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Effect of scientific learning approach on mathematical problem-solving ability of junior high school students

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Abstract

The scientific approach in learning at school aims to familiarize students with thinking, discussing, and creating using scientific principles and steps. Therefore, this research aims to increase student activity and find out how the scientific approach influences class students' problem-solving abilities. VIII Kartikatama Metro Middle School. Through problem-solving abilities, students can develop their thinking abilities to connect the knowledge and skills they already have to solve the problems given. This research is quantitative. The research location is Kartikatama Metro Middle School. The subjects in this research were 25 experimental class students and 25 control class students. The data collection technique used was the Posttest test. Data analysis techniques are carried out by testing research instruments, analysis testing, and hypothesis testing using the t-test. Based on the research results, the Sig value was obtained. (2-tailed) is 0.11<0.05, which means that there is an influence of the scientific approach model through the problem-solving abilities of class VIII students at SMP Kartikatama Metro or in other words, the average problem-solving ability of students in the experimental class is better than the average - average problem-solving ability of control class students.

Keywords: *Scientific Approach, Problem Solving, Quantitative.*

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INTRODUCTION

Education is a very important pillar in building a quality country. Humans are expected to grow into individuals who can adapt to their surroundings through education. High-quality education is needed to support the creation of quality human resources. In the curriculum of the education unit level (KTSP), it is stated that mathematics subjects need to be given to all students starting from elementary school to equip them with logical, analytical, systematic, critical, and creative thinking skills and the ability to work together. Mathematics is an important subject to learn because it provides benefits in everyday life (Nahdi, 2017). This is in line with the opinion of (Noor & Husna, 2017), who stated that mathematics is one of the disciplines that can improve thinking and argumentation skills, contribute to solving everyday problems and in the world of work, and provide support in the development of science and technology. Permendikbud No. 21 of 2016 concerning content standards (Hidayah, 2020) states that mathematics lessons aim for students to have the following competencies: a) demonstrate logical, critical, analytical, careful, and precise attitudes, be responsible, responsive, and not give up easily in solving problems; b) have curiosity, self-confidence, continuous enthusiasm for learning, reflective thinking, and interest in mathematics; c) have confidence in the power and usefulness of mathematics, as well as a critical attitude formed through learning experiences; d) have an open, objective attitude, and appreciate the work of friends in group interactions and daily activities; e) can communicate mathematical ideas clearly and effectively.

Problem-solving ability is linking mathematical concepts to expand students' knowledge of mathematics (Ita & Abadi, 2019). One of the goals of learning mathematics is for students to have problem-solving skills, including the ability to understand problems, design mathematical models, solve models, and interpret the solutions obtained (Sagita et al., 2023). This goal places problem-solving as an essential part of the mathematics curriculum. In the learning process and problem-solving, students can gain experience using the knowledge and skills they already have. This experience then trains students' thinking skills to be logical, analytical, systematic, critical, and creative in dealing with problems (Sari et al., 2016).

Most students only memorize the knowledge the teacher gives during the learning process. When students face problem-solving problems, they are unable to solve them. The lack of problem-solving skills is reinforced by the reality in the field, as experienced by grade VIII students at SMP Kartikatama Metro. Based on the results of an interview with one of the mathematics teachers at SMP Kartikatama Metro, it can be seen that the learning ability of students with a percentage of completion of 35% and incomplete of 65%, the incompleteness

of the test results is because most students have not been able to solve optimally, for example, story problems that contain problem-solving skills. The characteristics of students' problem-solving abilities in mathematics learning also vary; some are easy to grasp mathematics learning by 15%, moderate by 30%, and complicated by 55%. Related to limitations in problem-solving abilities, among others, (1) students prioritize problems that can be solved using routine procedures (using memorization of formulas), and according to the examples given; (2) students give up very quickly when given non-routine solutions, and (3) students cannot use the right strategy in problem-solving.

In relation to these results, a problem was found, namely the students' low ability to solve mathematical problems. The reasons for the low ability of students in solving mathematical problems are: (1) students are not yet able to understand mathematical concepts, and the ability to receive material is very difficult; (2) most students are unable to complete practice questions in the form of problem-solving given by the teacher; (3) when the test is carried out, most students are unable to complete problem-solving questions; (4) most students cannot identify what is known and asked from the question. Teachers must be able to use learning models that can improve the effective learning process (Abidin, 2019) in the sense that students must understand mathematical problem-solving in the learning process. The Scientific Approach is one alternative that can develop students' thinking skills in solving problems. The 2013 curriculum (Nulfita, 2014) explains that the learning process based on the scientific approach involves the realm of attitudes, skills, and knowledge. This shows that the scientific approach begins with fostering positive attitudes such as curiosity, wanting to investigate, and ultimately fostering learning habits. This positive attitude triggers the potential for observing, reasoning, and concluding skills. The domain of attitudes and skills will produce knowledge, which is the goal of the learning process (Sudirman et al., 2020). Thus, the learning process is carried out with a sense of pleasure, challenge, and cooperation. The goal factor, student factors, the situation, and the teacher himself influence the effectiveness of a model. Therefore, a teacher must use a model that provides varied learning and actively involves students in learning (Wulandari, 2016) to increase the creativity and critical thinking of students and strengthen students' problem-solving skills in the mathematics learning process. Based on the description above, the scientific approach can be used to improve problem-solving abilities and mathematical connections. Therefore, researchers are interested in conducting research entitled "The Effect of the Scientific Learning Approach on the Mathematical Problem-Solving Ability of Junior High School Students."

METHODS

The research method used is quantitative with a quasi-experimental research type. The design used is a Nonequivalent Posttest-Only Control Group Design. The population in this study were all students of class VIII of SMP Kartikatama Metro. Sampling was carried out using a purposive sampling technique based on the consideration that the classes selected were taught by the same teacher so that the treatment given was relatively the same. Therefore, the sample used for this study was class VIII A as the experimental class and class VIII B as the control class.

The data collection technique used in this study was a descriptive test. Before being given to students during the posttest, the test instrument was tested for validity, reliability, discriminating power, and difficulty level. Testing was carried out using the SPSS 22 application. The validity test results with Pearson correlation showed that the four questions met the valid criteria. The reliability test results with Cronbach's alpha showed that the four questions met the reliable criteria. The results of the difficulty level test showed that question number 1 was in the easy criteria, while the other questions were in the moderate criteria so that the four questions could be used. The results of the discriminating power test showed that the four questions were in the perfect criteria. Table 1 shows the grid for students' mathematical problem-solving ability test.

Table 1. Rubric of Problem-Solving Ability Test Questions

Learning Indicators	Problem Solving Indicators	No
Observing patterns in a sequence of numbers, determining the next term of a sequence of numbers	Identifying known, asked elements, and the adequacy of required elements.	1-4
Generalizing patterns of number sequences into an equation.	Formulating mathematical problems or constructing mathematical models.	1-4
Applying number pattern rules in solving various problems.	Applying strategies for problem solving	1-4
Solving contextual problems related to patterns of number sequences.	Explaining or identifying problem solving results	1-4

Before conducting data analysis, two prerequisite tests must be carried out: normality and homogeneity. The SPSS 22 application is used with the Kolmogorov-Smirnov test. The test results are shown in Table 2.

Table 2. Results of the Problem-Solving Ability Data Normality Test

Class	.sig	Test Decission
Experiment	0,113	H_0 accepted
Control	0,103	H_0 accepted

Table 2 shows that the data on mathematical problem-solving ability in the experimental and control classes have a sig value > 0.05, which means that H0 is accepted. Thus, the data comes from a normally distributed population. The following prerequisite test is the homogeneity test. The results of the homogeneity test with Anova are shown in Table 3.

Table 3. Results of the Homogeneity Test of Problem-Solving Ability Data

Test of Homogenity of Variances			
Mathematical Problem Solving			
Levene Statistic	df1	df2	sig.
0,256	1	48	0,615

The ANOVA test assumes that the variance of the two data groups is the same or homogeneous. From Table 4, it can be seen that the post-test value data of the experimental class and the control class have a sig value > 0.05, so H0 is accepted. Thus, the variance of the data of the two groups is not different, which means that both data are homogeneous. The following analysis is the analysis of the post-test data, namely the test of the equality of two means can be done using the t-test.

RESULT AND DISSCUSSION

From the data collection that has been done, data was obtained on students' mathematical concept understanding in classes using the scientific approach and classes using conventional learning models. Based on the processing of post-test score data, the highest value (xmaks), lowest value (xmin), average value ($\bar{x}$), and standard deviation (s) were obtained, which are presented in Table 4.

Table 4. Recapitulation of Students' Mathematical Problem-Solving Ability Data

Score Max	Experiment Class (Scientific Approach)				Control Class (Konventional)			
100	x_{maks}	x_{min}	$\bar{x}$	s	x_{maks}	x_{min}	$\bar{x}$	s
	96	58	83,58	8,367	96	42	77,00	9,251

The number of post-test data is 25 for the experimental and control classes. Table 3 shows that the experimental class's average value of conceptual understanding is 83.58, while the control class is 77.00. Furthermore, to prove the truth of the hypothesis in this study, data analysis was carried out using a nonparametric two-average equality test, namely the Mann-Whitney test. Table 5 shows a recapitulation of the hypothesis test calculations.

Table 5. Results of the Posttest Independent Samples Test of the Problem-Solving Ability of Students in the Experimental Class and Control Class

		Levene's Test for Equality of Variances		**t-test for Equality of Means**						
		F	**Sig.**	**T**	**Df**	**Sig. (2-tailed)**	**Mean Difference**	**Std. Error Difference**	**95% Confidence Interval of the Difference**	
									Lower	**Upper**
Problem-Solving Ability	Equal variances assumed	,256	,615	2,630	48	,011	6,560	2,495	1,544	11,57
	Equal variances not assumed			2,630	47,524	,011	6,560	2,495	1,543	11,57

Based on Table 5, the Sig. Levene's Test for Equality of Variances value is 0.615> 0.05, which means that the data variance between the experimental class and the control class is homogeneous or the same so that the interpretation of the independent sample t-test output table above is guided by the values contained in the table "Equal variances assumed." In the Sig. (2-tailed) section of 0.011> 0.05, then as the basis for decision making in the independent sample t-test, it can be concluded that $H1$: $\mu 1 > \mu 2$. There is an influence of the scientific approach learning model through the problem-solving abilities of class VIII junior high school students or in other words, the average problem-solving abilities of students in the experimental class are better than the average problem-solving abilities of students in the control class.

The results of this study are similar to the study (Khoeriyah & Ahmad, 2020) which revealed that applying a scientific approach-based learning model to grade VIII junior high school students succeeded in improving problem-solving skills in mathematics. The study results showed that students who were taught with a scientific approach had higher scores in problem-solving tests than the group using conventional learning models. (Khoeriyah &

Ahmad, 2020) It concluded that the scientific approach encourages students to think actively and develop solutions independently.

Furthermore, a study conducted by (Nuralam & Eliyana, 2018) tested the effect of the scientific approach on students' problem-solving abilities in science subjects. The results showed a significant increase in the problem-solving abilities of students who took part in learning with a scientific approach compared to students who used conventional learning. Applying this approach helps students understand concepts better and find solutions to the problems.

The results of another study by (Hasanah et al., 2020), namely this study observed the differences in problem-solving abilities between the experimental class using a scientific approach learning model and the control class using a direct instruction approach. As a result, students in the experimental class showed better problem-solving abilities, both in written and practical tests, than in the control group.

Furthermore, (Hasriyani et al., 2022) conducted a study comparing the application of the scientific approach learning model and the conventional approach in improving students' problem-solving abilities in mathematics subjects in grade VIII of junior high school. As a result, the scientific approach proved to be more effective in improving students' problem-solving abilities, as seen from the higher post-test results in the experimental class compared to the control class.

From the results of the study with the experimental class and the control class, as well as several existing studies, the application of the scientific approach learning model has a positive effect on students' problem-solving abilities. This happens because this approach encourages students to be directly involved in the learning process, think critically, and actively seek solutions to their problems. Therefore, it is recommended that educators apply a scientific approach to learning in schools to improve the quality of students' problem-solving.

CONCLUSION

Based on the formulation of the problem, objectives, results of the analysis, and discussions that have been described previously, it was obtained that there was an influence of learning through a scientific approach on the problem-solving abilities of class VIII students at SMP Kartikatama Metro or in other words, the average problem-solving abilities of students in the experimental class were higher than the average problem-solving abilities of students in the

control class. So, it can be said that the scientific approach to learning affects students' problem-solving abilities in the Number Pattern material for class VIII.

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