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Comparison of CORE and PBL Learning Models Based on Students' Mathematics Learning Outcomes

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Abstract

This study aims to determine (1) students' mathematics learning outcomes in the Connecting, Organizing, Reflecting, and Extending (CORE) model, (2) students' mathematics learning outcomes in the problem-based learning model (PBL), (3) comparison of the effectiveness of the learning model CORE and PBL based on learning outcomes. The type of this research is experimental research. Samples were taken using random cluster sampling in class IX students of SMP Negeri 03 Poleang. The results obtained are class $IX._A$ with 20 students as the class utilizing the CORE model and class IX_B with 21 students as the class using the PBL model. Data retrieval is done through a test technique to obtain data on students' mathematics learning outcomes. The research data were analyzed using descriptive and inferential statistical methods. The average value of students' mathematics learning outcomes in the CORE model is 83.9, while the value of PBL class mathematics learning outcomes is 77.3. Inferentially, hypothesis testing using t-test obtained $t_{count} = 2.743 > t_{table} = 1.685$ with a significant level = 0.05, indicating a significant difference in mathematics learning outcomes between students taught by the CORE and PBL learning models. Thus, applying the CORE learning model is more effective than applying the PBL model in terms of students' mathematics learning outcomes.

Keywords: CORE, problem-based learning, Learning outcomes

A. Introduction

Mathematics is a science that has a vital position in human life and knowledge development. Mathematics has a role in preparing and forming human resources who have analytical skills, interpersonal skills, skills in activities, and manage information and developing situations. This competency will provide a role for students in socializing in social life (Yudha, 2019).

Knowledge, attitudes, and skills will be formed through mathematics based on logical truths (Farman et al., 2019). Mathematics needs to be studied from the most basic level of education to a higher level. This is because mathematics is another source of knowledge. In other words, many sciences and their development are related to mathematics, so mathematics is helpful as a basic science for application in different fields (Sholihah & Mahmudi, 2015).

However, the fact is that mathematics is still a subject that students do not like. Apart from that, some mathematical objects are abstract. Also caused by notation and the use of mathematical language that is not understood. Students assume that mathematics is too much to count, so mathematical material is challenging to grasp, difficult for students to understand, and feels boring. Low interest in mathematics makes it difficult for students to solve mathematics-related problems. In addition to interest, several things that cause learning to feel bored are mathematics learning which only focuses on conventional learning methods, approaches, and models and does not stimulate student activities to participate actively (Farman & Yusryanto, 2018; Saparwadi, 2016). The teacher's learning is still a teacher center where the teacher is actively involved and dominates, so students have a minor role in learning. This causes the achievement of learning outcomes in mathematics subjects to be relatively low (Nurdianti et al., 2021).

Based on interviews with teachers of mathematics class IX conducted at SMP Negeri 03 Poleang. It is known that the daily test scores of students have not been able to reach the minimum standard of completeness of 73. The proportion of students who get the measure of fullness is only 26% of students. This is due to the lack of student interest in learning mathematics, and learning takes place in the classroom, the teacher still uses learning with a traditional approach. Thus, in carrying out the teaching and learning process, teachers generally use conventional learning models, which lead to lecture, discussion, question and answer methods, and practice questions. The teacher presented the material as effectively as possible during the learning process, but most students were silent. Even when the teacher asked questions regarding the material that had been explained, many students were unable to explain it well, and not all students were active in doing assignments. Some activities showed a lack of enthusiasm for students in learning.

Based on this phenomenon, it is necessary to have a learning model that can facilitate students actively learning to provide understanding to students in solving learning problems in mathematics. In addition, the learning model can attract students' attention during the learning process, placing students as active, creative, and critical individuals (Samura, 2019). The selection of learning models is vital in achieving the success of learning objectives. Learning with various methods can help achieve maximum results from the diversity and characteristics of students (Farman et al., 2021). Therefore, various models, methods, strategies, approaches, and learning techniques must be chosen and designed carefully so that students can learn with full attention, enthusiasm, fun, and not dullness. Students do not just memorize information but remember and store various data and implement it as much as possible. Implementing the information provided leads to understanding the material and learning outcomes of students' mathematics (Farman & Chairuddin, 2020). Cooperative learning is a learning model that is expected to develop independent learning skills. The application of cooperative learning models in teaching and learning activities as a learning model to increase the role of students in active learning, creative, and critical thinking so that students have good learning outcomes.

The cooperative learning model is not only able to develop academic abilities but can also develop non-academic abilities such as group discussion and collaboration. One cooperative learning model that provides an active learning atmosphere is CORE. The CORE model is a cooperative learning model whose steps consist of Connecting, Organizing, Reflecting, and Extending (Yunida & Noer, 2016). The CORE model can encourage and direct students to be more active in learning and allow students to reflect on their knowledge so that the material studied can be understood well and interact socially with their group friends (Wijayanti, 2012). The activities carried out in the CORE learning model by Shoimin are described as follows: (1) Starting learning with activities that attract students, namely by giving a game. (2) Connecting, namely the delivery of material by connecting concepts that students have studied with new concepts. (3) Organizing, namely, students organize ideas to understand the material provided and under the teacher's guidance. (4) The heterogeneous group division consists of 4-5 students. (5) Reflecting, namely reflecting by digging back into the information that has been obtained to be discussed in student group learning activities. (6) Extending, namely developing and expanding the given concept through individual task work (Azizah et al., 2012).

Several studies have shown that the CORE learning model positively influences learning. Research conducted by Kasmita et al. (2021) states that there is a significant interaction effect of the CORE Model with critical thinking skills on mathematics learning outcomes. Rasmita et al. (2020) concludes that the CORE learning model affects student learning outcomes in solving HOTS questions in class XI students. Nuri (2021) concluded that the mathematical reasoning ability of students who studied with the CORE learning model was better than conventional learning. Siregar et al. (2018) revealed that the critical thinking ability and mathematical disposition of students who received the treatment of the CORE learning model were overall higher than students who received the treatment of the direct learning model. Research by Ulfa et al. (2019) states differences in mathematical problem-solving skills between students who are taught with the CORE learning model and students who are trained using conventional learning. Research by Azizah et al. (2012) concluded that the CORE learning model is effective in learning where 87.5% of students achieve the minimum completeness criteria of 70 and the average grade of the class is 73.

The CORE learning model is very well applied in the learning process that prioritizes collaboration between students and arouses student interest so that students can explore the materials presented by the teacher to achieve learning objectives (Widiyanti, 2012). The learning process in the CORE learning model provides space for students to be able to build their own knowledge, create and present their ideas to their friends (Loka et al., 2020).

This research aims to (1) determine the mathematics learning outcomes of students taught by the Connecting, Organizing, Reflecting, and Extending (CORE) learning model for class IX students, (2) determine the mathematics learning outcomes of students taught using the PBL model of class IX students, and (3) compare the effectiveness of the learning model CORE and PBL based on learning outcomes.

B. Methodology

1. Research Design

This study is a true experimental study involving one class using the CORE model and one class using the PBL model. This design uses two randomly selected classes. The class given the treatment was called the experimental class (CORE), and the other was the experimental class (PBL). The research design is described as follows.

R	X_1	O_1
R	X_2	O_2

Description: R = Random
X_1 = treatment using the CORE learning model
X_2 = treatment using the PBL learning model
O_1 = CORE learning post-test score
O_2 = PBL learning post-test score

2. Populasi dan Sampel

The population in this study was all class IX students in the odd semester of the 2019/2020 academic year, consisting of three classes, namely $IX._A$ (20 student) $IX._B$ (20 student), and $IX._C$ (20 student) totaled 61 students. The sample of this research was selected by random cluster sampling. Cluster random sampling is sampling by taking three classes randomly to determine the experimental class, namely the class that received the CORE learning model, and the control class, namely the class that received the PBL model. The homogeneity of variance test was first carried out using Levene to determine the sample in this study. Statistics show that the variances of the three classes are the same or homogeneous, meaning that students have relatively the same abilities in these classes. After doing this randomly, two classes were selected, namely class $IX._A$ is the class that uses the CORE, and class IX_B as a class using the PBL model.

3. Instruments

The research data was collected using a learning outcomes test instrument consisting of 7 questions in the form of a description. Before the instrument was used, it was first tested to determine if the test's quality was good (Farman, Anjelina, et al., 2021). A good test must have validity, reliability, difficulty level, and distinguishing power (Arikunto, 2012). The formula used to determine the validity of the instrument concept through a trial test is the Product Moment Correlation Coefficient ($r_{xy)}$ from Pearson. The test criteria are if the probability value (sign.) is less than 0.05 or if $r_{xy} > r_{table}$, then the item is valid. The instrument reliability coefficient was determined using the Cronbach-Alpha formula (r_{11}). The interpretation of the test reliability coefficients used is as shown in Table 1 below:

Table 1. Interpretation of the Reliability Coefficient

Coefficient	Interpretation
$0{,}8 < r_{11} \leq 1{,}0$	Very high
$0{,}6 < r_{11} \leq 0{,}8$	High
$0{,}4 < r_{11} \leq 0{,}6$	Enough
$0{,}2 < r_{11} \leq 0{,}4$	Low
$0{,}0 < r_{11} \leq 0{,}2$	Very low

The difficulty index (DI) is between 0.00 and 1.0. The formula for finding the DI value is:

$$DI = \frac{Mean}{Maximum\ score}$$

The difficulty index is often classified as in Table 2 below:

Table 2. Interpretation of Coefficient Level

Coefficient	Interpretation
0.00 - 0.30	Difficult
0.31 - 0.70	Moderate
0.71 - 1.00	Easy

To find out the discriminatory power of questions for description questions, use the following formula:

$$D = \frac{upper\ group\ mean - bottom\ group\ mean}{maximum\ score}$$

Distinguishing power is classified in Table 3 below:

Table 3. Interpretation of the Distinguishing Power Coefficient

Coefficient	Interpretation
$0.00 \leq D < 0.20$	Poor
$0.20 \leq D < 0.40$	Enough
$0.40 \leq D < 0.70$	Good
$0.70 \leq D \leq 1.00$	Very good

Mathematics learning outcomes test is given after using the learning model in each class that has been selected. The analytical technique used is descriptive analysis and inferential analysis. Descriptive analysis describes research data in the form of the lowest value, highest value, mean (mean), standard deviation, and variance.

The learning outcomes of each student are adjusted to the categories listed in the assessment guide by educators and education units (Kue et al., 2022). The category of student learning outcomes refers in Table 4

Table 4. Category Student Learning Outcomes

Score	Category
$86 \leq S \leq 100$	Very High
$76 \leq S < 86$	High

$60 \leq S < 76$	Medium
$55 \leq S < 60$	Low
< 55	Very low

Inferential analysis was used to test the research hypothesis by independent t-test. Before testing the difference test, a prerequisite test was carried out in a normality and a homogeneity test.

C. Findings and Discussion

1. Findings

The results of the analysis of the instrument's validity level trial are shown in Table 5 below.

Table 5. Results of the Validity Test

No	r_{xy}	r_{count}	r_{table}	Decision
1	-0.120	-0.120	0.3202	Invalid
2	0.539	0.539	0.3202	Valid
3	0.528	0.528	0.3202	Valid
4	0.223	0.223	0.3202	Invalid
5	0.426	0.426	0.3202	Valid
6	0.021	0.021	0.3202	Invalid
7	0.717	0.717	0.3202	Valid

In Table 5, it can be seen that the four valid mathematics learning outcomes test items are numbered 2, 3, 5, and 7; the items declared invalid are numbers 1, 4, and 6. Thus, four questions can be used as an instrument for students' mathematics learning outcomes. In comparison, the reliability test results obtained the value of Cronbach's Alpha = 0.512. This means that the reliability of this test is included in the medium category. Thus, all the instruments tested on students meet the criteria, meaning that the instrument can be used as a measuring tool to measure mathematics learning outcomes.

The results of the analysis of the level of difficulty of the post-test questions for students' mathematics learning outcomes are presented in Table 6 below.

Table 6. Results of the Analysis of the Difficulty of Items

No	Difficulty Level	Information
2	0.83	Easy
3	0.7 4	Easy
5	0.8 4	Easy
7	0.03	Difficult

Based on Table 6 from the analysis of the level of difficulty of the post-test items for student learning outcomes, it can be seen that there are easy and complex interpretations of these items from the valid questions.

Table 7. Results of the Distinguishing Power of Questions

No.	D	Information
2	0.29	Enough
3	0.37	Enough
4	0.35	Enough
7	0.34	Enough

Based on Table 7 from the results of the analysis of the discriminatory power of the post-test questions, students' mathematics learning outcomes show that there is sufficient interpretation of the items from the valid questions.

The comparison of the CORE learning model and problem-based learning model based on mathematics learning outcomes are presented in Table 8 below.

Table 8. Results of Descriptive Analysis of Students' Mathematics Learning Outcomes

Class	N	Min	Max	mean	Standard deviation	variance
CORE	20	59.6	100	83.9	9.07	82.3
PBL	21	61.5	88.5	77.3	6.27	39.4

The descriptive analysis shows that the mean value of mathematics learning outcomes of students taught with the CORE learning model is 83.9. In contrast, the average mathematics learning outcome of students with a problem-based learning model is 77.3. This shows that the average mathematics learning outcomes of students taught with the CORE model are better than those taught using a problem-based learning model.

Inferential analysis tests the differences in students' mathematics learning outcomes applied to the CORE and PBL learning models. Previously, the analysis requirements test was conducted in normality and homogeneity tests. The normality test of the data was carried out using the Kolmogorov-Smirnov test, which showed that the data were normally distributed. The homogeneity test of variance used the F test. Meanwhile, the F-test's homogeneity test results obtained F value = 2.091, at a significant level = 0.05, and F table $_=$ 5.155. Because F_{count} = 2.091 <F_{table} = 5.155, it can be concluded that the data variance of the experimental and control class students' mathematics learning outcomes test data variance is homogeneous.

The statistical test used to test the two groups in this study used the t-test. The statistical test used to test the two groups in this study used the t-test. The test results obtained the value of $t_{arithmetic}$ = 2.743 < t_{table} = 1.685, which means it can be concluded that the mathematics learning outcomes of students taught by the CORE model are more effective than the PBL model in class IX students of SMP Negeri 03 Poleang.

2. *Discussion*

Students' mathematics learning outcomes in the CORE learning model have the lowest score of 53.3, the highest score of 100, the average value of 83, 9 (high category), the standard deviation of 9.07, and a variance of 82.30. Meanwhile, students' mathematics learning outcomes with the problem-based learning model have the lowest score of 61.5, the highest score of 88.5, the average value of 77.3 (medium category), the standard deviation of 6.27, and the variance of 39.36. This means that students' mathematics learning outcomes with the CORE learning model are higher than those with the PBL model. The average difference in students' mathematics learning outcomes is presented in Figure 1 below.

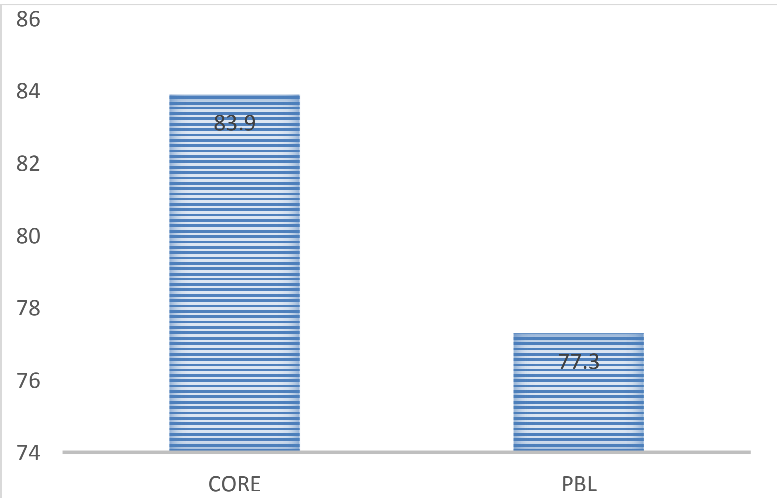

Figure 1. The Average Score of Students' Mathematics Learning Outcomes

Hypothesis testing with t-test for db = 39 at significant level = 0.05 obtained t value = 2.743 > t_{table} = 1.685 so that the hypothesis is rejected. Inferentially, there is a significant difference between the CORE and PBL learning models. This difference is because, in the CORE class, students are allowed to provide feedback on their knowledge so that students can know better about the material that has been studied. While in the PBL class, students are required to find theory or problem solving, so students who are slow in understanding the material will have difficulty solving problems. As Rasmita et al. (2020) states, in the CORE learning model, students build their knowledge so that the knowledge gained can be understood by students and lasts longer and their memories without having to memorize them. While in PBL, students try to solve real problems and formulate their own, the teacher continues to guide students with a system of encouraging them to ask questions (Chairuddin & Farman, 2019).

In achieving learning effectiveness, both CORE and PBL learning models are effective for use in teaching materials for powers and roots. However, students' mathematics learning outcomes in the CORE learning model are higher than in PBL. This means that applying the CORE learning model is more effective than using the PBL model regarding students' mathematics learning outcomes. This is in line with the research proposed by Wicaksana et al. (2014) and Trisnowali & Aswina (2019) that applying the CORE learning model influences mathematics learning outcomes.

D. Conclusion

CORE and PBL learning models are effectively applied in mathematics learning. The average students' mathematics learning outcomes in applying the CORE learning model was 83,9 (high category). In comparison, the average student learning outcomes in the PBL model are 77.3 (medium category). Compared to the two, the CORE learning model is more effective than the PBL model based on the mathematics learning outcomes of class IX students at SMP Negeri 03 Poleang. Thus, teachers and researchers need to apply and develop the CORE learning model to improve students' mathematics learning outcomes or improve other hard skills and soft skills in learning mathematics.

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