Original Article
ISSN (Online): 2350-0530
ISSN (Print): 2394-3629

International Journal of Research - GRANTHAALAYAH
March 2023 11(3), 79–86

THE EFFECT OF THE APOS-BASED LEARNING FOR SELF-CONFIDENCE AND MATHEMATICS LEARNING ACHIEVEMENT

Nasruddin [1], Markus Palobo [2]

[1] Department of Mathematics Education, Universitas Sembilanbelas November Kolaka, Indonesia
[2] Student at the Department of Mathematics Education, Universitas Negeri Surabaya , Indonesia

Received 18 February 2023
Accepted 19 March 2023
Published 05 April 2023

Corresponding Author

Markus Palobo,
markus.21026@mhs.unesa.ac.id

DOI
10.29121/granthaalayah.v11.i3.2023.5075

Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

ABSTRACT

The purpose of this study was to determine the impact of applying an APOS-based learning model on student self-confidence and mathematics learning performance. This research is an experimental study by Posttest Only Control Design. The location of this research is SMP PGRI ubuntudatu. The population of this study is class VII students. Sampling using the targeted sampling technique was continued using the cluster random sampling technique and samples were taken as VIIA as the control class and VIIB as the experimental class. The data collection techniques used are observation and testing. Data were analyzed descriptively and speculatively. Hypothesis testing by independent-samples t-test. As a result of our research, we found the following:
1) APOS-based learning model has a positive impact on student confidence. This effect was seen in explaining observations in experimental classes, indicating that student self-confidence was more likely to improve at each meeting than in control classes. 2) APOS-based learning models have a positive impact on class math learning performance. Effects are indicated by the obtained t-test results. From this, we can conclude that the APOS-based learning model has a positive impact on mathematics learners' confidence and performance.

Keywords: APOS, Self Confidence, Learning Achievement

1. INTRODUCTION

Education is a form of human culture that is dynamic and full of development Trianto (2007). Education always develops according to the changing times, in Indonesia this is marked by curriculum changes which further improve the quality of education. These changes are so that education in Indonesia can get better. Education can be done formally and non-formally. Formal education in schools covers many fields of knowledge, one of which is mathematics.

Mathematics is one of the basic sciences that has a significant role in everyday life and has been taught from elementary school to university. Learning mathematics at school is expected to be one of the fun learning activities for students which will later have an effect on the self-confidence and students learning achievements of mathematics.

Learning achievement is the result obtained by students from the learning process to master knowledge that is usually developed and usually learning achievement is shown in the form of numbers Vandini (2016) whereas according to Syahputra (2017) learning self-confidence is a learning activity carried out by students without relying on the help of other people, both friends and teachers, when they want to achieve learning objectives in the form of good mastery of knowledge with their own awareness and students can apply their knowledge in everyday life.

Based on observations and interviews, data was obtained that as much as 75% of student learning outcomes were still low or had not yet reached the minimum completeness criteria (KKM) determined by the school, namely 65 and student learning self-confidence was also low, as seen from students not having initiative such as not wanting to ask questions when experiencing difficulties , students also have no responsibility seen when they do not listen to the teacher's explanation properly and students do not have self-confidence characterized by tending to copy the work of friends without trying first.

This happens because the self-confidence of students is low and the way the teacher conveys learning material makes students feel bored and uninterested because the learning process is still teacher-centered. Students just sit listening and are not actively involved. Problems related to low self-confidence and learning achievement need efforts to improve learning through learning models. The learning model in question is one that fits the needs of students. In this case, the chosen model is the learning model with the APOS approach. APOS stands for action, process, object, and schema. By applying the APOS learning model students are required to play an active role in order to be able to master the material well and explain material that is understood independently to their group mates. Because the application of the APOS-based learning model uses student self-confidence in understanding and explaining material using their own language. Dubinsky, et al put forward a learning approach based on the APOS theory called cycles ACE learning. This learning cycle includes: (1) Activity (A), which involves work with computers with language interactive programming; (2) Class discussion (C), which requires existence cooperative learning, and (3) Exercise (E), there is exercise to strengthen or strengthen constructed concepts Mulyono (2011)

2. METHODS

This research is experimental research using a posttest only control design. There are two variables in this study, namely the independent variable and the dependent variable. The independent variable is the learning model with the APOS approach, and the dependent variable is learning confidence and students' achievement in learning mathematics.

The population in this study were class VII students of SMP PGRI Buntudatu for the 2021/2022 academic year, which were divided into 3 classes. The sample selection technique used a random sampling technique so that the research sample was obtained, namely class VII A as the control class with the conventional model and class VIIB as the experimental class with the APOS learning model.

The data in this study were collected through observation and written tests. The observation instrument was in the form of an observation sheet which contained 3 indicators of learning self-confidence, namely self-confidence, initiative and responsibility which were divided into 10 observed aspects, namely being calm when working on questions, being able to respond to the results of friends' work, being able to neutralize tension when working on problems, asking if there was material that is not understood without being told by the teacher, takes notes on the material explained, dares to take risks when working on questions, enthusiasm in participating in learning, does assignments given, has strong belief in the answers obtained, participates in presenting assignments; while the written test instrument is in the form of a description of mathematics learning achievement which consists of 5 questions.

The data analysis technique used for the results of observations uses descriptive statistics. The description of observation data on student learning self-confidence in the scale range used is a standard scale of five. Intervals and categories of student learning self-confidence scores by Sudijono (2006) are shown in Table 1.

Table 1

Table 1 Interval Category of Self-Confidence

Intervals	Category
Mi + 1,5 SDi<X	Very High
Mi + 0,5 SDi < X	High
Mi- 0,5 SDi < X ≤ Mi+ 0,5 SDi	Moderate
Mi- 1,5 SDi < X ≤ Mi- 0,5 SDi	Low
X≤ Mi- 1,5 SDi	Very Low

As for data on students' mathematics learning achievement, they were analyzed using an independent sample t-test. Before using the independent sample t-test, a prerequisite test was carried out first, namely the normality test using the Kolmogorov-Smirnov with a significant level of 0.05 assisted by the SPSS 21 program and the homogeneity test using the F-test with the following formula Sugiyono. (2012).

$$F = \frac{Biggest-Variant}{Smallest-Variant} \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad \text{Equation 1}$$

Meanwhile, to test the hypothesis of this study using the Independent Sample T-test statistical test Sugiyono. (2012)

$$t = \frac{\overline{x_1}-\overline{x_2}}{\sqrt{\frac{s_1^2}{n_1}+\frac{s_2^2}{n_2}}} \ldots\ldots\ldots\ldots\ldots\ldots \quad \text{Equation 2}$$

3. RESULTS AND DISCUSSION

This research was conducted at PGRI Buntudatu Middle School, by randomly taking two classes as research samples, namely class VIIB as the experimental class and class VIIA as the control class. The data described in this section are the results of the tests (posttest) achieved by students who were collected after being given the

APOS model treatment and descriptions of the results of observations of student learning self-confidence.

Description of data from observations of student learning self-confidence in the experimental class is shown in Table 2 below.

Table 2

Table 2 Data of Self-Confidence in Experimental Class

Category	Meeting				
	1(%)	2(%)	3(%)	4(%)	5(%)
Very Low	45,62	25,33	20,43	12,52	2,56
Low	54,38	33,43	30,14	12,43	4,52
Moderate	0	41,24	49,43	54,57	35,71
High	0	0	0	20,48	47,21
Very High	0	0	0	0	0

Based on Table 2, it is known that there is an increase in student learning self-confidence from the first meeting to the last meeting. At the beginning of the meeting there were still many students whose learning self-confidence was in the low category of 54,38% and very low of 45,62%. This is because students are still not used to the new learning model.

At the next meeting the students began to get used to using the APOS learning model. It can be seen from the observation results that the student's learning self-confidence increased. At the end of the meeting, 47,21% of students' mathematics learning self-confidence was in the high category, and none were in the low or very low category. This condition is because each student actively asks if there is material that is not understood, actively responds to the results of discussions with group mates, and enthusiasm in the learning process takes place.

Description of data from observations of student learning self-confidence in the control class is shown in Table 3 below:

Table 3

Table 3 Data of Self-Confidence of Control Class Students

Category	Meeting				
	1(%)	2(%)	3(%)	4(%)	5(%)
Very low	47,73	41,42	40,62	35,50	24,32
Low	52,27	44,20	45	35,75	32,46
Moderate	0	14,38	14,38	28,75	43,22
High	0	0	0	0	0
Very High	0	0	0	0	0

Based on Table 3, it is known that the percentage of students' mathematics learning self-confidence in the high category is 0%, the rest in the low and very low category of student learning self-confidence. This is because the learning model used makes students less active in the learning process. Students just sit receiving material without being actively involved in the learning process. As for students who ask a lot of questions in class and respond to the results of discussions are students who are really smart. This can be seen from the percentage of student

learning self-confidence at each meeting there are always those who are in the low and very low categories.

From Table 2 and Table 3 above it can be concluded that in the experimental class and control class there are differences in student learning self-confidence. In the experimental class at the end of the meeting there were 47,21% of students who were in the high category and less than 5% students who were in the low and very low categories. Whereas in the control class at the end of the meeting there were still 24,32% students in the very low category, 32,46% in the low category and no students in the high category. This shows that the experimental class has better learning self-confidence than the control class. So it can be concluded that the APOS learning model has a positive influence on students' mathematics learning self-confidence.

Data on students' mathematics learning achievements for the control and experimental classes are presented in the following table:

Table 4

Table 4 Description of the Experimental Class and Control Class Data

Statistics	Statistik Value	
	Experiment Class	Control Class
Sample	15	16
Ideal Value	100	100
Maximum	85	80
Minimum	58	47
Means	75,79	64,85
Median	73	65,5
Variance	79,7	140,42

Based on the data in Table 4, it can be seen that with the same number of samples there are differences in the test scores of the experimental class and the control class. In the experimental class the mean value is almost the same as the median. This shows that students who score above the KKM are more than students who are below the KKM, as many as 11 out of 15 students or 73,33% of students complete the KKM. Whereas in the control class, the median value is greater than the mean. This shows that more students scored below the KKM, namely 70, in this case 8 out of 16 students or 50% of students scored below the KKM determined by the school. From Table 1 above, it shows that the learning achievement of the experimental class with the APOS model has a higher average than the learning outcomes of the control class students who use the conventional model.

In this study, it is necessary to test the hypothesis to determine whether there is an effect of using the learning model with the APOS approach on student achievement. Before testing the hypothesis, a prerequisite test is first carried out, namely the normality test and homogeneity test. The results of the normality test of learning outcomes in the experimental class and control class with the help of the SPSS program can be seen in Table 2 as follows:

Table 5

Table 5 Normality Test Results

Class	Number of students	Asymp.Sig	Test results	Information
Experiment	15	0,05	0,193	Normal
Control	16		0,053	

Based on Table 5, it is known that the posttest data group for the experimental class obtained test results, which means that the data in the experimental class were normally distributed, and the control class obtained test results, which meant that the data in the control class were normally distributed. After the normality test was carried out, then the homogeneity test was carried out. Homogeneity test was conducted to find out whether the sample data came from populations with the same variance (homogeneous) or not.

The results of the homogeneity test of the experimental class and control class can be seen in Table 6 as follows.

Table 6

Table 6 F Test Calculation Results

Class	S^2	F_{result}	F_{table}	Information
Experiment	9,672	1,45	2,57	Homogen
Control	12,539			

Based on Table 6, it is known that the results of the calculation of the F test in the experimental class and control class obtained $F_{result} \leq F_{table} = 1{,}45 \leq 2{,}57$ with a significant level $\alpha = 0{,}05$, so it can be concluded that the data in the experimental class and control class come from the same or homogeneous population. Based on the prerequisite test, it is obtained that the population is normally distributed and homogeneous. Next, a hypothesis test was carried out using an independent sample t-test. The results of the independent sample t-test of the experimental class and the control class based on the results of the analysis, obtained $t_{result} = 2{,}435 > t_{table} = 1{,}71$. This means that it H_o is rejected and H_a is accepted, so it can be concluded that there is an influence of the APOS learning model on students' mathematics learning achievement.

The results of the analysis that has been carried out show that the self-confidence and achievement of students in the experimental class and the control class show differences. This difference is because the learning model applied to the experimental class requires students to play an active role in the learning process whereas in the control class students only passively listen to the explanations given by the teacher. better than the control class. This can be due to the characteristics of the APOS learning model which emphasizes students working in pairs and taking turns in explaining the parts of the material being studied.

Students are accustomed to independently understanding and conveying learning material to their group members alternately exchanging roles. By exchanging roles, students can explore their abilities in conveying their understanding of the material being studied and taught to their partners so that they can foster positive interactions during the learning process. Students are given the freedom to express their creativity when solving problems and make it easier for them to remember the material concerned with problem solving. Students also get

the opportunity to learn other parts of the material that they did not learn. Student learning self-confidence was observed based on 3 indicators, namely self-confidence, initiative, and responsibility for each experimental and control class. The observation results showed that students in the experimental class at each meeting experienced an increase in learning self-confidence. This is because students in the experimental class have been accustomed to being independent in expressing their opinions to their group partners and the results of group discussions with other groups. Increasing student independence shows that students' positive responses to learning with the APOS approach Lestari. (2014).

Another positive influence from the application of the APOS learning model can be seen in students' mathematics learning achievement. The results of the posttest analysis showed that the average posttest scores of students in the experimental class were higher than those in the control class. In the experimental class the average value obtained was 75,79 while in the control class the average value obtained by students was 64,85. This influence can be due to the experimental class, students play an active role in the learning process, so that the information obtained can be well constructed in the student's memory than students in the control class who tend to be passive in the learning process. The results are in accordance with the results of several studies that the learning approach with the APOS model is very effective for helping students in improving understanding of mathematical concepts Asiala et al. (1997), Dubinsky (2001). This influence is based on the result of the treatment, namely the use of the APOS learning model has an influence on students' mathematics learning achievement. Learning with the APOS approach can improve students' understanding of mathematical concepts Agustina (2018). With the APOS learning model students are invited to learn more actively and dominate the learning process in class and are trained to be more independent and also have creativity. Thus, the APOS learning model can influence student learning outcomes in mathematics. learning with the APOS approach helps students to learn to construct an understanding of the mathematical material being studied, so that the understanding built through the APOS learning approach allows students to use the concept well. student success in constructing the mathematical concepts being studied will foster self-confidence in students' abilities to solve various problems related to mathematical concepts that are self-constructed in learning with the APOS approach.

4. CONCLUSSION

The APOS learning model is a learning model that requires students to be active and independent in the learning process. Based on the results of data analysis and discussion, it can be concluded that:

1) The APOS learning model has a positive effect on student learning self-confidence. This effect is shown in the description of the results of observations of the experimental class indicating that student learning self-confidence increased at each meeting compared to the control class.
2) The APOS learning model has a positive effect on class student achievement in mathematics. This effect is shown from the results of the t-test obtained, which is greater than.

As for suggestions that can be put forward based on research results, namely, teachers are expected to be able to use the APOS learning model as an alternative solution in order to make it easier for students to believe in their own abilities to think, seek information from other sources, and learn from other students so that

they can improve self-confidence and student mathematics learning achievement, besides that students are expected to be more confident, to be active and independent in the process of learning mathematics with the application of the APOS learning model, and for further researchers it can be used as a reference and reference by further researchers who research the APOS learning model. It is hoped that with the results of this study, educators can consider designing learning that helps students build an understanding of the concepts of the material being studied, so as to increase students' self-confidence, and support the achievement of satisfactory learning achievements.

CONFLICT OF INTERESTS

None.

ACKNOWLEDGMENTS

None.

REFERENCES

Agustina, N. (2018). Kemampuan Pemahaman Konsep Siswa Smp Pada Materi Persamaan Garis Lurus Dalam Pembelajaran Berbasis Apos. HISTOGRAM : Jurnal Pendidikan Matematika, 2(1). https://doi.org/10.31100/histogram.v2i1.34.

Asiala, M., Dubinsky, E. D., Mathews, D. M., Morics, D., and Oktaç, A. (1997). Development of Students' Understanding of Cosets, Normality, and Quotient Groups. The Journal of Mathematical Behavior, 16(3), 241–309. https://doi.org/https://doi.org/10.1016/S0732-3123(97)90029-8.

Dubinsky, E. D. (2001). Using a Theory of Learning in College Mathematics Courses. MSOR Connections, 1(2), 10–15. https://doi.org/10.11120/msor.2001.01020010.

Lestari. (2014). Implementasi Brain-Based Learning Untuk Meningkatkan Kemampuan Koneksi dan Kemampuan Berpikir Kritis Serta Motivasi Belajar Siswa SMP. Jurnal Pendidikan Unsika, 2(1), 36–46. https://doi.org/10.35706/judika.v2i1.120.

Mulyono, M. (2011). Teori Apos Dan Implementasinya Dalam Pembelajaran. Journal of Mathematics and Mathematics Education, 1(1).

Sudijono, A. (2006). Pengantar Evaluasi Pendidikan, Cet. In Jakarta : Rajagrafindo, 1, (1).

Sugiyono. (2012). Metode Penelitian Kuantitatif, Kualitatif dan R and D.Bandung:Alfabeta. Metode Penelitian Kuantitatif, Kualitatif Dan R and D.Bandung:Alfabeta. https://doi.org/10.1017/CBO9781107415324.004.

Syahputra, D. (2017). Pengaruh Kemandirian Belajar Dan Bimbingan Belajar Terhadap Kemampuan Memahami Jurnal Penyesuaian Pada Siswa Sma Melati Perbaungan. At-Tawassuth Pascasarjana Akuntansi Universitas Muhammadiyah Sumatera Utara, 2(2). https://dx.doi.org/10.30821/ajei.v2i2.1227.

Trianto. (2007). Model Pembelajaran Terpadu dalam Teori dan Praktek. Jakarta, Prestasi Pustaka.

Vandini, I. (2016). Peran Kepercayaan Diri terhadap Prestasi Belajar Matematika Siswa. Formatif : Jurnal Ilmiah Pendidikan MIPA, 5(3). https://doi.org/10.30998/formatif.v5i3.646.