

WORD PROBLEMS PMRI OF ALGEBRA FORM TO KNOW THE ABILITY OF MATHEMATICAL PROBLEM SOLVING OF THE STUDENTS CLASS VII

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Abstract

This study aims to produce a form of algebra word problems PMRI valid and practical, as well as having a potential effect was to determine the ability of mathematical problem solving of the students class VII. The development research carried out in two stages preliminary and formative evaluation. The research subjects are students of class VII 8 SMP Negeri 1 Palembang. Data collection techniques in this study is the walk through to determine the validity of the story about, the documentation to determine the practicality of word problems and tests to determine the potential effects of a math problem-solving abilities of the students. Valid found that about stories that have been developed have appropriate content, and language constructs. Practical results obtained from tests on small stages where the group is about the story that has been developed is easy to use by users and easy to use by students. The results of the field test showed that about stories that have been developed have a potential effect on the ability of mathematical problem solving of the students class VII, namely the emergence of diversity measures and mathematical problem-solving strategies on students' answers. This is consistent with the results of the field test found 47,8 % included in the excellent category and 30,4 % included in both categories.

Key words: research development, word problems, PMRI approach, problem solving of math

INTRODUCTION

The curriculum is closely related to education. The implementation of the curriculum is also very related to each subject in the implementation of education in schools. One of the subjects is on the curriculum in 2013 to the level of junior high school (SMP) is a mathematical (Kemendikbud, 2012: 15) and one of the juridical foundation curriculum is Ministerial Regulation RI No. 22 In 2006 (Kemendikbud, 2012: 3). Based on the above, the Ministerial Regulation RI No. 22 In 2006 one of the goals is to solve a mathematics problem that includes the ability to understand the problem, devised a mathematical model, solve the model and interpret the obtained solution (Rahardjo and Waluyawati, 2011:1).

Problem solving begins with a problem. Problems in mathematics can be presented in the form of matter is not a matter of routine in the form of word problems, depictions of phenomena or events, images or illustrations puzzle (Lidinillah, 2008: 2). Therefore, the ability of the students in solving the problem may begin with the provision of non-routine problems in the form of word problems.

Word problems are presented in the form of a story and related to circumstances experienced by students or close to daily life (Sumarno, 2008: 3). In the word problems, there are several things to consider students to assist in solving the problem at about the story. According Sumarno (2008: 3) in word problems, there are several ways that can help students in dealing with questions about the word problems is read carefully, separating and revealing (what is known, asked and done), making a mathematical model of the problem, solve the model by mathematical rules, and returns the answer to the model answer to the original question.

According Sumarno (2008: 2) word problems are one of the matter that most students like less and less successful because the word problems are not merely a matter of simple mathematical, but intersect with issues of language and modeling of everyday life. In addition, according to Bahri (2009: 78) only 40% of students were able to complete math word problems well. Means there are 60% of students who are less skilled in solving word problems.

Factors affecting students in problem solving is the students' understanding about the sentence, concept mastery of the students, the quality and quantity of the story about the teacher and student accuracy in reading, understanding and working on the story (Khoiriyah, 2009: 109). Therefore, the quality and quantity of word problems about a given teacher is one of the factors that affect students in problem solving on word problems. Based on the above, the teacher attempts to make a good word problems become an important part of student success in achieving mathematics courses. Apart of word problems that have been developed, the learning approach used in the learning process also greatly affects the ability of students in mathematical problem solving word problems that have developed them. According Darhim quoted (Syaiful, 2012: 38), one approach is seen as an approach to mathematics learning is expected to enhance the students' skills in mathematical problem-solving approach is Realistic Mathematics Education (PMR).

According to research Zulkardi (2002: 11) that the approach can PMRI be a promising approach for implementation in Indonesia, in accordance with the principles and characteristics PMRI. According Gravemeijer (2004) there are 3 principles of PMRI in accordance with the principles of RME namely: (1) Guided Reinvention; (2) Didactical Phenomenology; (3) Self Development Models. According Zulkardi (2002: 29) there are 5 characteristics of PMRI in accordance with the characteristics of RME, namely: (1) using the contextual issues; (2) using a model or a bridge with a vertical instrument; (3) using the contributions of students; (4) interactivity; (5) is integrated with other learning topics.

Previous research had never developed a realistic approach that is Syaiful (2012). The results of this study showed that PMR approach can enhance mathematical problem solving ability junior high school students, because the principles and characteristics of the PMR approach are focused on solving the problem, so it will make the students always try to solve mathematical problems. Therefore, the approach is expected PMRI mathematical problem solving ability of students can be known from about the word problems that have been developed.

Based on the above, in this study researchers developed a form of algebra word problems using PMRI approach to know ability of mathematical problem solving students as word problems is a one of the problems that can be used to know the ability of mathematical problem solving students.

Based on the above background, the formulations of the problem of this research are: (1) how to develop a word problems of algebra form using PMRI approach to know the ability of mathematical problem solving of the students class VII valid and practical? (2) how the potential effects of the administration of word problems of algebra form using PMRI approach to know the ability of mathematical problem solving of the students class VII of SMP Negeri 1 Palembang?

The purpose of this study was to: (1) generate the word problems of algebra form using PMRI approach to know the ability of mathematical problem solving of the students class VII valid and practical; (2) know the the potential effects of the giving the word problems of algebra form using PMRI approach that have been developed for the test results to know the ability of mathematical problem solving of the students of class VII of SMP Negeri 1 Palembang.

RESEARCH METHOD

This research was conducted in the second semester of school year 2013-2014. The subjects were students of class VII 8 SMP Negeri 1 Palembang. The research method in this study is the development of a research or development (Akker et al, 2006: 4). This research will develop a form of word problems of algebra form using PMRI approach to know the ability of mathematical problem solving of the students class VII. This development is done in two stages: preliminary and formative evaluation stage. Preliminary phase consists of analysis and designing, while the formative evaluation phase consists of self evaluation, expert reviews, one to one, small group and field tests (Zulkardi, 2006).

In the preparation stage of the analysis includes the analysis of junior high school curriculum in 2013, the analysis of class VII, and analysis about the story according to the material. At the stage of designing, researchers designing assessment instruments that include writing indicators, manufacture lattice problems that are relevant to the core competence, basic competence and materials, as well as word problems according to the material and problem-solving steps.

In the self-evaluation carried out by the researcher's own assessment of the matter that the story has developed. The results of word problems is referred to as the first prototype. At this stage of expert reviews, the results of which have been developed about the story given to the expert. Experts (validators) validate the results of the first prototype. At this stage, the expert gives suggestions and comments, as well as written on the sheet validation is used to revise the questions on the first prototype.

In stage one to one, the researchers tested the word problems the first prototype. The results of students' answers and comments of students when the test is used to revise the word problems the first prototype. The results of the revision of the first prototype named second prototype. The second prototype is tested on a small group (small group). At this stage, prompted 6 students of class VII to solve word problems that have been

developed to look and comment on the practicality of the matter in the second prototype. The results of students' answers and comments of students at this stage are used to revise the word problems of the second prototype. The results of the testing and revision of the second prototype are called the third prototype.

The third prototype was tested to a broader scope. The third prototype was tested to the subject of research to know the ability for mathematical problem solving student of class VII.

Techniques of Data Collection

Walk Through was carried out to get advice and comments for revising the instrument from the experts word problems. Experts give advice and comments focused on content, constructs and language.

Document used is curriculum 2013. Documents were also obtained from testing one to one form of student answer sheets and sheets of comments/advice students on the first prototype. In addition, documents obtained from testing a small group of students answer sheets and sheets of comments/advice students on the second prototype, that is to know about the practicality of the word problems that have been developed.

Tests were conducted to determine the potential effects of word problems that have been developed to know the ability of solving problem students of class VII. This test is performed on the stage of the test field. The test used was a written test with essay form. Tests were performed on the stage field test to determine the ability of mathematical problem solving of the students class VII.

Analysis Techniques of Data

Data from the validation of the experts in the form of advice and comments on the stage of expert reviews analyzed descriptively. In addition, the results of the validation of the validator to word problems that have been developed, were calculated according to the Likert scale. Scores have been obtained, adapted to the validity of the categories word problems. After that, the results were analyzed descriptively. The validity of the categories shown in Table 1 below:

Table 1. Categories validity of Problem have been developed.

Score intervals	Category
29 – 35	Best
22 – 28	Good
15 – 21	Enough
8 – 14	Less
0 – 7	Least

(Sugiyono Modification., 2013: 95)

Document analysis is to analyze the curriculum in 2013. Documents obtained from testing one to one form of student answer sheets and sheets of the students' comments on the first prototypes were analyzed descriptively. In addition, documents obtained from testing a small group of students answer sheets and sheets of student comments on the second prototype also analyzed descriptively, that is to know about the practicality of the word problems that have been developed.

Analysis of the test results to know potential effects the ability of mathematical problem solving of the students of the test results on the field test stage. Based on the scores obtained by each student was then given a score for each student that can be obtained from the calculation with the formula:

$$\text{Value of Students} = \frac{\text{Scores Obtained}}{\text{Maximum Score}} \times 100$$

(Arikunto Modification, 2012:272)

The value of each student was analyzed descriptively with regard category value problem-solving ability of the students as shown in Table 2 below :

Table 2. Categories Value Problem Solving Ability.

Interval Nilai	Kategori
80-100	Best
60-79	Good
40-59	Enough
20-39	Less
0-19	Least

Arikunto Modification (2012: 281)

RESULTS AND DISCUSSION

Based on previously described frame of mind, there are two stages in this research is preliminary and formative evaluation. In analysis, the researcher conducted an analysis of students that aimed to know number of students. Grade students VII 8 totaling 25 students with details of 9 men and 16 women. Analysis of the material that identifies junior mathematics instructional materials in accordance with the curriculum of 2013. Material in the research is a form of algebra that will be used as an instrument of word problems using PMRI approach. The algebraic form of the material is also associated with triangular and quadrilateral material. Analysis of the curriculum used is the curriculum in 2013, the structure of the curriculum in 2013 for all subjects are core competencies of spiritual attitudes, social attitudes, knowledge and skills. In addition, core competencies revealed to be the basis of competence, as defined basic competencies to achieve core competencies.

At the stage of designing is a story about the design using PMRI approach made includes word problems, gratings problem, question cards and answer key. Researchers develop word problems using PMRI approach that consists of 5 questions.

In the self-evaluation phase, researchers conducted a self-assessment of word problems that have been developed. The story about the researchers have developed based on the content, construct, and language. The next question that has been designed validated by experts and teachers on stage expert reviews. In addition, the first prototype was also tested in phase one to one and a revised which aim to produce better about the second prototype. At this stage of expert reviews, all items were validated by experts and teachers in terms of content, construct, and language. The first prototype is validated by experts and teachers, namely: (1) Muhammad Yusuf is Lecturer Faculty of Teacher of Mathematics Unsri; (2) Riza Agustiani an Outstanding Lecturer; (3) Nurjannah a seventh grade mathematics teacher of SMP Negeri 1 Palembang.

At this stage, the results of the validation have been found that the level of validity of the questions included in the category of very good and good. Comments and advice from experts and teachers are good enough, but it should be noted again that context is used in the word problems, writing indicators, the composition of matter and the meaning of each sentence in the problem. Based on the validation of the experts and the teachers, the researchers correct the first prototype according with the advice and comments validator.

In stage one to one, the first prototype was tested in 3 student of class VII 3 SMP Negeri 1 Palembang. Answer sheets and sheets of the students' comments were analyzed in order to know the difficulties that may occur during the learning process using the problem. Based on the five questions that have given that to problem number 1, 4 and 5 are easy to understand in the answer. Then to problem 2 and 3 students commented that it is difficult because students are not familiar with the story problem the need of mathematical problem solving ability. Based on this first prototype corrected become the second prototype.

Phase small group aims to look at the practicality of the second prototype. Small Tests group consisted of 6 students of class VII 3 SMP Negeri 1 Palembang. Based on the answers to the problem and comments of students who have analyzed the general conclusion that the students are already good in answering the problem on the second prototype, and the prototype is easy to use by users and easy to use by students. Student comments on the five questions given researchers are to problem number 2 and 4 have almost all the students to understand, but it needs to be revised or corrected slightly in terms of sentence structure in problem, whereas for problem 1, 3 and 5 are easy to understand and understood students. Based on the corrected second prototype became the third prototype.

Phase field test is to determine the potential effects on the test results in the form of students' mathematical problem solving ability. Researchers present 5 problems form essay. The results of the field test of the diversity are seen in the students' solutions to solve problems, to determine the potential effects of a math problem-solving abilities of the students. The test is given with reference to that student is considered to have a potential effect in solving the question if there are steps in solving mathematical problems. In accordance with the results of field tests that have been done, for the percentage of students whose test results are shown in Table 3 as follows:

Table 3. Percentage Test Based Category Test.

Student Value	Category	Frequency	Percentage(%)
80-100	Very Good	11	47,8
60-79	Good	7	30,4
40-59	Enough	4	17,4
20-39	Less	1	4,4
0-19	Very Less	0	0
Total		23	100

Discussion

The process of development that has been made at the preliminary stage and formative evaluation, obtained using the word problems of algebra form using PMRI approach to know the ability of mathematical problem solving valid and practical, as well as having a potential effect. Valid to say of word problems obtained from expert reviews that stage researchers asked for comments and suggestions from experts and teachers on aspects of content, constructs and language. Word problems in accordance with the content aspect of basic competence (KD) and indicators of achievement of competence. Word problems in aspects of language that is in accordance with good language and correct spelling enhanced (EYD) and no sentence that multiple interpretations. Word problems that have developed in the aspects of the construct that is if the word problems in accordance with the characteristics and principles PMRI, in accordance with the steps in solving mathematical problems and in accordance with the level of class VII . The results of the validation of the experts and teachers found that the level of validity of the questions included in the category of very good and excellent. Practicality can be seen in small group testing phase. The results of the trial at this stage of the small group showed that most students can complete a given problem and the word problems are easy to use by students, so we get a word problems the practical .

Phase Field test is a test that is done to the subject of the research, which aim to know potential effects of word problems that have developed. The potential effect that students' mathematical problem solving ability. In the implementation of this test, the researcher analyzed the students' problem-solving abilities in the form of student steps in solving the problem on the test item. Based on the results of field tests students on stage test given to 23 students of class VII 8 SMP Negeri 1 Palembang that as many as 11 students including very good category, 7 students including good category, 4 students including enough category, and 1 student including less category. Based on the responses of the students at this stage of field testing the ability of students in mathematical problem solving to problem number 1, 2 and 3 are quite good in math problem solving steps, but to question number 4 and 5, re-checking step in solving math problems is not too looked.

Students have been able to solve the problem in the problem with steps of mathematical problem solving. In each question, there are some students who can solve the problem by using the algebraic form, but there are also some students solve the problem by doing arithmetic operations directly. In addition, mathematical problem-solving strategies do students have also been good enough to draw the problems that exist in the problem that is particular to the story about the numbers 2, 3 and 5. Therefore, the algebra word problems using PMRI approach has potential effects on students' mathematical problem solving ability.

The following some questions and answers students :

Problem number 1

Picture 1. Answer number 1 Student A

Student A has been able to solve the problem using mathematical problem solving steps with good and problem solving that has looks the algebra form, so we get the right result.

Problem number 2

Picture 2. Answer number 2 Student B

Student B has been able to solve the problem using mathematical problem solving steps with good and problem solving strategies using students B with problems drawing on word problems and have not looked the algebra form but solve it directly with arithmetic operations, so we get the right result .

Dik: $L = 170 \text{ m}^2$
 \rightarrow Luas tanah = 63 m^2
 \rightarrow Sisa tanah = 51 m^2
 \rightarrow Lebar = 7 m

Ditanya: Keliling Lap. Takraw $\times 4$

Penyelesaian:
 $L = L_{\text{Lap. Takraw}} + L_{\text{Sisa tanah}}$
 $170 \text{ m}^2 = 63 \text{ m}^2 + 51 \text{ m}^2$
 $170 \text{ m}^2 = 114 \text{ m}^2 + L_{\text{Lap. Takraw}}$
 $L_{\text{Lap. Takraw}} = 170 \text{ m}^2 - 114 \text{ m}^2$
 $L_{\text{Lap. Takraw}} = 56 \text{ m}^2$
 $L_{\text{Lap. Takraw}} = P \times L$
 $56 \text{ m}^2 = P \times 7 \text{ m}$
 $56 \text{ m}^2 = 7P$
 $P = \frac{56}{7}$
 $P = 8 \text{ m}$

$K_{\text{Lap. Takraw}} = (7+7) + (8+8)$
 $= 14 + 16$
 $= 30 \text{ m}$

$K_{\text{Lap. Takraw}} \times 4 = 30 \text{ m} \times 4$
 $= 120 \text{ m}$

Jadi jarak / keliling Lap. Takraw = 120 m

$L_{\text{Lap. Takraw}} = P \times L$
 $= 8 \text{ m} \times 7 \text{ m}$
 $= 56 \text{ m}^2$

$K_{\text{Lap. Takraw}} = 120 \text{ m} : 4$
 $= 30 \text{ m}$

$L_{\text{Sisa tanah}} = L_{\text{Luas tanah}} - L_{\text{Lap. Takraw}}$
 $= 63 \text{ m}^2 + 51 \text{ m}^2 + 56 \text{ m}^2$
 $= 170 \text{ m}^2$

Picture 3. Answer number 2 Student C

Student C was able to solve the problem using mathematical problem solving steps with good and problem solving've student C looks algebra form, but do not use problem-solving strategies by drawing on the word problems, but also obtained the right result.

Problem number 4

Dit: Tiga menyusun 12 risoles berbentuk Δ dengan panjang sisi 3 cm , di piring persegi panjang dengan lebar $5,2 \text{ cm}$. 4 piring dapat memuat 2 risoles, jika risoles dipotong dua bagian sama besar. Jika Olga memiliki plastik persegi panjang seluas $72,8 \text{ cm}^2$ dan lebarnya sama dengan lebar piring.

Dit: Hitunglah panjang sisa plastik yg dpt dipotong Olga untuk membuat piring!

Dikub:

Panjang piring = 4×3
 $= 12 \text{ cm}$

$L_{\text{plastik}} = P \times L$
 $72,8 = P \times 5,2$
 $P = \frac{72,8}{5,2}$
 $P = 14 \text{ cm}$

Panjang sisa = $14 \text{ cm} - 12 \text{ cm}$
 Panjang sisa = 2 cm

Jadi panjang sisa 2 cm .

$L_{\text{plastik}} = P \times L$
 $= 14 \times 5,2$
 $= 72,8 \text{ cm}^2$

$L_{\text{piring}} = P \times L$
 $= 12 \times 5,2$
 $= 62,4 \text{ cm}^2$

$L_{\text{sisa}} = P \times L$
 $= 2 \times 5,2$
 $= 10,4$

$72,8 - 62,4 = 10,4$

Picture 4. Answer number 4 Student D

Student D has been able to solve the problem using mathematical problem solving steps with good, problem solving strategies students D use this problem by drawing on the matter of the story and have looked the algebra form, so we get the right result.

Dik: 11 risoles berbentuk Segitiga Sama Sisi dgn panjang sisi 8 cm akan disusun dipiring P. panjang dgn lebar 5,2 cm. 4 pojok piring masih dpt memuat 2 risoles, jika dipotong 2 bagian 5 m besar.

Dit: jika orga memiliki Plastik P. panjang Seluas 72,8 cm² & lebar 11,4 cm dgn piring. Hitunglah panjang sisa plastik yg dpt dipotong untuk menutupi piring!

Jawab:

$P_{\text{piring}} = 3 \times 12 \text{ cm} = 12 \text{ cm}$

$\text{Luas piring} = 12 \times 5,2 = 62,4 \text{ cm}^2$

$\text{Luas Plastik} = 72,8 \text{ cm}^2 - 62,4 \text{ cm}^2 = 10,4 \text{ cm}^2$

$P_{\text{sisa}} = \frac{\text{Luas}}{\text{lebar}} = \frac{10,4}{4,7} = 2,2 \text{ cm}^2$

Jadi, Panjang sisa Plastik = 2,2 cm²

Memahami Masalah

Merencanakan dan Melakukan Pemecahan Masalah

Melakukan Pemeriksaan Kembali

Picture 5. Answer number 4 Student E

Student E has been able to solve the problem using mathematical problem solving steps with a enough good, problem solving strategies students E use this problem by drawing on word problems and have not looked the algebra form, but there are errors in arithmetic operations division and achieve the results less precise, this is probably because less of accuracy of the student at the time of the division arithmetic operations.

CONCLUSION

Based on the research that has been done, it can be concluded as follows : (1) This research has produced a word problems of algebra form using PMRI approach to knows the ability of mathematical problem solving of the students class VII valid and practical. Valid drawn from the results of that assessment validator experts and teachers of the fifth word problems, where the results of the validation of experts and teachers from word problems that have been developed in the category of very good validity and good. Word problems that have been developed have been based on the content (according with the basic competencies and indicators), construct (according to the characteristics and principles PMRI, according with the steps in solving mathematical problems and according with the level of class VII) and language (according to language is good and right with the enhanced spelling (EYD) and no sentence that multiple interpretations). Practicality of the five stories that have been developed that can be seen from the results of tests on a small group stage, where most of the students can understand and solve a given problem. This means about a story that has been developed is easy to use by users and easy to use by students; (2) word problems that have been developed have a potential effect that mathematical problem solving ability of the students of class VII. This looks steps and diversity mathematical problem-solving strategies on students' answers on the field test stage. Based on the results of field tests were given to 23 students of class VII 8 SMP Negeri 1 Palembang that as many as 11 students including the very good category with a percentage of 47,8%, 7 students including good category with a percentage of 30,4%, 4 students including enough category with a percentage of 17,4% and 1 student including less category with a percentage of 4,4%.

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