equality of Means						
							Mean Differenc e	Std. Error Differenc e	95% Confidence Interval of the Difference	
		F	Sig.	T	Df	Sig. (2-tailed)			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

Based on Table 5, in the equal variances assumed and equal variances not assumed sections, there are two significance values, namely 0.000, which in this study uses the equal variances assumed significance value because in the test for homogeneity It has been established shown the data various kinds are consistent with one another. So, it can be concluded that the significance value is 0.000 <0.05 As a result, H1 is given approval while H0 is disapproved of. It is possible to inferred that there exists an obvious distinction between the two. 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.

DISCUSSION

According to the findings of the information study, information were obtained that the ability to understand mathematical concepts in class VIII D and VIII E MTs N 1 Purbalingga after the application of the discovery learning and CORE learning models assisted by pop-up books had increased. It is clear that the mean n-gain score in the experimental class I during

learning was 0.656 while the mean n-gain result of experimental class II is during learning was 0.366. Based on the outputs according to n-gain interpretation, clearly demonstrate the fact that discovery learning model assisted by the pop-up book is quite successful with an average percentage value obtained of 65.6%. While the CORE learning model assisted by a pop-up book is in an ineffective interpretation has a median percentage value obtained of 36.6%.

According to analysis use the independent sample t-test, it shows clearly significant difference is shown among both of them. This can be seen from calculations using the SPSS Statistics 23 application, the output resulted in independent sample t-test get a significance of 0.000 who is considered to be less than the significant limit of 0.05, then H_0 is not accepted and H_1 is accepted. So it would be stated that there is a obvious distinstion between the ability to understand mathematical concepts of students who use the discovery learning model assisted by the pop-up book and CORE learning model assisted by a pop-up book on polyhedron material.

The discovery learning model assisted by pop-up books is superior to CORE, because in the discovery learning process students can explore much more of their 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.

This is corresponding to the findings of a study that carried out by Risa Mulyanto, where claimed of the mathematics solution-seeking skills among learners who acquired the CORE learning model were not stronger to the mathematical problem-solving abilities of students whose acquired the discovery learning model. (Putri & Eliarti, 2017). This study aligns with Martucillia's research, which identified that students in class VIII at SMP Negeri 3 Bengkulu City achieved better results in learning mathematics on polyhedron material through the discovery learning model compared to the expository approach. (Martucilia, 2022). And this research corresponds to Nurul Nadia Adha's study that confirms there are differences between the CORE (Connecting, Organizing, Reflecting, Extending) and reciprocal teaching learning models on the reasoning and connection abilities of class VII students of SMPN 1 Tanjung Morawa (Adha, 2019).

CONCLUSION AND SUGGESTIONS

As stated in the findings from the investigation as well as examination that conducted, a conclusion exists to be drawn there represents a huge disparity in the comprehension of mathematical topics among students that implement 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, outcomes concerning the study 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.

In future research, researchers can explore utilization of discovery acquiring knowledge through applying it of other learning media or in combination with digital technology. This can open opportunities to develop learning strategies that are more innovative and successful in terms of enhancing their comprehenstion of mathematical concepts. Also for future researchers who wish to continue research with the same learning model, it is recommended to pay close

attention to all the limitations in this study. Thus the research results obtained will be much more.

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