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THE EFFECT OF THE M-APOS (MODIFICATION-ACTION, PROCESS, OBJECT, SCHEMA) LEARNING MODEL ON THE ABILITY TO UNDERSTAND THE MATHEMATICAL CONCEPTS OF FIFTH GRADE STUDENTS AT SDN 3 PEMATANG TAHALO

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Abstrak
Penelitian ini dilatarbelakangi oleh masalah yang ditemukan peneliti di SDN 3 Pematang Tahalo, yaitu rendahnya kemampuan siswa dalam memahami konsep-konsep pada pembelajaran Matematika. Penelitian ini bertujuan untuk melihat pengaruh Model Pembelajaran M-APOS terhadap Kemampuan Memahami Konsep Matematika Siswa Kelas V di SDN 3 Pematang Tahalo. Penelitian ini adalah penelitian kuantitatif dengan populasi seluruh siswa kelas V di SDN 3 Pematang Tahalo. Jenis penelitian ini menggunakan eksperimen semu, desain penelitian Only Posttest Control Group Design, sehingga instrumen posttest akan diberikan kepada kelas kontrol dan kelas eksperimen. Penelitian ini dilaksanakan di SDN 3 Pematang Tahalo menggunakan teknik pengambilan sampel, yaitu teknik total sampling. Sampel penelitian ini terdiri dari dua kelompok kelas, yaitu kelas eksperimen yaitu kelas V A dan kelas kontrol yaitu kelas V B. Penelitian ini menggunakan teknik pengumpulan data berupa wawancara, tes uraian, dan dokumentasi. Berdasarkan analisis data yang telah dilakukan, hasil penelitian berdasarkan hasil perhitungan uji-t (Independent Samples T-Test) sesuai dengan keputusan teknik analisis data yang digunakan dalam penelitian ini dengan tingkat signifikansi 5% (0,05) pada nilai sig. (2-tailed) < 0,05 (0,016 < 0,05), dapat disimpulkan bahwa H0 ditolak dan H1 diterima dengan pernyataan bahwa terdapat pengaruh yang signifikan dari model pembelajaran M-APOS terhadap kemampuan pemahaman konsep matematika siswa kelas V di SDN 3 Pematang Tahalo.
Kata Kunci: Model Pembelajaran M-APOS, Pemahaman Konsep, Matematika

Abstract
This research is motivated by the problem found by researchers at SDN 3 Pematang Tahalo, namely the low ability of students in understanding concepts in Mathematics learning. This study aims to see the effect of the M-APOS Learning Model on the Ability to Understand Mathematical Concepts of Grade V Students at SDN 3 Pematang Tahalo. This research is a quantitative study with a population of all grade V students at SDN 3 Pematang Tahalo. This type of research uses a quasi-

experimental, Only Posttest Control Group Design research design, so that the posttest instrument will be given to the control class and the experimental class. This research was conducted at SDN 3 Pematang Tahalo using a sampling technique, namely the total sampling technique. The sample of this study consisted of two class groups, namely the experimental class, namely class V A and the control class, namely class V B. This study used data collection techniques in the form of interviews, essay tests, and documentation. Based on the data analysis that has been done, the results of the study based on the results of the t-test (Independent Samples T-Test) calculation are in accordance with the decision of the data analysis technique used in this study with a significance level of 5% (0.05) at a sig. value. (2-tailed) < 0.05 (0.016 < 0.05), it can be concluded that H0 is rejected and H1 is accepted with the statement that there is a significant influence of the M-APOS learning model on the mathematical concept understanding ability of fifth grade students at SDN 3 Pematang Tahalo.

Keywords: M-APOS Learning Model, Concept Understanding, Mathematics

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INTRODUCTION

Education has a very important role in human life, especially being able to make humans knowledgeable and able to carry out development in their lives as citizens. Education must be developed from various sciences, because quality education is seen from the successful application of these sciences so that it can show the intelligence of a nation. Education is also an investment in human resource development, where skills and abilities are important factors for humans to live their lives.

The importance of education requires humans to learn various sciences through the education level, one of the important sciences to master is mathematics. Mathematics is a field of science that trains reasoning to think logically and systematically to solve problems, with a typical way of solving which is abstract, consistent, hierarchical, and deductive thinking; it is a field of science that trains reasoning to think logically and systematically to solve problems (Hudoyono 2020).

Mathematics requires various abilities in order to understand it well, at the level of education, especially in elementary school, mathematics lessons become the main lesson, starting from the lower grades to the high grades get mathematics lessons with a variety of

materials that must be mastered, but lately mathematics has become a lesson that is considered difficult by most students, especially elementary school students.

Students' difficulties in math lessons can be caused by several factors. School environmental factors are very influential in the success of learning mathematics, the most influential school environment is the teacher. A good teacher is a teacher who is able to convey the teaching material he controls through various strategies, methods, and approaches that are in accordance with the characteristics of students, so that in this way, students' understanding of the material becomes better. The ability of students in mathematics lessons is not only fixated on how to count, but there are still many mathematical abilities that must be mastered by students, especially at elementary school age, namely understanding mathematical concepts (Nur Fitriani 2022).

Understanding mathematical concepts is one of the abilities or skills to recognize, understand and explain a situation or action, which has general properties known in mathematics. The ability to understand the concept means that it has three main things that must be mastered, namely recognizing, understanding and explaining within the scope of mathematics. In this case when the teacher teaches new material, what students must do is first understand the concept so that it is easy to solve the problems given related to the material that takes place (Rahayu 2020).

Indicators of concept understanding that must be achieved by students, namely: being able to restate concepts that have been learned, being able to classify objects based on the requirements of a concept, applying concepts algorithmically, being able to provide examples and not examples related to the concepts studied, presenting concepts in various forms of mathematical representation (Siti Ruqoyyah and Sukma Murni 2021). Seeing this, the ability to understand mathematical concepts is very important and is the key for students to learn mathematics well.

Based on the results of observations at SDN 3 Pematang Tahalo which were carried out when mathematics learning activities in grade five were taking place, researchers found that the indicators of concept understanding had not been achieved. This is evident when researchers observed learning activities in the classroom which began with the teacher explaining the material about data processing, the explanation was followed by giving examples of problems and how to solve them, then the teacher gave practice problems for students to do, when working on problems, most students looked confused and even repeatedly asked the teacher how to solve them.

Based on the facts that the researchers found, the researchers can conclude that the indicators of the ability to understand the concepts of grade V students at SDN 3 Pematang Tahalo are still not achieved. So it can be said that students still do not have good concept understanding skills. The low ability to understand the mathematical concepts of grade V students at SDN 3 Pematang Tahalo is also evident in the results of the end-of-semester mathematics test scores which are still low on average, many students score below the average.

Based on the data from the results of the end-of-semester test scores above, of the 38 students obtained 57.8% who scored below 70. While those who scored above 70 were

42.2% of students. The researcher then asked for questions and some students' math answer sheets that had been assessed by the teacher, on the students' math answer sheets, especially the essay section, there were a lot of wrong answers, even from the answer sheets given to researchers, there were several students who answered completely unrelated to the solution requested in the question. Researchers also found that many questions in multiple choice and essay are the same type of question, only differentiated by the question sentence. So if students' understanding of mathematical concepts is good then they should be able to more easily solve these problems and can get better grades.

This data is reinforced by the results of interviews with fifth grade teachers at SDN 3 Pematang Tahalo, explaining that most students' math scores are always below average. Students often have difficulty answering math problems, even to solve problems that use formulas, students are often careless in solving them. Even though the teacher has given explanations and examples of problems. According to the confession of the fifth grade teacher of SDN 3 Pematang Tahalo, he had never heard of and applied the M-APOS model in learning mathematics.

Based on the results of observations at SDN 3 Pematang Tahalo, precisely in the fifth grade, it can be concluded that there are several factors that cause the low ability to understand mathematical concepts, namely: low curiosity of students, so that they complete tasks as they are and even seem perfunctory, teachers still use teaching methods with simple models and have not improved the ability to understand mathematical concepts.

Overcoming the problem of low concept understanding ability in students, it is necessary to improve the quality of learning. There are various alternatives that can be done so that the quality of learning increases, one of which is choosing a learning model that supports the improvement of the ability to understand mathematical concepts. The learning model is a systematic conceptual framework designed by an educator to achieve the desired learning objectives and is used to succeed teaching and learning activities.

In connection with the ability to understand mathematical concepts, of course, there are many learning models that can be applied. One of the existing mathematics learning models is Modification-Action, Process, Object, Schema (hereinafter M-APOS). M-APOS includes a constructivist learning model. The M-APOS learning model is a modification of an APOS Theory developed by Ed Dubinsky. In learning in APOS theory (Action, Process, Object, Schema) is implemented by using the ADL cycle (activity, class discussion, problem practice) (Saefudin 2019).

Research using the M-APOS model has been done before but with different variables. The first research was conducted by Khadijah, Rivdya Eliza and Putri Fajri entitled “The Effect of Modification-APOS Model on Mathematical Reasoning Ability of Class VIII Students of Mtsn Kota Solok”. Based on data analysis and hypothesis testing, it is found that the mathematical reasoning ability of students who use the M-APOS model is better than students who use conventional learning models.

The second research was conducted by Dwi Maulida Sari and Diyah Hoiriyah with the title “Students' Logical Thinking Ability Using the M-APOS Learning Model”, Based on the analysis of the discussion of the research results, it shows that there is a very good

increase in the high category in students' mathematical logical thinking ability after being given learning by using the M-APOS learning model.

The third research was conducted by Rahmi Putri, Mukhaiyar, and Azwar Ananda with the title "Application of the M-Apos Learning Model to Improve Mathematical Concept Understanding Ability", The improvement that occurred in the learning outcomes of students in the experimental class showed that the Modification - Action, Process, Object, and Schema (M-APOS) learning model could help students in understanding the relationships and functions discussed in class VIII MTsN 2 Kerinci. Compared to the traditional learning approach, the application of the learning model of applying students' mathematical ideas Modification - Action, Proceses, Object, and Schema (M-APOS) is better in improving the ability to understand mathematical concepts.

The fourth research was conducted by Eliza, Eri Saputra, and Herizal with a study entitled "Application of the M-APOS Model in Mathematics Learning to Improve the Mathematical Problem Solving Ability of MTSN 4 East Aceh Students" based on the results of the study showed that there was an increase in the mathematical problem solving ability of students through the M-APOS learning model in class VIII Statistics material at MTsN Aceh Timur. The equation in previous research with current research is both using the M-APOS learning model to improve understanding of mathematical concepts.

Based on the foregoing, this study aims to determine the effect of the M-APOS (Modification-Action, Process, Object, Schema) learning model on the ability to understand the mathematical concepts of fifth grade students at SDN 3 Pematang Tahalo. Researchers hope that the results of this study can increase knowledge for those who read, especially for educators in the process of improving students' understanding of mathematical concepts.

METHODS

This research uses quantitative methods with the type of quasy experiment research and uses a post-test only control design. Data collection techniques in this study were using interviews and documentation techniques. The sampling technique used is total sampling, total sampling is a sampling technique where the number of samples is the same as the total population. The reason researchers take the total sampling technique is because according to (Sugiyono 2019) the population is less than 100, so it is better if the entire population is used as a sample. Therefore, the sample of this study consisted of two groups, namely the experimental class and the control class, the total sample was 38 students, class A was used as a control class with 17 students and class B was used as an experimental class with 21 students. The instrument in this study is a description test instrument with a total of 10 questions which will be used to measure the ability to understand students' mathematical concepts after being treated with the M-APOS (Modification-Action, Process, Object, Schema) learning model for 4 meetings, which will be tested on research samples in class V SDN 3 Pematang Tahalo. The learning steps using the M-APOS model are using the ACE cycle (activities, class discussion, exercises). This stage begins with the teacher giving a resitation task or task worksheet to students and then done individually by students with the aim of forming understanding and providing experience to students in deepening the

material. The next stage is the class discussion stage, at this stage the teacher forms students into several groups and provides discussion worksheets to be done in groups, then the teacher appoints several students to be representatives in each group to convey the results of the work obtained. After that the teacher and learners discuss and discuss the work of each group. After the students' discussion is complete, students are given practice problems to apply the concepts that have previously been built in the form of solving problems. The activity carried out at this stage is that the teacher gives additional assignments of problem exercises to students. Before the test instrument was given, the researcher first tested the instrument on the test instrument to be used. The test of the test instrument was carried out on students outside the research sample, the test was carried out on grade VI students of SDN 3 Pematang Tahalo in the odd semester of the 2024/2025 school year with 21 respondents to determine the validity, reliability, difficulty level, and differentiating power of the test instrument.

RESEARCH FINDINGS AND DISCUSSION

The instrument tests that have been carried out in the trial class aim to obtain good research instruments to use. After conducting an instrument test by testing the validity, reliability, level of difficulty, and differentiation, the researcher analyzed and determined what number of question items were feasible and good to use for research. The conclusion of the results of the instrument test obtained based on the results of the validity, reliability, difficulty level and differentiation can be seen in the following table:

Tabel 1 – Intrument Trial.

	1	2	3	4	5	6	7	8	9	10	11	12
Valid-ity	0,465	0,513	0,087	0,711	0,525	0,619	0,505	0,422	0,507	0,305	0,617	0,665
Relia-bility	0,727	0,727	0,727	0,727	0,727	0,727	0,727	0,727	0,727	0,727	0,727	0,727
Level of dfficult	0,94	0,64	0,88	0,65	0,58	0,59	0,77	0,59	0,72	0,29	0,60	0,84
Differentiation	0,589	0,197	0,513	0,502	0,489	0,593	0,019	0,457	0,432	0,425	-63	0,426

Based on the table above is that with 21 respondents and a significant level = 0.05 with an r table of 0.433. The question is said to be valid if the value of rcount ≥ rtable. So it can be seen that valid questions are questions number 1, 2, 4, 5, 6, 7, 8, 9, 11, 12. While invalid questions are questions number 3, 10. This shows that 10 question items are suitable for use for data collection in research because the questions have fulfilled the function of a good measuring instrument in measuring students' understanding of mathematics learning concepts.

Table 2 – Data Normality Test Result

	Statistic	Df	Sig	Statistic	Df	Sig
Experiment Class	.101	35	.200*	.948	35	.097
Control Class	.093	35	.200*	.948	35	.195

Table 3 – Data Homogenity Test Result

	Levene Statistic	df1	df2	Sig.
Based on Mean	.028	1	68	.867
Based on Median	.026	1	68	.872
Based on Median With adjusted df	.026	1	66.904	.872
Based on trimmed mean	.023	1	68	.881

Based on the analysis of the data obtained, at the level of normality significance, which is 5% or 0.05, the results were obtained for the experimental class of (sig. 0.200 > 0.05) and the experimental class of sig. (0.200 > 0.05) then the data from the two sample groups were normally distributed. Furthermore, a homogeneity test was carried out using the SPSS Statistics 26 application and showed the acquisition of sig scores. > 0.05 (based on mean of 0.867, based on median of 0.872, based on median and with adjusted df of 0.872, based on trimmed mean of 0.881) then the variance of the data is homogeneous.

Researchers have conducted normality tests and homogeneity tests that are normally distributed and have homogeneous variances, so the next step or final stage is the independent t-test. This hypothesis test is conducted to determine whether or not there is an effect of the M-APOS (Modification-Action, Process, Object, Schema) learning model on the ability to understand the mathematical concepts of fifth grade students at SDN 3 Pematang Tahalo. The criteria for decision making are as follows, if the sig value (2-tailed) ≥ 0.05 then H0 is accepted and H1 is rejected, which means there is no significant effectIf the value (2-tailed) ≤ 0.05 then H0 is rejected and H1 is accepted which means there is a significant influence. The independent t hypothesis test was carried out using the SPSS program, as for the independent t test results as follows:

Table 4 – Result of Hypothesis Submission

	T	df	Sig (2-tailed)	Mean Difference	Std. Eror Difference
Equal Variances assumed	2.529	36	.016	9148	3.618
Equal Variances not assumed	2.568	35.807	.015	9148	3.563

The results of the posttest data analysis were obtained through a test instrument of 10 questions which were used as a research test tool using the material in the Mathematics book for grade V students. The item instrument was given to 2 classes, namely the experimental class and the control class. Based on the results of the posttest scores, it can be seen that the experimental class obtained an average score of 80.52 with a total score of 1369, then for the results of the posttest scores in the control class obtained an average score of 71.38 with a total score of 1499. The results of the posttest analysis can be seen in the following table:

Table 5 – Posttest Analysis Result

	N	Min	Max	Sum	Std. Deviation
Experiment Class	17	58	98	1369	12.364
Control Class	21	53	95	1499	13.016
Valid N (listwise)	38				

Based on the research that has been carried out, researchers found several obstacles when applying the M-APOS (Modification-Action, Process, Object, Schema) learning model, namely: students feel difficult and not confident when going to work on task worksheet given by the teacher at the beginning of learning, this problem is caused because students are accustomed to solving problems after the teacher explains the material to be studied, then at the class discussion stage students look difficult when working on discussion worksheets because at the discussion stage the teacher has not explained related material to be studied and at this stage students are required to be able to construct their own understanding.

M-APOS considers that learners' knowledge and understanding is a tendency to respond to the conditions of mathematical problems experienced and then reflect them into a social context, then learners develop mathematical ideas through actions, processes, and mathematical objects and then combine them in schemes so that they can be used to solve mathematical problems. Then to be utilized in solving a problem at hand, the individual builds and forms mathematical thinking through actions, processes, mathematical objects, which are then combined in a scheme. The goal to be achieved from M-APOS is the formation of students' mental formation. The meaning of students' mental formation in this context is the formation of actions into processes, then into objects, then objects can be decomposed back into processes. Action, process, and object are decomposed back into schema, which is then abbreviated as APOS (Action, Process, Object, Schema).

This research was successful due to several influences including the M-APOS (Modification-Action, Process, Object, Schema) learning model making students think actively because students are always given questions to explore the knowledge they have beforehand about the material being studied and explore their knowledge again after gaining knowledge by combining their prior knowledge and new knowledge. Learners are allowed to find out for themselves the answers to the questions given, according to what they know, then the educator provides answers in accordance with the theory, which is then accepted by students and adjusted to the students' previous knowledge. The M-APOS (Modification-Action, Process, Object, Schema) learning model facilitates students in learning to understand the concepts of the material taught through the provision of resitation tasks or LKT (Task Worksheet) at the beginning of learning which contains information related to learning materials and questions that can construct or shape students' understanding.

CONCLUSION

Based on the results of the research that the researchers have conducted, it can be seen that there is an effect of the M-APOS (Modification-Action, Process, Object, Schema) learning model on the ability to understand the mathematical concepts of fifth grade students at SDN 3 Pematang Tahalo. This can be seen in the average posttest score of the experimental class which is higher at 80.52 compared to the average posttest score of the control class which is 71.38. Based on the acquisition of the results of the hypothesis test calculation using the independent samples t-test using the SPSS Statistics 26 application also shows that the acquisition of sig. (2-tailed) <0.05, which is obtained at 0.016 <0.05 (5%) of 38 students. This is in accordance with the decision-making criteria if the significance (2-tailed) <0.05 then H0 is rejected and H1 is accepted with the conclusion that the M-APOS Learning Model (Modification-Action, Process, Object, Schema) Affects the Ability to Understand Mathematics Concepts of Grade V Students at SDN 3 Pematang Tahalo. In the

application of the M-APOS (Modification-Action, Process, Object, Schema) learning model to concept understanding in mathematics subjects there are several obstacles and difficulties, therefore it is hoped that future researchers can see or measure the application of this learning model so that the limitations in the research to be carried out can be minimized as well as possible. Then further researchers are expected to examine the application of the M-APOS (Modification-Action, Process, Object, Schema) learning model on other materials / subjects and measure other aspects of mathematical ability or different grade levels and are expected to be able to manage the class and time allocation optimally in applying the M-APOS (Modification-Action, Process, Object, Schema) learning model so that learning can be more effective and efficient.

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