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Research Article

The Effect of Enactive-Iconic-Symbolic Model of Problem-based Learning Oriented Blended Learning to Improvement of Problem-solving Skills of Elementary School Students

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Abstract.
A development research that aims to see the effectiveness of the use of the problem-based learning model enactive-iconic-symbolic-oriented blended learning on the problem-solving skills of 4^{th} grade elementary school students in Karangploso Malang. The research used was a quasi-experimental research design with a pretest-posttest control group design. The subjects of the study were students of SDN Girimoyo 2 Karangploso Malang grade 4, total 59 people. The instrument used is a written test related to problem solving. The data obtained were analyzed using the t test. The results of data analysis show that 1) there was an increase in students' problem-solving abilities before and after being given treatment. The average value of the pretest and posttest of problem-solving abilities, respectively, is 55 and 84. Thus, it can be said that there is an influence of the enactive-iconic-symbolic problem-based learning model on students' problem-solving abilities; 2) the problem-solving skill of students using the PBM-ENIKSI model experienced a significant change compared to students using the conventional model, this was proven based on the results of the t-test with sig (2-tailed) ⊠ 0.025.

Keywords: problem-solving ability, problem-based learning-enactive-iconic-symbolic

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1. INTRODUCTION

Problem solving is the main ability in learning mathematics for students [1]. Involves higher and lower order thinking skills. With problem solving skills, students' problem solving skills improved, carry out procedures, and deepen conceptual understanding [2]. Many experts state that the focus of teaching is teaching students to think, use their rational powers, and become problem solvers [3], [4]. Problem solving skills are activities that require someone to choose a way out that can be done according to the abilities possessed by the person himselfn [5]–[7]. Most experts recommend the use of problem-based learning models in the classroom learning process in order to improve problem solving abilities [8]–[11]. However, the facts on the ground, the results of interviews

with teachers revealed that problem-based learning is not an easy learning model to implement so teachers feel reluctant to use it. This is caused by several factors and one of them is the unaccustomed factor so that the teacher's habits are still carrying out conventional learning. As the results of research [12]–[14] show that there are several obstacles experienced by teachers in implementing the PBM model. The obstacles experienced were that the teacher had difficulty in determining the problem and when helping students investigate independently and in groups. It is not easy for teachers to position themselves as facilitators, guiding, exploring deeper understanding, and supporting student initiatives, which then have an impact on student learning outcomes. The obstacle experienced by this teacher was the implementation of the first and third stages of the problem-based learning model.

Apart from being the goal of learning mathematics, problem solving is also the main means of learning mathematics. Problem solving is one component of the standard mathematical process that is very important, because in carrying out the learning process and getting the results, students are given the opportunity to implement their abilities and experiences to solve non-routine problems. [15]. The ability to find solutions to problems can be interpreted as the ability of students to understand problems, set methods for finding solutions, carry out predetermined methods of finding solutions, and re-check the solutions obtained. This is done to get the best solution and statement of understanding of the problems made by students [15]–[18]. Therefore, the learning process that can activate students must be paid more attention and developed in order to help students develop and improve problem solving skills.

Students' practical mathematical abilities need to be developed such as problem solving, making connections, understanding various representations of mathematical ideas, communicating their thought processes, and explaining the reasoning they do [19]. The low problem solving ability of students causes students to make many mistakes when solving problems, including: students are careless and less careful, make mistakes when changing information, and make mistakes to understand the problem. Problem solving skills must be possessed by every student to get used to dealing with various kinds of problems, both problems in mathematics, problems in other fields of study, and problems related to everyday life. Hope in achieving an innovative and creative learning process is a noble goal for a teacher. Teacher performance affects student learning achievement [20]. Therefore, It is necessary for teachers to train their students' problem solving skills. There are several learning models that can be used to teach mathematics, including: realistic mathematics approach, problem-based learning, cooperative learning, and contextual approaches. of several learning models that have

been mentioned, only learning using problem-based learning is appropriate to improve and develop students' problem solving skills [21].

Problem solving ability is closely related to the representation made. Enactive-iconic-symbolic is a mental representation model [22]. The main key to finding the best problem solution lies in representational skills which include construction and utilizing abstract representations in the form of mathematical sentences, diagrams, tables, and others. Furthermore, in his research, It was stated that the ability to reconstruct an understanding of a problem is the main thing that can be used to get the right solution to a problem.

PBM ENIKSI is one of the innovative learning models developed through the blending Bruner's theory and PBL to elaborate question-solving skills. There are four stages in problem solving according to Polya, namely (1) understanding the problem, (2) planning a strategy, (3) executing the strategy, and (4) re-examining [16]. The PBM ENIKSI model is one learning model begins with giving questions related to the material to be discussed, then looking for solutions to problems according to Bruner's theory. The ENIKSI PBM model elaborated to realize and improve students' mathematical problem solving skills through fun, open, independent, and directed delivery so that students can build understanding according to student ability levels

The PBM ENIKSI model is One of the most efficient models in improving the learning rate of mathematics at the elementary level. This is adapted to the cognitive development of basic level students is concrete operational. At this time, students need a stimulus in the form of concrete objects in understanding something. After he understands it, the student will continue to understand the abstract. So that the material can be absorbed optimally by elementary level students, it is necessary to deliver material that is in accordance with the student's cognitive development.

The PBM-ENIKSI model relies on the notion of constructivism, in which the main character is the theory of Piaget and Vygotsky. This theory is very well applied in practice in learning because students are given the opportunity to construct their own knowledge through things that have been done and related to students or the environment in which they live. [23]. The implementation is that the teacher can create a conducive learning situation, so that all the talents and abilities of students can grow and develop optimally.

During the Covid-19 pandemic, teachers are forcing teachers to design a lesson that fits current conditions and still pays attention to the stages of students psychological developmentr. Confidence to be able to organize quality learning is a noble goal for a teacher. Teacher performance affects student learning achievement [20]. The current

condition, cannot force elementary school students to study fully online, but limited face-to-face learning is still required while still complying with health protocols according to the appeal from the government. Therefore, the education office allows schools to apply blended learning.

Blended learning is defined as a traditional face-to-face class where students are equipped with part of the e-learning learning and in the other part they relate to the lecturer or with other classmates face-to-face [24]. In addition, blended learning is also defined as learning that combines synchronous and asynchronous learning settings appropriately to provide learning effectiveness and efficiency [25]. Synchronous learning is a learning activity that is carried out at the same time and in the same or different places, while asynchronous learning is a learning activity that is carried out at different times and places [26]. In blended learning there are six elements that must be present, namely: (1) face-to-face (2) independent learning, (3) using applications, (4) tutorial activities, (5) collaboration, and (6) evaluation [27].

Based on the problems above, what will be studied in this research are: how effective is the use of the blended learning-oriented PBM-ENIKSI model in improving students' problem solving abilities?

2. METHOD

The research used was a quasi-experimental research design with a pretest-posttest control group design. The research subjects were students of SDN Girimoyo 2 Karangploso Malang class IVA (experimental class) as many as 30 students and class IVB (control class) as many as 29 students. The sampling technique used random sampling criteria. The research instrument used a test in the form of 5 problem-solving ability questions. Tests were given before and after learning was carried out to both classes. This was done to obtain data on improving the problem-solving ability of the two classes. The data analysis technique used includes the normality test and homogeneity test (for initial data analysis), the hypothesis test used is a t-test. For the testing process using the help of the SPSS 16.

3. RESULTS AND DISCUSSION

This research is part of the research on developing the blended learning-oriented PBM-ENIKSI model for primary school students. This study discusses the effect of the blended learning-oriented PBM-ENIKSI model on the problem-solving abilities of elementary

school students. The effectiveness of this model is seen from the problem-solving ability test before (pretest) and after (posttest) treatment is given. The average increase in learning outcomes of problem solving abilities is shown in Tables 1 and 2 [14], [15].

3.1. Normality Test

In this study, the Mann-Whitney and Shapiro-Wilk tests were used to determine whether the data obtained was normally distributed or not. Based on the test results it is known that the significance level of the data in the experimental class is 0.200 □ 0.05 and the control class is 0.182 □ 0.05. This shows the sig □ α value and it can be concluded that the data for both classes are normal. The complete normality test results can be presented in Table 1.

Table 1: Recapitulation of the results of the normality test for the experimental class and the control class.

No	Class	Score	Kolmogorov-Smirnov[a]	Shapiro-Wilk	Comparison with α	Description
1	Experimen	Pretes	0,034	0,088	□ 0,05	Normal Distribution
		Postes	0,200	0,043	□ 0,05	Normal Distribution
2	Control	Pretes	0,200	0,410	□ 0,05	Normal Distribution
		Postes	0,182	0,151	□ 0,05	Normal Distribution

3.2. Homogenety Test

In addition to the normality test, the researcher also conducted a homogeneity test to find out whether the sample group had a homogeneous variance or not by using the Levene test. The homogeneity test results can be presented in Table 2.

Table 2: Result of Analysis of Homogeneity of Variance of Data on Problem Solving Ability.

No	Class	Significance Value	Comparison with □	Description
1	Experimen	0,061	0,061 □ 0,05	Homogen
2	Control	0,054	0,054 □ 0,05	Homogen

The criterion for homogeneous variance is when sig □ α. The results of data processing showed that in the experimental class the significance value obtained was 0,061 □ 0,05, while in the control class the significance value obtained was 0,054 □ 0,05, it means that the variance of the data on improving the problem-solving skills of educators

is homogeneously distributed. The criterion for homogeneous variance is when sig α. It means that the data obtained is homogeneous.

3.3. Hypothesis Testing

Hypothesis testing was conducted to determine the effectiveness of the use of the enzymatic-iconic-symbolic problem-based learning model oriented to blended learning. The effectiveness of this model is seen from the problem-solving ability test before (pretest) and after (posttest) the treatment is given. To find out the difference in the value of problem solving abilities before and after learning using this model, the experimental class used a two-sample t test (sample paired test). The test results can be seen in Table 3 and Table 4.

Table 3: Statistical Results of Two-Sample t-Test (Sample Paired Test).

Paired Samples Statistics					
		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pretest	55.37	30	14.085	2.571
	Posttest	84.17	30	10.771	1.966

Table 4: Result of Two-Sample T-Test (*Sample Paired Test*).

Paired Samples Test	Paired Differences	Pair 1 pretest – posttest		
		Mean		-28,800
		Std. Deviation		7,490
		Std. Error Mean		1,367
		95% Confidence Interval of the Difference	Lower	-31,597
			Upper	-26,003
		T		-21,061
		Df		29
		Sig. (2-tailed)		000,0

Based on table 3, it is known that there is an increase in the average problem solving ability of students before and after being taught using this model by 29. Based on the output results in Table 4, it can be seen that the sig value is 0.000 and the significance level is 0.05/2 = 0.025. Based on the test criteria, H0 is rejected if the significance (2-tailed) 0,025. So it can be concluded that there are differences in students' problem solving abilities before and after being taught using this model. Furthermore, a t-test

(Independent Sample T-Test) was conducted to determine the difference in the problem-solving ability scores of students who were taught using this model and not. The results of the Independent Sample T-Test can be seen in Tables 5 and 6 below.

Table 5: Statistical Results of T-Test Tests (Independent Sample T-Test).

Group Statistics					
	Class	N	Mean	Std. Deviation	Std. Error Mean
nilai kpm	1	30	84.17	10.771	1.966
	2	29	64.66	14.266	2.649

Table 6: Result of t-Test (*Independent Sample T-Test*).

Independent Samples T-Test	Value Problem Solving Ability			
			Equal variances assumed	Equal variances assumed
	Levene's Test for Equality of Variances	F	3.780	
		Sig.	.057	
	t-test for Equality of Means	T	5.942	5.914
		Df	57	52.088
		Sig. (2-tailed)	.000	.000
		Mean Difference	19.511	19.511
		Std. Error Difference	3.284	3.299
		95% Confidence Interval of the Difference — Lower	12.936	12.891
		Upper	26.087	26.132

Based on Table 5, information is obtained that the average value of problem solving abilities of students who are taught using an PBM-ENIKSI model oriented to blended learning is higher than that of educators who are taught not to use an enzymatic-iconic-symbolic problem-based learning model oriented to blended learning. Based on the output results in Table 6, it is known that the sig value on the t-test for Equality of Means is 0.000 and the significance level is 0,05/2 = 0,025. Based on the test criteria, H0 is rejected if the significance (2-tailed) ⊠ 0,025. Based on this it is known that the problem solving abilities of students in the two classes are treated differently. Thus,

statistically descriptive, it can be said that there is a difference in the effectiveness of the PBM-ENIKSI model with blended learning orientation and the conventional model in improving problem-solving skills for grade IV elementary schools.

4. CONCLUSION

The use of the PBM ENIKSI model oriented to blended learning has given good results to the improvement of students' question-solving abilities. The results showed that: 1) there was an increase in students' problem solving abilities before and after being given treatment. The average value of the pretest and posttest of problem-solving abilities, respectively, is 55 and 84. Thus, it can be said that there is an effect of the PBM ENIKSI model on students' question-solving abilities; 2) the question-solving skills of students using the PBM-ENIKSI model experienced a significant change compared to students using the conventional model, this was proven based on the results of the t-test sig (2-tailed) 0,025.

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