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The Effectiveness of the Read, Answer, Discuss, Explain, Create (RADEC) Learning Model on Students' Mathematical Problem Solving Abilities

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Abstract

This study aims to evaluate the effectiveness of Read, Answer, Discuss, Explain, Create (RADEC) in improving students' problem-solving abilities. The study was conducted through a quasi-experimental test where a group of students were given problem-solving exercises using the RADEC model, while the other group used the Discovery Learning model. Researchers also use data collection techniques in the form of posttests and documentation related to student learning outcomes. The results showed that the use of the RADEC model significantly improved the problem-solving ability of students compared to the control group. The result of this study is that the acceptance and shows that, $t_{count}=3.957>1.994=t_{table}$, and the conclusion of this study is the ability to solve mathematical problems with the RADEC learning model better than the Discovery Learning model.

Keywords: RADEC Learning model, Mathematical ability, Problem solving.

1 INTRODUCTION

Mathematics is one of the most important subjects, in learning mathematics students are expected to understand what is being learned. Mathematics learning is basically a teaching and learning process built by teachers to develop students' thinking creativity, and can construct new knowledge as an effort to increase good mastery of mathematical material (Agustiana, Putra, & Farida, 2018; Mawaddah & Maryanti, 2016). In education, the development of problem-solving skills is one of the main goals. This ability not only helps students in learning in school, but also plays an important role in their preparation for future demands. According to research by Johnson, Smith, and Williams (2019), having strong problem-solving abilities can improve students' academic achievement in various subjects. Problem solving is one of the objectives in the learning process in terms of curriculum aspects (Alghadari & Kusuma, 2018; Rahmawati, Kusuma, & Nurrahmah, 2023). The importance of problem solving in learning is also conveyed by National Council of Teacher of Mathematics (NCTM). According to NCTM (2000) the mathematical thinking process in mathematics learning includes five main standard competencies, namely: (1) Problem Solving; (2) Reasoning and Evidence; (3) Communication; (4) Connection; (5) Representations (Hafriani, 2021). Problem-solving ability is a process in overcoming the difficulties faced to achieve the goal of the problem. Mathematical difficulties will have a direct impact on solving mathematical problems, so students will have difficulty solving mathematical problems. Thus, when students are given problems and students cannot solve the problem correctly, it can be said that students have difficulty in solving mathematical problems, where the difficulty of solving problems is the inability of students in one or more steps to solve mathematical problems (Latifah & Afriansyah, 2021). In the

national mathematics test score at the Bogor Regency level, West Java Province has decreased.

In 2016/2017 the average score was 48.57 and in 2018/2019 with an average of 41.80, this is due to the lack of understanding and level of mastery of student mathematics learning material. The level of material mastery from one of the SMP Amal Mulia 2 schools, the average score is quite low, based on the percentage of mastery for Geometry material in SMP Amal Mulia 2 students in 2018/2019 ranks lowest among Algebra materials, which is 35.70. Learning mathematics material building space is still low because there are still many students of SMP Amal Mulia 2 who still have difficulty in learning geometry material building space, causing not optimal student learning achievement in cube and block material.

Cube and block material is a branch of mathematics that is taught with the aim that students can understand the properties and relationships between the elements of cubes and blocks and can be good problem solvers. Based on observations made at school, students' low problem-solving ability can be seen when students are given daily questions related to mathematics, especially on the material Pytagoras theorem, where students tend to have difficulty in understanding and solving problems. Students have difficulty in determining the mathematical concepts used in solving problems, besides that students have difficulty in determining between known and asked from the problem. Even though understanding the problem is one of the steps to solve the problem. The stages of the error, should be able to be anticipated by students, starting from reading the questions, observing the questions, to the stage of working on the questions. However, students tend to jump to conclusions to solve the problem, resulting in and impacting the results of incorrect answers (Polya, 1973).

Math problems are tools that are used not only to help students develop their thinking skills but also help them to develop their basic skills in solving problems both problems related to mathematics and problems in everyday life. This math problem does not immediately know the strategy of solving it, so it requires knowledge, skills, and understanding that has been learned before. So that students must understand mathematical concepts and be able to apply them correctly in problem solving (Nurfatanah, Rusmono, & Nurjannah, 2018).

Math students' problem-solving abilities can affect learning outcomes. Students with good mathematical problem solving skills have better mathematics learning outcomes, while students with less mathematical problem solving skills, then their mathematics learning results are still not satisfactory. This is a general goal in learning mathematics because the ability to solve mathematical problems will certainly greatly help students in dealing with problems they encounter both in different fields of study and in everyday life. Problem-solving ability is a process that students do to complete mathematical tasks given to them by making an effort to solve the problem, and understand the solution (Amaliatunnisa & Hidayati, 2023). Students' mathematical problem solving ability, in solving problem solving to understand problems, identifying known problem problems and strategies needed to solve problems, students can explain the results of problem problems and students use mathematical formulas or symbols, involved in solving problems if associated with the learning model in this study, then the indicators used by researchers are indicators of solving ability problem according to Polya.

Problem solving indicators according to Polya there are four steps that can be taken to solve the problem, namely: (1) Understand the problem. (2) Problem Solving Planning (Make a plane), (3) Carry out the plan, (4) Look back at the completeness of problem solving (look back). Polya indicators have a clear and strategic structure in problem solving, by using polya indicators of ontr students in 93 the process of how students achieve these answers, and can also see the development of problem solving skills. Therefore, one of the efforts to improve students' mathematical problem solving skills is with the RADEC learning model.

The RADEC learning model is a model of a student-centered learning activity (Student Centered Learning) by carrying out a series of activities for understanding concepts,

collaborating, solving problems, and producing an idea/work (Ismail et al., 2022). In the application according to Gunawan et al. (2023) of the RADEC model in the learning process, there are several steps that must be considered. According to there are five stages of learning that RADEC are: (1) Reading Stage or Read ; (2) Answering Stage or Answer; (3) Discussion Stage or Discuss; (4) Explaining Stage or Explain; (5) Creating Stage or Create. The RADEC learning model provides a structured framework for dealing with problems and finding optimal solutions. By following the steps of the model (RADEC), so as to clearly identify problems, analyze in depth, develop creative solutions, provide 94ontrol94ive, and communicate well between teachers and students.

Type Discovery Learning is a model to develop a way of active learning by discovering oneself, investigating oneself, then the results obtained will be faithful and long-lasting in memory Discovery according to Astari, Suroso, and Yustinus (2018). Discovery is a learning model developed based on constructivist views. Discovery Learning discovering concepts through a series of data or information obtained through observation or experiment. Discovery learning Defined as a learning process that occurs when learning material is not presented in its final form, but is expected by students to organize themselves (Fitriyah & Warti, 2017).

In this study using a learning model that can be applied to improve problem solving skills is the RADEC learning model on cube and block material using a learning system that increases student activity, creativity and increases understanding in student learning can solve problem solving. So the focus in model effectiveness research (RADEC) on problem-solving ability for experimental classes and for 94control classes uses conventional learning models or learning models that teachers usually use in schools, namely the discovery learning model. So researchers compared the RADEC learning model with the discovery learning learning model. The goal is to determine the effectiveness of the RADEC model on the ability to solve mathematical problems in experimental classes using the RADEC model, compared to control classes using the 94 Discovery Learning model.

2 RESEARCH METHODS

The type of research used in this study is quantitative research. This research uses a quasi-experimental method, where a type of quasi-experiment that uses all intact subjects (Intact Group) to be treated (Treatment), posstest-only control design research design. This study has two research variables, namely one independent variable and one dependent variable. As an independent variable is a learning model (Yogaswara et al., 2019), the RADEC and Discovery learning models. Meanwhile, what becomes a dependent variable is problem-solving ability. The experimental class group received learning treatment: read, answer, discussion, explain, and create, while the control class group received learning treatment Discovery Learning. The place for this research is carried out at SMP Amal Mulia 2 school with the research subjects being grade VIII semester 2 students of the 2022/2023 academic year.

In research Sampling techniques with Cluster Random Sampling (Azwar, 2010), and selected class VIII D as the experimental class and class VIII A as the control class with 36 students each. The test made in this study contains the sub-subject matter of blocks and cubes. Tests are used to measure students' mathematical problem-solving abilities on block and cube material. Using the calculation of validity tests, rehabilitation tests, differentiation and difficulty levels. The test used is in the form of an essay (description) which amounts to 8 questions of cube and block material. Tests are used to obtain information on improving students' mathematical problem-solving abilities. The six questions had previously been tested for problem-solving ability test instruments through the question item analysis stage and met four test criteria, namely, validation, reliability, discriminating power, and difficulty index.

The data collection technique applied is a written test. This test aims to determine the extent of students' problem-solving abilities after learning both using the RADEC and Discovery Learning model. The data analysis technique applied in this study is described into three stages, namely, first normality test, second homogeneity test, and third independent sample *t*-test.

3 RESULTS AND DISCUSSION

The results of researchers after conducting research on student learning activities, obtained better results in the experimental class after applying the RADEC learning model. Where in the learning process students in the experimental class are given practice questions, where the questions are given with problem-solving skills and work steps in accordance with the RADEC learning model. In the step of identifying the problem, students quite easily understand the problem given by the researcher through each step contained in the student worksheet, so that students are able to determine the adequacy of the known elements of the given problem and are able to formulate a mathematical model of the existing problem. In the RADEC learning model, students are more active in asking, discussing in determining the solution of existing problems through solving steps contained in student worksheets so that students are quite easy to solve these problems. While in discovery learning model learning, there are still some students who are still confused because In discovery learning, the role of the teacher is more as a facilitator than guided learning. This can result in a lack of supervision and direct feedback from teachers to students. By providing exercises that refer to the RADEC model can improve problem-solving skills.

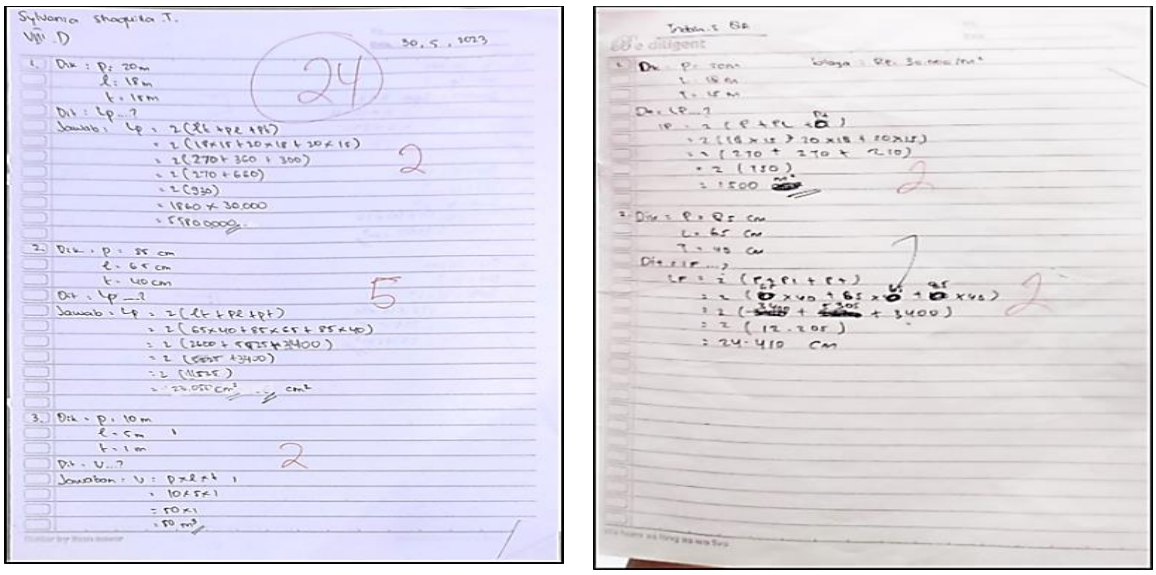
According to Wijayanto and Santoso (2018) which states that learning using teaching materials is very effective in improving problem-solving skills. To find out the problem-solving ability, students are given six essay questions that refer to indicators of problem-solving ability. The indicators of problem-solving ability according to are as follows: a) Understanding the problem, where students must be able to identify the adequacy of elements of a problem; b) Formulate / compile mathematical models, in this indicator students are expected to be able to formulate existing problems into mathematical models; c) Choosing a problem-solving strategy, in this indicator students choose a strategy to apply the mathematical model that has been created; d) Explain and check the correctness of the answers (conclude) (Polya, 1973). The research that has been carried out is a quasi-experimental research with research objects divided into two groups, namely the class VIII D experimental group and the Class VIII A control group. The RADEC learning model to the problem-solving ability of grade VIII students of SMP Amal Mulia 02 Cileungsi on cube and block material. In this study, researchers first made a test instrument in the form of 8 essay questions, the questions were then tested to meet the requirements for a good test to be used as research questions. The test requirements for good test questions are to go through several stages, namely validity tests, reliability tests, difficulty levels and different power tests.

3.1 Evaluation of research instruments

Validity test calculation Use formulas person product moment (Hidayat, 2021). Conducted on 8 questions from the variable of problem solving ability on cube and block material, the calculation results of the validity test that have been carried out the results of the validity test there are 6 valid questions and 2 invalid questions from the variable of the problem solving ability instrument, while the reliability test with method Alpha Cronbach (Arikunto, 2021) to estimate the reliability index of an instrument that Conducted on questions from the variable problem-solving ability on cube and block material, the calculation results of the reliability test carried out as attached obtained the calculation result of the reliability value of 0.72 including questions with high reliability criteria. A difficulty test is performed

to find out which questions are simple, medium or dif vels of intellectual ability, the results of the difference power test as attached to the results of the difference power test with sufficient criteria there are 6 questions and the results of the criteria that are lacking there are 2 questions, after the question test is carried out to determine sufficient test questions, then from the validity test results, Reliability tests, difficulty levels and differentiating power can be concluded that there are 6 questions that can be used as questions for research data collection. Preliminary data from students' daily math test scores for the 2022/2023 academic year, then researchers treated with posstest tests for measure the outcome or impact of the treatment or intervention given to the treatment group in the study. The results are calculated through several tests, namely the normality test, homogeneity test, and *t*-test.

To determine the level of student problem-solving ability based on indicators of student problem-solving ability, you can see the picture after the RADEC model treatment then a student posstes test is carried out on the results of student answers in Figure 1.



(a) (b)

Figure 1. Sample of Student's Answers

Figure 1(a) is the Answer from Student' Experiment Class and Figure 1(b) is the Answer from Student' control Class.

The step taken after the control class and experimental class were completed was given treatment, namely both classes were given posttest questions consisting of 6 questions that had been validated. Posttest results are carried out final data tests, including normality test, homogeneity test, *t*-test of problem solving abilities.

3.2 Normality test result

Test data normality using methods liliefors against tests of mathematical problem-solving ability. The results of normality test is presented in Table 1.

Table 1. Normality Test Results

Learning group	N	Test statistics			Conclusion
		α	L_{count}	L_{table}	
Experimental Class	36	0.05	0.109	0.147	Normally distributed
Control Class	36	0.05	0.142	0.147	Normally distributed

The results of normality calculations with the liliefors test for experimental class posttest values obtained values L_{count}=0.109 and L_{table}=0.147, at a significant level α=0.05

and n=36 because L_{count}=0.109<0.147=L_{table} then H0 is accepted, so it can be concluded that the experimental posttest values are normally distributed. As for the results of the calculation of the liliefors test for the control class posttest values, L_{count}=0.142 and L_{table}=0.147 were obtained, at a significant level α=0.05 and n=36. because if L_{count}=0.142<0.147=L_{table}, it can be concluded that the control posttest values are normally distributed.

3.3 Homogeneity test result

The homogeneity test aims to find out whether the value data from the experimental class and the control class are homogeneous or not, the homogeneity test in this study uses the test Fisher according to (Supardi, 2013). The result of the calculation of test F experimental class value and control class value to determine homogeneity, The test results can be seen in Table 2.

Table 2. Homogeneity Test Results

Learning group	N	Test statistics		Conclusion
		α	Variance	
Experimental Class	36	0.05	34.14	Homogeneous
Control Class	36	0.05	52.80	Homogeneous

The results of the homogeneity test calculation on the experimental class value and the control class value to determine homogeneity at a significant level of 5% with the numerator degree of freedom is 35 and the denominator degree of freedom is 35. If F_{count}=1.546 and F_{table}=1.757. So it is accepted if obtained F_{count}<F_{table}, it is said that the values of the experimental class and the control class are homogeneous.

3.4 t-test result

The results of the t-test calculation aim to determine whether the results of the posttest values between experimental and control classes have different average values or not. The *t*-test is also used in testing research hypotheses, accepted or rejected hypotheses. The results of the *t*-test can be seen in Table 3.

Table 3. *t*-Test Results

Sources of Variation	Experiment	Control
Number of Variations	2507	2297
N	36	36
$\bar{X}$	69.63	63.80
Variance	34.14	52.80

The results of data calculation using the *t*-test obtained value t_{count}=1.994 at the real level α=5% and dk=36+36-2=70 obtained t_{table}=1.994. It means that mathematical problem solving capabilities with the RADEC learning model are better than the Discovery Learning model. This research mathematical problem solving ability of the RADEC learning model is better than the Discovery Learning model in mathematics learning.

4 CONCLUSION

Based on the results of research, mathematical problem solving ability is an important and useful skill in various aspects of life. By developing this ability, a person can become more effective in overcoming problems and achieving success. Research conducted at SMP Amal Mulia 02 for problem-solving ability with the RADEC model in experimental class students had an average score of 69.63 higher than the control class of 63.80. Based on the average scores of the two classes and the data that have been tested, it can be concluded that the

mathematical problem solving ability of the RADEC learning model is better than the Discovery Learning model in mathematics learning.

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