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The Effect of Connected Mathematics Project Model and Learning Cycle 5e Model on Mathematics Learning Outcomes

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Abstract
This research is motivated by real problems, namely that there are still many students who get low math learning outcomes because they use learning models that are not in accordance with student needs. This study aims: 1) to determine the mathematics learning outcomes in classes that apply the CMP learning model, 2) to determine the mathematics learning outcomes in classes that apply the LC5E learning model, 3) to determine the effect of the difference in mathematics learning outcomes between classes that apply the CMP learning model and classes that apply the LC5E learning model at SMA Negeri 109 Jakarta academic year 2023/2024. This research used a quantitative approach with the Quasi Experimental Design method. The sample consisted of two XI classes taken randomly, with the experimental class applying the CMP model and the control class applying the LC5E model, each totalling 40 students. The results showed that there was a different effect of math learning outcomes between the two learning models. The average math learning outcomes in the experimental class (CMP) reached 88,90, while in the control class (LC5E) the average was 82,63. Hypothesis testing using the Independent Samples T-Test test shows a Sig. value of $0.032 (< 0.05)$, which means there is a different effect between the learning outcomes of the two groups. Therefore, the CMP learning model is more effective in improving students' mathematics learning outcomes than the LC5E model, especially if the instrument used is Higher Order Thinking Skill (HOTS) questions.

Keywords: mathematics learning outcomes, CMP model, LC5e model, Hots questions

INTRODUCTION

Mathematics is an integrated subject in the education curriculum in Indonesia. Mathematics takes a very important role in the developments of science (Asrar et al., 2023). Math is synonymous with calculation and reasoning (Megawati & Megawanti, 2022). Mathematics can increase students' intellectual power, strengthen students' ability to solve a problem, and train students to channel an idea based on the knowledge that students have. Mathematics trains students to get used to thinking systematically.

Learning mathematics is very important for students, therefore students are expected to pursue mathematics well in order to obtain satisfactory mathematics learning outcomes. In fact, there are still many students who get low math learning outcomes, this is because the students used a conventional learning model. Along with the research results by Kresma (2014), students use conventional learning models when learning only focuses a teacher who explains lessons in front of class and there are no other activities that make students active, causing students to be bored during math learning (Kresma, 2014). In addition, conventional learning models can also result in weak student understanding of the material because the learning process is only dominated by the teacher (Palinussa, 2020).

Efforts are made to get rid of student boredom when learning mathematics, namely the need for a varied learning model that can support students to obtain satisfactory mathematics learning outcomes. In Permendikbud No. 22/2016, it's explained that teachers must find the right learning model to improve the efficiency and effectiveness of achieving students' graduation competencies. In addition, learning should be done in a way that students interact with each other, transmit positive energy, be exciting, challenging, effective, and encourage students to be actively involved, and allow enough room for initiative, inventiveness, and independence based on students' talents, desires, personal development and psychology. In connection with this, a student centered learning model is needed. The CMP model and LC5E model are very appropriate, because both require students to be actively involved in each stage.

The CMP model encourages students to work on math-related project (Sari et al., 2020). The main purpose of the CMP model is to support students to develop mathematical knowledge, understanding, and skills, as well as an awareness and appreciation of the enrichment of relationships between parts of mathematics and between mathematics and other disciplines (Harahap, 2020). So that students can more actively develop their ability to be able to discuss mathematical knowledge represented by graphs, numbers, or other mathematical forms fluently. The CMP model was developed by the University of Michigan to integrate mathematical ideas into real-life contexts for students to better understand learning (Wardhani, 2015). While the LC5E model encourages students to design their knowledge and experience by reviewing the material that has been given, which is then discussed with their group mates (Aditya et al., 2019). The LC5E model is designed so that students can master all learning achievements by being actively involved (Shofiah et al., 2018). Therefore, it is expected that these two learning models can help students obtain satisfactory mathematics learning outcomes.

In order to overcome low mathematics learning outcomes due to teacher-centered learning models, researchers are encouraged to conduct a study entitled "The Effect of CMP Model and LC5E Model on Mathematics Learning Outcomes" where this model focuses on students. This research will be conducted at SMA Negeri 109 Jakarta on circle material. This study aims: 1) to determine the mathematics learning outcomes in classes

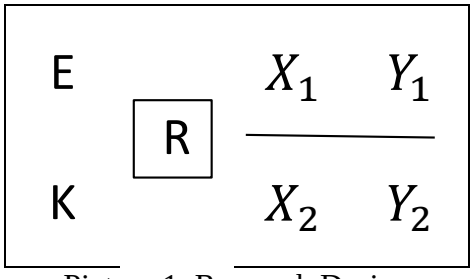
that apply the CMP learning model, 2) to determine the mathematics learning outcomes in classes that apply the LC5E learning model, 3) to determine the effect of the difference in mathematics learning outcomes between classes that apply the CMP learning model and classes that apply the LC5E learning model.

This research is hopefully able to benefit significantly for many parties. For students, this research is expected to increase comprehension of mathematical concepts and enthusiasm for learning (stated in Permendikbud No. 22/2016). For teachers, this research allows them to increase the variety of learning models and improve teaching skills by studying the research results obtained. This can make the learning process more interesting for students and teachers can gain new insights into the effectiveness of using both learning models. For schools, this research can improve the quality of mathematics learning, which positively affects students' math learning outcomes as well as school reputation. In addition, this research could help schools in adopting the right learning model to increase students' academic achievement in mathematics. For researchers and future researchers, this research can add insight and knowledge about the steps to obtain math learning outcomes using these two learning models. This research can also help the development of effective and innovative learning models in mathematics lessons, as well as contribute knowledge about the effect of these two learning models on mathematics learning outcomes, which can be the basis for further research. Thus, this research has broad implications and can help increase the future quality of mathematics education.

METHOD

This research was a type of classroom experiment. The research method used the Quasi Experimental Design method with a Quantitative approach. In the Quasi Experimental Design method, it had a characteristic that how to determine the class that would be used as the experimental class and the control class was done randomly, then the class used had to be equivalent (Isnawan et al., 2020). According to Isnawan (2020), the characteristics of the two classes used had to be the same to ensure that the initial conditions of the students were the same and the improvement of students' abilities was indeed caused by the application of the learning model applied, not because the initial conditions of the students were already different.

In this research design, observations were first made to see the summative test results of students so that two homogeneous classes would be obtained. Furthermore, the two classes were treated with different learning model actions. The experimental class was treated with the CMP model action while the control class was treated with the LC5E model action. When the discussion of the circle material has been completed, the math learning outcomes will be measured in both classes by giving a 9 question description test. The resulting math learning outcomes of the two classes were compared to see the statistical hypothesis.



Picture 1. Research Design

Description:
E : Experiment class
K : Control class
R : Random
X_1 : Class treated with CMP model action
X_2 : Class treated with LC5E model action
Y_1 : Results of studying mathematics with the CMP model treatment
Y_2 : Results of studying mathematics with the LC5E model treatment

The population reached by the study is class XI students of SMA Negeri 109 Jakarta in the 2023/2024 academic year. Sampling using the Cluster Random Sampling technique, it was found that the class to be used as research was class XI - 5 (experimental class) and class XI - 6 (control class), with a sample of 40 students for each class. The instrument used is an open-ended description test (Extended Response Question) type of Higher Order Thinking Skill (HOTS) questions. The instrument are validity and reliability tested.

This study used descriptive and inferential statistical data analysis techniques, where the results of these descriptive statistics can facilitate readers in knowing data information related to math learning outcomes. While inferential statistics are useful for drawing conclusions from hypotheses that have been formulated (Thelessy et al., 2022). Normality test, homogeneity test, and hypothesis testing are tests contained in inferential statistics.

FINDINGS AND DISCUSSION

Data before treatment is data obtained before students are given treatment with different learning model actions. In this study, the pre-treatment data is the summative test results of students on the inverse function and function composition material.

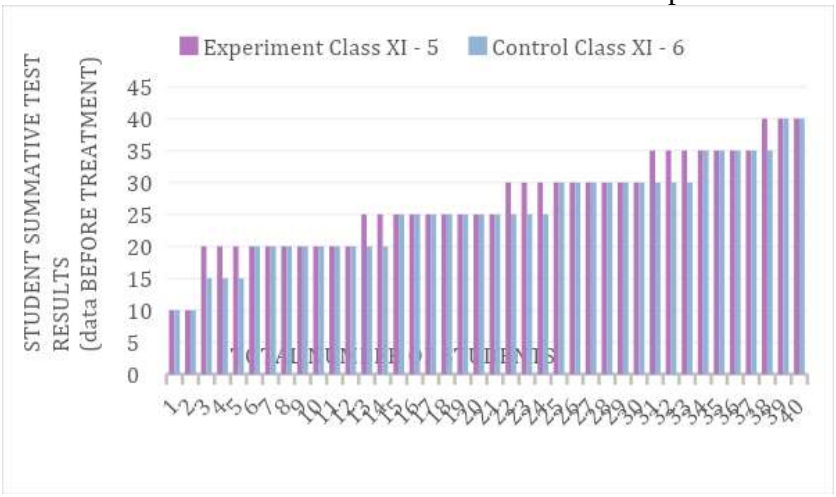


Diagram 1. Data before Treatment in Experimental and Control Classes

Based on Diagram 1, the data before treatment in both classes have the same maximum value and minimum value, namely the maximum value is 40 and the minimum value is 10. As for what distinguishes the data of the two classes, the average value of the experimental class is 27 while the average value of the control class is 25,5. For the statistical test results of the two classes using SPSS as follows.

Table 1. Data before Treatment of Experiment Class and Control Class

Class	Maximum Value	Minimum Value	Mean	Std. Deviation	Variance
Experiment XI – 5	40	10	27,00	7,408	54,872
Control XI – 6	40	10	25,50	7,408	54,872

Data after treatment is data obtained after students are given treatment with different learning model actions. In this study, the data after treatment is the math learning outcomes.

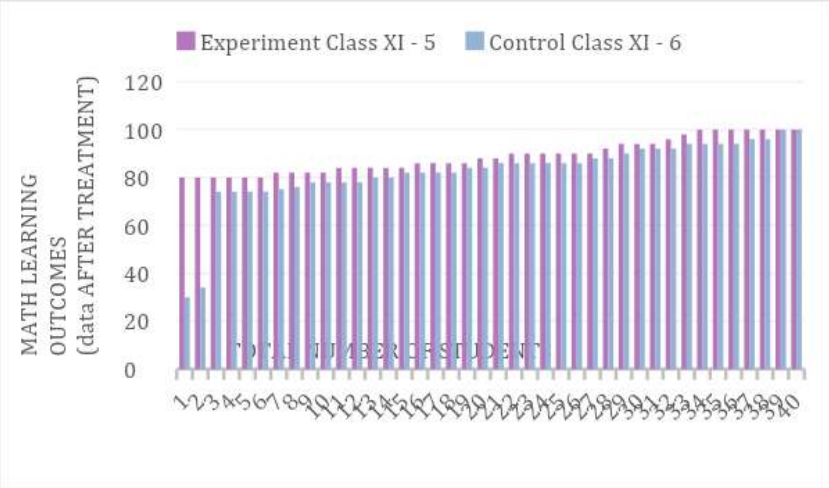


Diagram 2. Mathematics Learning Outcomes of Experimental and Control Classes

From Diagram 2, the math learning outcomes in both classes show a significant difference. In the experimental class, the maximum value is 100 and the minimum value is 80, while in the control class the maximum value is 100 and the minimum value is 30. The average value of the experimental class is 88,90 while the average value of the control class is 82,63. For the statistical test results of the two classes using SPSS as follows.

Table 2. Mathematics Learning Outcomes of Experiment Class and Control Class

Class	Maximum Value	Minimum Value	Mean	Std. Deviation	Variance
Experiment XI – 5	100	80	88,90	7,001	49,015
Control XI – 6	100	30	82,63	13,924	193,881

Validity Testing and Reliability Calculation

Before being used as an instrument in the study of learning outcomes of both classes, validity and reliability tests were conducted first. The validity test in this study was carried out by two experts, and then carried out on students who were different from the research school. The goal is that the instrument is not biased. Expert validation is carried out to measure the feasibility of the content on the research instrument to be used (Putri et al., 2023). In this case, experts provide opinions and suggestions for improvement to researchers to ensure that the instruments used are in accordance with the quality of the material and the objectives to be achieved. Meanwhile, student validation is carried out to measure how accurate the instrument used is (Puspita & Tirtoni, 2023).

Validity testing uses The Pearson product-moment correlation coefficient test technique, while the calculation of reliability uses the Cronbach Alpha test technique. The first step to find out the description test questions used are valid, first determine the r_{tabel} value. According to the book compiled by Darma (2021), the $N-2$ formula is used to determine the r_{tabel} value in the df column, where N is the number of answers (Darma, 2021). Thus, the value of $r_{tabel} = 0{,}2913$ is obtained with $N = 33$. From the validity test results, 9 out of 12 question items were valid because $r_{count} > r_{tabel}$. Meanwhile, according to the Guilford Criteria, there are five levels of qualification in the reliability test results, including very high reliability $(> 0{,}90)$, high reliability $(0{,}71 - 0{,}90)$, moderately high reliability $(0{,}41 - 0{,}70)$, low reliability $(0{,}21 - 0{,}40)$, and very low reliability $(< 0{,}21)$ (Parinata & Puspaningtyas, 2021).From the results of the calculation of the reliability of the 9 question items, the Cronbach's Alpha value is 0,724. These results state that the description test questions used are reliable with a high level of reliability. So, it can be concluded that there are 9 out of 12 question items that are declared significant regarding the correlation between the questions used.

Normality Test

This test uses the Kolmogorov Smirnov test technique, which aims to determine whether the data used in the study is normally distributed or not. This test was conducted on data before treatment and math learning outcomes. For the results of the calculation of the normality test of data before treatment of both classes using SPSS as follows.

Table 3. Sig Value. Kolmogorov Smirnov Normality Test of Data before Treatment of Experiment Class and Control Class

Class	Sig.	α	Description
Experiment XI – 5	0,076	0,05	Normally distributed
Control XI – 6	0,096	0,05	Normally distributed

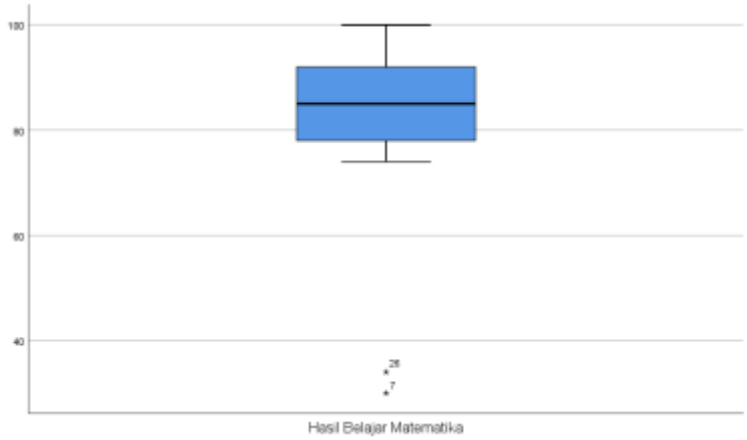
Based on Table 3, normality test of data before treatment of experimental class found Sig. Kolmogorov Smirnov value $> 0{,}05$ which is 0,076, while the data normality test before the control class treatment found the Sig. Kolmogorov Smirnov value $> 0{,}05$ which is 0,096. So it can be stated that the data before the treatment of both classes is normally distributed. Furthermore, the results of the calculation of the normality test of the learning outcomes of the two classes using SPSS are as follows.

Table 4. Sig Value. Kolmogorov Smirnov Normality Test of Mathematics Learning Outcomes of Experiment Class and Control Class

Class	Sig.	α	Description
Experiment XI – 5	0,062	0,05	Normally distributed
Control XI – 6	0,000	0,05	Not Normally distributed

From Table 4, normality test of math learning outcomes of experimental class found Sig value. Kolmogorov Smirnov value $> 0{,}05$ which is 0,062, while the normality test of the control class math learning outcomes found the Sig value. Kolmogorov Smirnov value $< 0{,}05$ which is 0,000. So it can be stated that the experimental class math learning outcomes are normally distributed, while the control class data is not normally distributed.

In order for the data in the control class to be normally distributed, it can be done by removing outlier data, then doing the normality test again (Sakundari & Rizqi, 2024). According to Hawkins (1980) in research conducted by Sihombing et al., (2023), data outliers are reviews that deviate significantly from other reviews (Sihombing et al., 2023). Outlier checking is done using the Outlier Boxplot technique. The results of checking boxplot outliers on the control class math learning outcomes data using SPSS are as follows.



Picture 2. Outlier Boxplot Output Results of Control Class Mathematics Learning Outcomes Data

From Picture 2, the output results show that there are outlier data on the 7th and 26th data. After disposing of outlier data, it is concluded that the number of samples in the control class math learning outcomes data from 40 to 38 students. Furthermore, the normality test will be carried out again with a sample of 38 students. For the results of the normality test calculation after removing outlier data on the math learning outcomes of the two classes using SPSS as follows.

Table 5. Sig Value. Kolmogorov Smirnov Normality Test of Mathematics Learning Outcomes of Experiment Class and Control Class after Removing Outlier Data

Class	**Sig.**	α	**Description**
Experiment XI – 5	0,062	0,05	Normally distributed
Control XI – 6	0,200	0,05	Normally distributed

From Table 5, normality test of math learning outcomes of experimental class found Sig. Kolmogorov Smirnov value $> 0{,}05$ which is 0,062, while the normality test of the control class learning outcomes found the Sig. Kolmogorov Smirnov value $> 0{,}05$ which is 0,200. So it can be stated that the math learning outcomes of both classes are normally distributed.

Homogeneity Test

This test uses the Levene Statistic test technique, which aims to determine whether the data used in the study is homogeneous or not. This test was conducted on data before treatment and math learning outcomes. For the results of the calculation of the homogeneity test of data before the treatment of the two classes using SPSS as follows.

Table 6. Sig Value. Levene Statistic Homogeneity Test of Data before Treatment of Experiment Class and Control Class

Levene Statistic	**df1**	**df2**	**Sig.**
0,069	1	78	0,794

From Table 6, homogenity test of data before treatment of both class found Sig. Levene Statistic value $> 0{,}05$ which is 0,794. So it can be stated that the data before the treatment of both classes is homogeneous.

Table 7. Sig Value. Levene Statistic Test of Homogeneity of Mathematics Learning Outcomes of Experiment Class and Control Class after Removing Outlier Data

Levene Statistic	**df1**	**df2**	**Sig.**
0,207	1	76	0,651

From Table 7, homogenity test of math learning outcomes of both class found Sig. Levene Statistic value $> 0{,}05$ which is 0,651. So it can be stated that the math learning outcomes of both classes are homogeneous.

Hypothesis Testing

This test uses the Independent Samples T-Test test technique, because the data used produces a normal and homogeneous distribution of data (Lestari & Sujati, 2023). The Independent Samples T-Test test aims to determine whether or not there is a different effect of math learning outcomes with the CMP model and the LC5E model. This test is carried out in order to solve the statistical hypothesis of the study.

For the results of the calculation of hypothesis testing of math learning outcomes with the CMP model and the LC5E model as follows.

Table 8. Sig Value. T-Test Hypothesis Testing of Mathematics Learning Outcomes with CMP Model and LC5E Model

	Sig.	α	**Description**
Mathematics Learning Outcomes	0,032	0,05	Accept H_1

From Table 8, hypothesis test of math learning outcomes of both class found Sig. T-Test value $< 0{,}05$ which is 0,032. So it can be stated that Accept H_1, that is there is a difference in the effect of mathematics learning outcomes with the CMP model and the LC5E model.

The statistical hypothesis in this study is a type of alternative hypothesis H_a, that is a hypothesis that states a different effect from the results of the study (Zaki & Saiman, 2021).

DISCUSSION

This study aims to determine the effect of CMP model and LC5E model on mathematics learning outcomes in class XI SMA Negeri 109 Jakarta. To find out whether or not there is a different effect of the math learning outcomes, first an observation is made to see the summative test results of students so that two homogeneous classes will be obtained. Furthermore, the two classes were treated with different learning model actions. The experimental class was treated with CMP model action while the control

class was treated with LC5E model action. And both are given the same material, namely the circle.

This study used two classes, which are experimental class XI – 5 and control class XI – 6. These two classes are given different learning models, namely the CMP model and the LC5E Model. Furthermore, the mathematics learning outcomes in both classes will be measured by giving a 9 question description test. The description test is a type of HOTS question.

This research was conducted for 5 meetings. Starting with the observation of student initial conditions, continued with the learning process for 4 meetings and ended with a description test to determine the mathematics learning outcomes of two different classes. The total lesson hours used in this study were 15 JP, with 1 JP lasting 40 minutes. Meanwhile, the instrument validity test was carried out 3 times, which included a validity test with two experts and a validity test with students which was carried out for 1 meeting at different schools.

In this study, using two learning models: CMP and LC5E. Each model has different stages, with CMP having three stages and LC5E having five stages. Although their stages are different, both have the same goal, which is to increase student participation in the learning process. Each stage in the learning model has a significant connection, so that students can learn actively and effectively.

Implementation of CMP Model

The launching problem stage is used to introduce the circle material as well as introduce the software (Geogebra) to students. In this stage, students are given problems or contextual situations involving circle material and students are invited to find solutions using relevant mathematical concepts and skills.

The exploring stage is used to help students understand the concept of circle material through direct experience and exploration. In this stage, students can explore the circle material with the help of software tools (for example: students conduct experiments by changing the variables, and observing the changes that occur in the graph), students investigate case regarding the material in the circle.

Summarizing stage is used to help students strengthen their understanding of the concept of circle material and identify what is still not mastered. In this stage, students can make conclusions from the results of discussions about the concept of circle material that has been learned, students do self-reflection on their understanding of the concept of circle material (identifying what is still not mastered for further planned understanding improvement), and students are given tasks or tests to measure students' understanding of the concept of circle material which then the results of this activity for evaluation in future learning.

Implementation of LC5E Model

The engagement stage is used to motivate students to be interested and have greater curiosity about the circle material. In this stage, teachers apply interesting strategies to arouse students' interest in circle material (for example: linking the concept of circle material with contextual situations or technology), giving questions to provoke students' curiosity, and utilizing technology to make learning more interactive.

The exploration stage is used to understand the concept of circle material in more detail and depth. In this stage, students are given the opportunity to work together in their

groups, where the activity is without any direct instruction from the teacher. To do scientific activities.

The explanation stage is used to develop a deep understanding of the circle material and connect it with students' prior knowledge. In this stage, students explain the concept of the circle material using their own sentences, and prove the truth and then discuss it together.

The elaboration stage is used to deepen students' understanding of the circle material and develop their skills in applying concepts in different situations. In this stage, students do further practicum activities and solve problems in each problem.

The evaluation stage is used to evaluate the students understanding of the circle concept. In this stage, students carry out exams or project assignments according to the teacher's instructions to measure student understanding, besides that it can also be with class or group discussions. While in this stage, the teacher also gives feedback to help students improve their understanding if they feel less mastered.

Effect of CMP Model and LC5E Model on Mathematics Learning Outcomes

To determine whether or not there is a different effect of mathematics learning outcomes with the CMP model and the LC5E model, data on mathematics learning outcomes were observed. Data on mathematics learning outcomes were obtained through mathematics learning outcomes tests from both classes. The results of data analysis obtained, that the average value with CMP model treatment (experimental class) is higher than the average value with LC5E model treatment (control class). Sig value. T - Test is $0{,}032$ ($< 0{,}05$), this indicates that in both models there is a different effect of math learning outcomes.

Results of this study in accordance with the results of earlier research implemented by Asmedy (2020) and Fauzi et al. (2021), which states a difference in learning outcomes of students treated with the CMP model and the Conventional model as well as that math learning outcomes with the CMP model are better than math learning outcomes with the Conventional model. Both discuss geometry material in class X. According to Asmedy (2020), the proof of the two hypotheses is caused by differences in the learning models used, teacher anticipation, and the role of students in dealing with obstacles that arise during the learning process. Students taught with the CMP model proved to be more active than students taught with the Conventional model, because the model focuses on students. This also shows that the initial ability of students before being given the treatment of learning models is not superior to those given the treatment of learning models (Fauzi et al., 2021).

Furthermore, research conducted by Tunikmah (2016), it is proven that the ability to build students' mathematical knowledge is optimally improved through the learning process with the CMP model. The application of the model allows students to share ideas, improve understanding of mathematical concepts, and students become creative because they can collaborate their abilities by using software.

CONCLUSION

This study aims: 1) to determine the mathematics learning outcomes in classes that apply the CMP learning model, 2) to determine the mathematics learning outcomes in classes that apply the LC5E learning model, 3) to determine the effect of the difference in mathematics learning outcomes between classes that apply the CMP learning model and classes that apply the LC5E learning model. From the data findings, the CMP model

obtained a greater average value than the LC5E model. Thus, the CMP model is recommended in improving mathematics learning outcomes, especially if the instrument used is HOTS questions.

The limitations of this study only explore math learning outcomes with circle material, so it is hoped that future researchers can explore and improve math learning outcomes on different materials and topics. And teachers are advised to select the right learning model according to the interests of their students. The positive effect of CMP learning on math learning outcomes shows that CMP is worth using as a guide for teachers for the teaching and learning experience in the classroom.

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