

Efforts to improve mathematics problem-solving ability through problem-based learning model

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Abstract

Based on interviews conducted by researchers with one of the senior mathematics teachers at the State Senior High School Bantul 1 (for simply, SMA Negeri 1 Bantul), as well as direct observations in the field by giving preliminary tests, the researchers concluded that the ability of students in SMA Negeri 1 Bantul in solving math problems was still low. This study uses a problem-based learning model with the Class Action Research (CAR) method with data analysis techniques from the results of the problem-solving ability test given at the end of each cycle. This research was conducted in class X MIPA 1 SMA Negeri 1 Bantul with 36 students. The results showed that the results of the mathematical problem-solving ability of students of class X MIPA 1 SMA Negeri 1 Bantul increased from cycle 1 to cycle II. In the first cycle, classical completeness from 72.2% increased to 94.4% in the second cycle. Based on the description above, it can be concluded that the problem-based learning (PBL) learning model can improve students' mathematical problem-solving abilities in trigonometry material for class X MIPA 1 SMA Negeri 1 Bantul in the 2021/2022 school year.

Keywords: problem-based learning, problem-solving

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INTRODUCTION

The general purpose of learning mathematics is so that students can have problem-solving skills with the stages that must be carried out, namely: understand the problem, plan problem-solving, carry out problem-solving, and re-examine. The results of the TIMSS survey are coordinated by the IEA (International Association for the Evaluation of Educational Achievement) wherein each of its participations, Indonesia always gets results below the predetermined average. In addition, the results of an interview with a senior mathematics teacher at SMA Negeri 1 Bantul and direct observations in the field, it was concluded that students still had difficulties in solving mathematical problems. The results of the initial test showed that only 16.6% of the 36 students were able to solve the questions. Therefore, to increase students' mathematical problem-solving abilities, innovative learning methods are needed to train students to think critically in solving given problems. Problem-based learning is one of the learning models that can be used because it allows students to go through the learning process with problem-solving activities. David Esemá, et al (2012) stated "problem-based learning is a learning method that uses problems as the first step in collecting and integrating new knowledge". This problem determines the direction of learning carried out in groups. Thus, the authors are interested in improving students' mathematical problem-solving skills by applying the problem-based learning model at the Senior High School 1 Bantul in 2021/2022.

RESEARCH METHOD

This research was conducted at SMA Negeri 1 Bantul class X MIPA 1 with 36 students using Classroom Action Research (CAR) and the technique of analyzing problem-solving ability test results and was carried out in two cycles. The implementation of Cycle 1 consists of planning activities, then actions and reflections. Then in Cycle II, revisions were made in Cycle 1, then planning activities continued with action and reflection. At the end of each cycle, a test is carried out. Each student is asked to answer three questions on the test. Students are declared to have completed learning (individual completeness) if the student's correct answer scale is 70%. In addition, the class is declared to have completed its learning (classical completeness) if the class is obtained 85% of students are declared to have completed their studies.

RESULTS AND DISCUSSION

Research and data collection was carried out at the State Senior High School 1 Bantul class X MIPA 1 from March 31, 2022, to May 30, 2022. In the learning process, the model used is a problem-based learning model for class X trigonometry. Data on problem-solving abilities are obtained from test results. Tests are given at the end of each cycle. According to the results of the initial test given, out of 36 students, only 6 students or 16.6% achieved complete problem solving, 22 (61.1%) students got very low scores, 8 students (22.2%) get a low score, 3 students (8.3%) get a moderate score, 3 students (8.3%) get a high score, and 0 students (0%) get a very high score. for complete results can be reviewed in Table 1.

Table 1. Description of students' ability levels in solving mathematical problems on diagnostic tests

Mastery percentage	Ability Level	Many students	Percentage of students	Problem-solving skills
90% s/d 100%	Very high	0	0%	
80% s/d 89%	High	3	8,3%	
70% s/d 79%	Currently	3	8,3%	16,6%
60% s/d 69%	Low	8	22,2%	(Incomplete)
0% s/d 59%	Very low	22	61,1%	
	Σ	36	100%	
The average value of students			49,7	

From the description above, it appears that the provision of diagnostic tests in SMA Negeri 1 Bantul class X MIPA 1 using trigonometry material is in the very low category. According to the student's test results, several errors were found, namely: (1) The problems given are not well understood by students, (2) students find it difficult to plan the solution to the given problem because they do not know the concept of the sine and cosine rules, (3) students are less careful in carrying out each stage, resulting in operating errors, (4) students do not conclude.

Description of research results cycle I

Planning Cycle 1

At the planning stage of cycle 1, the researcher prepared an implementation plan for learning 1 according to the example of dilemma-based learning, student worksheets, and teaching and learning activity units using the trigonometry of the law of sine and cosine.

Implementation of Action Cycle 1

At the action implementation stage, the researcher acts as a teacher in the field of mathematics studies who applies problem-based learning or problem-based learning in learning scenarios that can be observed in the lesson plan. The learning activities are categorized into three stages using details of initial activities, core activities, and closing activities. The learning process in cycle 1 was carried out in two meetings.

Data Analysis Stages

After the implementation of cycle 1 took place, students are given a problem-solving ability test 1 which aims to see the success of the given action and to check the location of the mistakes made by students in solving problems related to the material about the sine rule. According to the results of the problem-solving ability test 1, The problem-solving ability of students was obtained after being given action 1 in cycle 1 in class X MIPA 1, State High School 1 Bantul. Based on the criteria for completeness of problem-solving, namely the percentage of students who reach 70%, TKPM 1 results obtained 26 of 36 students have completed solving problems with a classical percentage of 72,2. Of the 36 students, 8 students (22,2%) scored 90 who were categorized as students with very high abilities, 7 students (19,4%) scored 80-89 categorized as high-ability students, 11 students (30,6%) scored 70-79 categorized as students with moderate ability, 5 students (13,8%) scored 60-69 categorized as students with low ability, 5 students (13,9%) students scored 59 categorized as students with very low ability. The average score obtained by students is 74. More details can be seen in Table 2.

Table 2. Description of students' mathematical problem solving ability levels in Cycle 1

Mastery percentage	Ability Level	Many students	Percentage amount	Completeness of problem-solving
90%-100%	Very high	8	22,2%	72,2% (Incomplete)
80%-89%	High	7	19,4%	
70%-79%	Currently	11	30,6%	
60%-69%	Low	5	13,8%	
0%-59%	Very low	5	13,8%	
Σ		36	100%	

Action reflection stage Cycle 1

Based on the results of observations of student activities, problem-solving ability tests, and complete learning, then several things must be improved in cycle II. Following are the failures that occurred during Cycle 1 activities.

- a. At the time of group formation, the class atmosphere became uncontrollable because some students did not pay attention to the group division process so it was difficult to find a sitting area and group. This takes quite a lot of time.
- b. Students have not been able to fully complete and re-examine the results of their work. This is because students are wrong in carrying out operations on the completion steps.
- c. Students do not study the Teaching and Learning Activity Unit well so students have difficulty working on the Student Worksheet.
- d. Because a lot of time is wasted, the teacher does not convey the complete reinforcement of the material at the end of the lesson.

Description of research results cycle II

Cycle II action planning

In phase II action planning cycle, researchers prepare lesson plans II in accordance with the problem-based learning model, Student Worksheets and Teaching and Learning Activity Units for trigonometry, and questions for the test at the end of cycle II.

Stage of implementation of cycle II actions

the researcher becomes a teacher in the field of mathematics studies who will carry out problem-based learning in learning scenarios that can be observed in the Learning Implementation Plan II. The learning process in cycle II is also divided into three stages, namely the initial activity, core activities, and closing activities. The learning process for cycle II was also carried out in 2 meetings. After the second cycle was completed, students are again given a test for cycle II. The results were obtained by students after being given action in cycle II in class X MIPA 1 SMA Negeri 1 Bantul.

Based on the criteria for completeness of problem-solving, namely the percentage of students who reach 70%, The results of the Problem-Solving Ability Test II obtained 34 out of 36 students who have completed solving problems with a classical percentage of 94,4%. Of the 36 students, there were 20 students (55.6%) who scored 90 and were categorized as students with very high abilities, 11 students (30,6%) who scored between 80-89 were categorized as high-ability students, 3 students (8.3%) scored between 70-79 categorized as students with moderate ability, 2 students (5.6%) scored between 60-69 categorized as students with low abilities, and 0 students (0.0%) scored 59 which were categorized as students with very low abilities. The average grade value obtained by students is 87.2. This can be seen in full in Table 3.

Table 3. Description of Students' Mathematical Problem Solving Ability Levels in Cycle II

Mastery percentage	Ability Level	Many students	Percentage amount	Completeness of problem-solving
90%-100%	Very high	20	55,6%	94,4% (Complete)
80%-89%	High	11	30,6%	
70%-79%	Currently	3	8,3%	
60%-69%	Low	2	5,6%	
0%-59%	Very low	0	0,0%	
	Σ	36	100%	

Based on the data analysis above, 33 out of 36 students (91,6%) have achieved learning mastery in the Problem-Solving Ability Test ($\geq 70\%$). Thus, students' learning mastery in solving problems on trigonometry material in cycle II has been completed classically. The overall mathematical problem-solving ability of students can be observed in Table 4.

Table 4. Description of students' problem solving ability level each action

Number	Troubleshooting test indicator	Diagnostic test	Percentage	
			Cycle 1	Cycle II
1	Ability to understand problems	68,5%	88,8%	94,4%
2	Ability to plan problem-solving	41,2%	86,1%	88,9%
3	Ability to carry out problem-solving	62,6%	44,4%	86,1%
4	Ability to re-examine the completion procedure	27,7%	61,1%	72,2%

The full results can be seen in Figure 1.

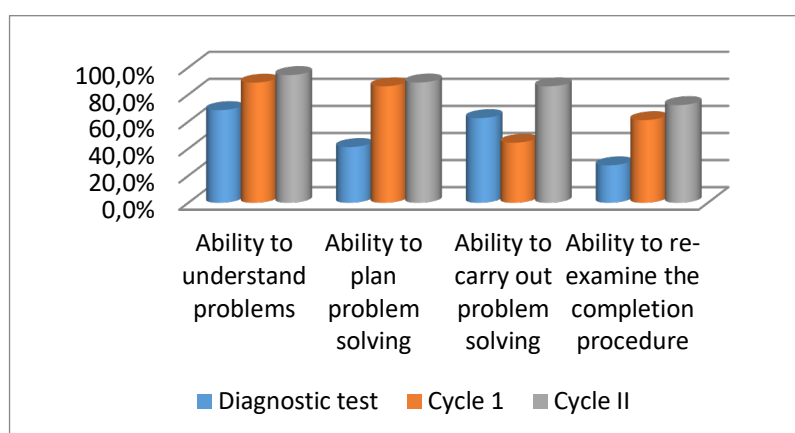


Figure 1. Description of students' mathematical problem solving ability in each action

From the description above, it shows that there is an increase in classical completeness in the ability of students to solve mathematical problems in the application of problem-based learning models on trigonometry material. This is in accordance with the analysis of the mathematical problem-solving ability test of students in class X MIPA 1 SMA Negeri 1 Bantul. after the implementation of learning cycle 1 and cycle II, an increase in the ability of students in solving mathematical problems. on the diagnostic test, there are only 6 students or 16,6% of the 36 students who achieve minimal mastery classically, but in cycle 1 it increased significantly to 26 students or 72,2% had achieved classical mastery. It means that from the diagnostic test to the Problem Solving Ability Test 1, 20 students or 55,6% have achieved mastery in solving problems. In the second cycle, it increased again to 34 students or 94,4% who had achieved complete problem-solving. That means, from cycle 1 to cycle II, 14 students or 38,9% have reached completeness in solving problems.

CONCLUSION

Based on the data analysis of students' problem-solving ability tests, it was found that the level of students' mathematical problem-solving ability increased from cycle 1 to cycle II. In the first cycle of classical completeness, 72,2% increased to 94,4% in the second cycle. It means that from cycle 1 to cycle II, there are 14 students 38,9% who have achieved mastery in solving problems. In addition, there was also an increase in students' mathematical problem-solving ability test results from every aspect of problem-solving from cycle 1 to cycle II. In cycle 1, the highest problem-solving aspect was obtained in the aspect of the ability to understand problems with a percentage of 88,4% in the high category, while the lowest problem-solving aspect was obtained in the aspect of carrying out problem-solving with a percentage of 44,4% in the incomplete category. In the second cycle, the highest problem-solving aspect was obtained in the aspect of the ability to understand problems with a percentage of 94,4% with the complete category, while the lowest problem-solving aspect was obtained in the aspect of the ability to carry out problem-solving and the ability to re-examine which had the same percentage with a percentage of 72,2% categorized as incomplete. Based on the description above, it can be concluded that the problem-based learning (PBL) learning model can improve students' mathematical problem-solving abilities in the trigonometry material for students of class X MIPA 1 SMA Negeri 1 Bantul in the 2021/2022 academic year.

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