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IMPROVING STUDENTS MATHEMATICAL PROBLEM SOLVING ABILITIES BY USING PROBLEM-BASED LEARNING APPROACH

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Abstract

This study aims to develop learning tools with a problem-solving approach and to analyze the effect of using a problem-solving approach on problem-solving abilities in mathematics problem-solving abilities in grade V SDN Susukan 04 as many as 23 students. The research was conducted at SDN Susukan 04. The method used in this study was the Plomp development model which consisted of three stages: (1) Preliminary Research; (2) Prototyping Phase; (3) Assessment Phase. The subjects in this study were students of class V SDN Susukan 04. The type of data in this study was quantitative. This quantitative data was obtained from the validation result score, the score of 10 students on the observation sheet and the learning material mastery test (TPBA) score. The validation phase of teaching materials developed with the Problem-based Learning approach and validation of the problem-solving ability test. Seeing what happened to students, it was necessary to strive the development of the teaching materials to improve problem-solving abilities in learning Mathematics with the Problem-based Learning approach, as the importance of solving abilities learning problems in teaching success. The test for the difference in the problem-solving ability test of the experimental class and the control class could be seen from the mean of the experimental class = 78.70> the mean of the control class = 64.76. So it can be concluded that the average problem-solving ability of the experimental class students were higher than the problem solving ability of control class students.

Keywords: problem solving ability; teaching materials; problem based learning

Abstrak

Penelitian ini bertujuan untuk mengembangkan perangkat pembelajaran dengan pendekatan pemecahan masalah dan menganalisis pengaruh penggunaan pendekatan pemecahan masalah terhadap kemampuan pemecahan masalah kemampuan pemecahan masalah matematika pada siswa kelas V SDN Susukan 04 sebanyak 23 siswa. Penelitian dilakukan di SDN Susukan 04. Metode yang digunakan dalam penelitian ini adalah model pengembangan Plomp yang terdiri dari tiga tahap yaitu: (1) Penelitian Awal (Preliminary Research); (2) Fase Pengembangan (Prototyping Phase); (3) Fase Penilaian (Assesment Phase). Subyek uji coba pada penelitian ini adalah siswa kelas V SDN Susukan04 Jenis data pada penelitian ini adalah kuantitatif. Data kuantitatif ini diperoleh dari skor hasil validasi, skor10 siswa pada lembar observasi dan skor hasil tes penguasaan bahan ajar (TPBA). Tahap validasi terhadap bahan ajar yang dikembangkan dengan pendekatan problem based learning dan validasi pada tes kemampuan pemecahan masalah. Melihat yang terjadi pada siswa, maka perlu di usahakannya pengembangan bahan ajar untuk meningkatkan kemampuan pemecahan masalah belajar matematika denngan pendekatan Problem Based Learning, mengingat pentingnya kemampuan pemecahan masalah belajar dalam keberhasilan mengajar. Uji perbedaan tes kemampuan pemecahan masalah kelas eksperimen dan kontrol dapat dilihat bahwa mean kelas eksperimen = 78,70 >mean kelas kontrol = 64,76 Jadi dapat dikatakan bahwa rata-rata kemampuan pemecahan masalah siswa kelas eksperimen lebih tinggi dari pada kemampuan pemecahan masalah siswa kelas kontrol.

***Kata kunci**: kemampuan pemecahan masalah; bahan ajar; problem based learning*

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INTRODUCTION

Education is a vehicle for preparing a generation that is independent, creative, responsible, and has noble character. One of the subjects that plays a role in realizing these educational goals is mathematics. According to the National Council of Teachers of Mathematics (NCTM, 2000) people who have mathematical competence can open doors to a more productive future.

One of the math competencies that is required in the 21st century is problem solving. The purpose of mathematics subjects in schools is to enable the students to solve the problems which include the ability to understand problems, design mathematical models, solve the models and interpret the solutions obtained (Faturahman, 2015).Based on the stated problems, it is necessary to grow mathematical creative thinking of the students who do not like mathematics to improve their learning outcomes. Cooperative learning promotes creative thinking by increasing the number of ideas, quality of ideas, feelings of stimulation and enjoyment, and originality of expression in creative problem solving (Buchori & Cintang, 2018).

Based on research conducted by PISA (OECD, 2012), it shows that 0% of Indonesian students are at level 6 mathematics ability, in fact almost 80% of students are still in level 1 of the 6 levels specified. In addition, the average score of Indonesian students' mathematical ability of 371 is still below the 2009 PISA score of 496, ranking 61 out of 65 countries. In line with the PISA research, the results of the research conducted by TIMSS show that in 1999, 2003, and 2007, the mathematics learning achievement score shows that 8th grade students in Indonesia obtained scores of 403, 412, and 405, meanwhile in 2011 Indonesia achieved this score of 386. This score is still under the average scale which is determined, namely 500 (Ar-raniry, 2016). Problem solving is an important component of the mathematics curriculum and it contains the core of mathematical activities, so that the problem solving skills need to be a concern in the learning process. Understanding mathematics using real problems requires learning that really designs a learning environment with real or real problems with student activities (Farhan, 2014). Many theories and experts state how important problem-solving skills are. Problem solving must be the focus of learning mathematics. One of the general goals of learning mathematics is that students have problem solving abilities (Haghverdi et al., 2011).

Learning and teaching activities in the education and training process have an important role in presenting permanent information to students. In order to enable students to learn better, their advanced mental process skills have to be developed. In other words, the skills needed in order to create solutions for problems and learn by comprehension instead of memorizing have to be given to students (Aksoy, 2012). The meaningfulness of learning mathematics is characterized by awareness of what is done, what is understood and what is not understood by students about facts, concepts, relations, and mathematical procedures. Based on the observation results, there are some students of SDN Susukan 04 who have difficulties when entering the geometry material. The results of an interview with one of the teachers also shows that his mastery of mathematics, especially calculating the

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volume of cubes and cuboids, is 54.40%. The results of the preliminary research indicated that only half of the students had completed classical study, meanwhile the other half had the ability to solve questions under standard. Furthermore, the teacher explained that the students tend to experience difficulties when doing the solving problems in building materials. Students also still have difficulty understanding contextual problems. As a result, students are not able to model the problem in a mathematical form. Therefore, the problem solving ability of SDN Susukan 04 students is still low. The current use of teaching materials does not support the students' abilities. In addition, a research conducted by (Vera Rosalina Bulu, 2020) also states that the teaching materials used by teachers are teaching materials assistance for teachers in providing training to students where the teaching material does not facilitate teachers in carrying out learning. Mathematics teaching material is a set of mathematics material that is arranged systematically both written and unwritten in such a way so that it can create an environment or atmosphere that allows students to learn mathematics (Ibrahim, 2011). The mathematics teaching materials to develop problem solving skills at SDN Susukan 04 have not been developed. Teaching materials do exist, but it is only a formality to meet the administrative demands.

The problem solving method can affect students' mathematics learning achievement. The results of Pugalle indicated that there were significant differences in the academic achievement of students who were taught through the traditional methods and problem-solving methods (Pugalle, 2010). The result of this study indicates that there are significant differences in the academic achievement of students who are taught through traditional methods and problem-solving methods. In addition, it was also found that students' academic achievement is better taught through problem-solving methods compared to students taught through traditional methods

One way that can be taken to improve problem-solving skills is by presenting a contextual problem that stimulates the students to learn. This method is known as Problem Based Learning. Problem Based Learning is designed to stimulate higher-order thinking in problem-oriented situations by encouraging student cooperation in groups to complete tasks (Kiptiyah, 2016). PBL can be started by developing problems that: (1) capture the students' interest by relating it to the issues in the real world; (2) describe or bring the previous students' experiences and learning; (3) integrate the content of the learning purposes with the problem solving skills; (4) require cooperation, multi-staged method to solve it; and (5) require students to carryout some independent researches to collect or obtain all information relevant to the problem (Nu'man, 2015).

After state of the art of previous research survey, in mathematical learning, using problem solving strategies has an impact on student's abilities and skills. The result of the study show that the problem solving approach affects the ability and academic achievement of students. Makes it easier for students to solve difficult problems and contributes to student achievement and knowledge development. The level of achievement of students taught by problem solving methods is different from conventional teaching methods (Tambunan, 2019).

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Students who have kinesthetic learning styles do not have the same pattern in solving mathematical problems with the Polya stage (Huda & Suyitno, 2017). Most of the students at SDN Susukan 04 tend to experience difficulties when they learn the geometry material. The result of mathematical mastery paticularly in calculating the volume of cubes and cuboids is 54.40%. The students also still have difficulty in understanding contextual problems. As a result, the students are not able to model the problem in a mathematical form. Thus, the problem solving ability of SDN Susukan 04 students is still low. Therefore, it is necessary to develop teaching materials on cube and cuboid material with a problem-solving approach so that the problem-solving abilities of fifth grade students at SDN Susukan 04 can improve.

METHOD

This research is a development research with a quantitative approach. This development research used the Plomp development model design research, which consists of three phases: (1) Preliminary Research; (2) Prototyping Phase; (3) Assessment Phase. The research subjects were the fifth grade students as many as two classes of SDN Susukan 04 Semarang Regency, the material to be given was about cubes and cuboids by taking two classes, namely Class Va as the control class as many as 23 students and class Vb as the experimental class as many as 23 students.

In the Preliminary Research, the observations and analysis of student behavior in learning activities in class V SDN Susukan 04, the assessment of the geometry materials, and investigation of supporting sources used by teachers in learning were implemented. This was needed as a reference in preparing materials to overcome the students' abilities in solving Mathematics problems. The initial statge of the research was drafting the problem solving ability tests. The assessment on this test was limited to the cognitive applications that referred to the problem solving. The test consisted of 10 items with the time allocation of 80 minutes. The test was equipped with the answer key and the assessment norm. The scoring norm was adjusted to the quality of each item, where the scores were assigned to the questions. The student's answer was consulted with the answer key, the result of the student's answer to each item of the question was added.

In the Prototyping Phase, the product development that supported Mathematics learning with the problem-based learning approach was implemented. At this stage, it was not only the research products which were developed but also the assessment instruments that were used to measure the validity (using the judgment from the experts), the practicality (assessments using student responses on a limited scale test) and the effectiveness (the results of the product implementation) of the research products. The product which was developed is a textbook with a problem-based learning approach. The Prototyping Phase was the development of the cube and cuboid teaching materials and test instruments (TKPM) refers to the problem-based learning approach.

The last phase was the assessment phase. In order to fulfill the practical and valid requirements oft the products that had been developed in the previous phase, the first stage was a validation test to measure the validity of the product which would be utilized to

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measure the certainty and effectiveness of the product. This validation test was carried out by two validators who are experts of Mathematics learning. The instrument used was a mastery test of teaching materials. Furthermore, after the revision of the validation test had been carried out, the product of this research was tested on the trial subject for product effectiveness and effectiveness.

The implementation stage was not carried out explicitly but was integrated in the implementation of the research, that was when conducting field trials of learning devices in the scope of the research subject.The implementation in a broader scope was not carried out in this study, due to the limitations of the situation and conditions of research implementation.

The technique and data analysis used validity, practicality and effectiveness tests. Before treating the experimental class and the control class, a pretest was carried out in the class experiment and control class to determine whether the variance before being treated is homogeneous and normal.

RESULTS AND DISCUSSION

The results of the homogeneity and normality test for the experimental class and control class using the calculation of SPSS is based on the output sig value (Table 1) is 0.460> 0.05, so it can be concluded that the variance of the experimental and control groups was homogeny.

Table 1. Test of homogeneity of variances

Levene Statistic	df1	df2	Sig.
.554	1	44	.460

The results of the normality test for the experimental class and the control class were also obtained using calculations SPSS based on the output sig values (Table 2) are 0.200 for the experimental class and 0.100 for the control class (both variances are more than 0.005) so it can be concluded that the variance of the experimental and control groups is normal.

Table 2. Test of normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Kontrol	.063	23	.200*	.702	23	.622
Eksperimen	.060	23	.100*	.634	23	.680

Then the effectiveness test was carried out on the device being developed. Testing is done for fulfilling one measure of the effectiveness of the learning device. The data obtained are in the form of data student activity. Student activity data were obtained using observation sheet instruments. Besides data activity required is also a test of problem-solving abilities used to measure ability student problem solving at the end of the lesson. Problem-solving ability tests are also conducted in control class. The results of the calculation of the t value of the control class = 2.398 (Table 3), and the t value for the experimental class = 4.114 (Table 4), so it can be said that the experimental class is better than the control class. From the results of sig 0.025 <0.05 (Table 4), it can be said that there are differences in the problem-solving abilities of the control and experimental classes.

Table 3. One-sample test control class

	Test Value = 70					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
eksperimen	4.114	22	.000	8.696	4.31	13.08

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Table 4. One-sample test experiment class

	Test Value = 70					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
kontrol	2.398	22	.025	3.913	.53	7.30

The test for the difference in the problem-solving ability test between the experimental and control classes can be seen that the mean of the experimental class> the mean of the control class. So it can be said that the average problem solving ability of the experimental class students is higher than the control class students' problem solving ability (Table 5).

Table 5. Group statistics

	klasnew	N	Mean	Std. Deviation	Std. Error Mean
kpm	kontrol	23	64.76	6.496	1.636
	eksperimen	23	78.70	10.137	2.114

The problem solving ability of students in the experimental class is influenced by other variables, namely student interest. Obtained the value of R square = 0.729. Or in other words, the students' problem solving ability in the experimental class is influenced by other variables, namely the student's interest of 0.729 or 72.9% (Table 6)

Table 6. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.844[a]	.729	.696	6.523

The results of this study discussed about the quantitative approaches and development related to the improvement of mathematical problem solving. The presentation of the development and quantitative approach contains data and analysis of the validity, practicality and effectiveness of mathematics teaching materials related to the problem-based learning approach for fifth grade students of SDN Susukan 04.

The results showed that the students' problem-solving abilities improved after learning using the problem-based learning, this can be seen from the results of the statistical tests which show that the sig results of the experimental class and the control class show 0.03 <0.05 in line with the results of the study (Rahmawati, 2014). States that there is a positive correlation between students who are given a problem-solving approach and the tools they compile. In addition, it was also found that the students' problem solving abilities were better than students who were taught through conventional (Anugraheni, 2013).

The validation stage of the teaching materials developed using problem-based learning approach and validation on the problem-solving ability test. Some of the revisions made on the teaching materials were developed with realistic mathematics learning and problem-solving ability tests and it was carried out by the validators. The results of the assessment of draft 1 (Diputra, 2016) stated that there was a positive response from students towards the problem solving tools developed, this was equivalent to the development of the teaching materials book which had an average score of 3.26 and had very good criteria with good conclusions, so it could be used. The validator's assessment of the problem-solving ability test was based on the indicators contained in the validation sheet. The results of the assessment obtained valid criteria with an average score of 3.32 and had very good criteria with good conclusions, so they could be used. The results of the tools were then tested in the trial class in fifth grade of SDN Susukan 04. The test of the exam questions was carried out including: (1) the reliability test obtained the

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reliability coefficient r_{11} = 0.79. In accordance with the reliability criteria, it can be concluded that the problem-solving ability test had high reliability, (2) the difficulty level test showed that 1 item with easy classification, 7 items with moderate classification, and 2 items with difficult classification, (3) the difference power test showed that 2 items with very good classification, 8 items with good classification. The results of the items analysis were then used to select as many as 8 items in the final draft of the problem-solving ability test. Before doing the treatment, a pretest was carried out in the experimental class and the control class to determine whether the variance before being given the treatment was homogeneous and normal or not. The results of the homogeneity and normality test of the quantitative approach class and the development class using the SPSS calculation based on the output sig value was 0.460> 0.05, so it could be concluded that the variance of the experimental class and control class groups was homogeneous. The calculation of SPSS based on the output of the sig value was 0.200 for the experimental class and 0.100 for the control class (both variances are more than 0.005), so it could be concluded that the variance of the experimental class and control class group was normal. Then the effective-ness test was carried out on the tools that were being developed.

Tests were carried out to meet the measure of effectiveness of the learning device. The data obtained was in the form of student activity data. The student activity data were obtained using observation sheet instruments. In addition to the activity data, the problem-solving ability test was also needed to measure the students' problem-solving abilities at the end of learning. Judging from the results of sig 0.003 <0.005, it could be said that there were differences in the problem solving ability of the experimental class and the control class. The difference test of the problem-solving ability both the experimental class and the control class could be seen as follows: the mean of the experimental class = 8.70>the mean of the control class = 64.76. It could be said that the problem solving ability of the experimental class is higher than the control class.

Based on the whole results of mathematics problem-solving ability test, it could be seen that the percentage of students who completed their studies reaches 70%. This means that the percentage of the students who completed their studies falls into good criteria. This also means that the mathematics teaching materials developed are effective in terms of students' mathematics learning achievement. The results obtained by researchers in this study were relevant to the results of the previous studies which stated that problem-based mathematics teaching materials can facilitate or develop and train students' problem-solving abilities and mathematics learning achievement.

The field trials included the implementation phase were conducted to determine the feasibility and effectiveness of mathematics teaching materials developed. At this stage, mathematics teaching materials were used in learning. Initially, the students were very enthusiastic in participating in learning, but there were problems when they read and understood the contents of the student books used. It was started with the teacher greeting and students answering the greetings, the teacher provided the motivation, perception and explained the learning material that would be learnt.

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Furthermore, the teacher distributed the student books that had been designed by researchers and the teacher instructed the students to read the book on the first page regarding to the introductory material in a form of problems related to everyday life related to what they learnt. Initially some students had difficulty understanding the material in the student books, even though at the previous development stage revisions had been made.

After understanding the problems contained in the student books, the teacher instructed the students to carry out investigations in order to solve the problems that exist at the beginning of the student books. Investigating problems was in the form of understanding concepts and finding formulas with presentations followed by illustrated images in real life so that the students did not only imagine but also saw and could easily find the concepts in the material being studied. In addition, at the problem investigation stage students could discuss intensively so that they would ask, answer, critique, correct, and clarify each other about their mathematical concepts or arguments that arouse in the discussion. In this activity it also allows the development of students' abilities to make, refine, and explore conjectures in order to strengthen their understanding of the mathematical concepts being studied, or towards the mathematical problems being solved. These activities allowed the students to collect and analyze information, carry out investigations, and make conclusions. Thus, the atmosphere of cooperation in groups as described above could train and develop mathematical problem solving skills.

From the description above, it can be concluded that the development of teaching materials with problem-solving approach is valid, practical and effective. It is valid is because it is based on the results of expert validation. It is practical because it is based on the responses of students and teachers regarding to the teaching materials developed, and it is effective from the results of the experimental group treatment on the development of the teaching materials provided, so it can be concluded that the teaching materials of the problem solving approach are effective to improve the problem solving skills in fifth grade student of SDN Susukan 04.

This is in line with Ibrahim (2011) research that PBL can better facilitate students in problem solving, communication and group work., and PBL can be started by developing problems that: (1) capture the students' interest by relating it to the issues in the real world; (2) describe or bring the previous students' experiences and learning; (3) integrate the content of the learning purposes with the problem solving skills; (4) require cooperation, multi staged method to solve it; and (5) require students to carryout some independent researches to collect or obtain all information relevant to the problem (Nu'man, 2015). PBL makes it easier for students to solve difficult problems and contributes to student achievement and knowledge development (Tambunan, 2019). PBL can improve students' problem solving and kinesthetic (Huda & Suyitno, 2017). In other words, mathematics teaching materials developed with a special content of problems in the teaching material can directly enable students to solve mathematical problems with the help of related learning models such as problem-based learning models.

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CONCLUSION AND SUGGESTION

Based on the research objectives, the results of the research analysis and knowledge that have been described above, it can be concluded that the research conclusion is that the problem-solving abilities of the students increase with the provision of a problem-based learning approach. The difference test of the problem-solving ability of the experimental class and the control class showed that the difference test of the experimental class was greater than the control class (78.70> 64.76). So it can be concluded that the average problem solving ability of the experimental class students is higher than the control class students' problem solving abilities

Suggestions from research that have been carried out are as follows: (1) Further research is needed to improve the problem-solving skills of students in Mathematics, (2) This research have gone through 3 stages, namely the initial research, the development stage and the assessment stage. To find out how effective this teaching material is and how it differs from other learning, it is necessary to continue with other research such as experimental research or applied to class action research.

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