

Development of Mathematics Learning Tools Based on RME Approach to Improve Mathematical Communication Skills of Class VIII Students in Junior High Schools

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Abstract - Mathematical communication skills possessed by students are still low. This is because students are not familiar with story questions or mathematical communication problems. For this reason, it is necessary to improve mathematical communication skills with an RME-based approach. The purpose of this study is to look at the contribution of the tool in the form of RPP and LKPD with an RME-based approach to improve students' mathematical communication skills. The research conducted is development research, which uses the Plomp model with the stages of the first phase of preliminary research, the second phase of development or prototyping and the third phase of assessment. The discussion in the introduction includes preliminary observations, questionnaires, interviews and preliminary tests. The results obtained from the preliminary analysis are 1. Students in learning are happier and like to ask friends rather than the teacher, 2. Students prefer group learning or discussion. 3. Students prefer to start the lesson with examples of problems or problems related to the material and theory. 4. Students like LKPD which are pictorial, colorful, and attractive. Next, the researcher designed a product in the form of a learning tool, namely RPP and LKPD, which went through a self evaluation stage to see typos and punctuation errors, after which the product was validated by 5 experts. The value of product validity provided by the valuator is 89.29% for RPP with very valid criteria, while for LKPD with a percentage of 88.02% that is with very valid criteria. After that a valid product is carried out a one-to-one process to solicit student opinions if there are deficiencies in the LKPD, and then subsequently it is applied in small classes before being applied to large classes or one class. The final test results obtained to see the effectiveness of the product being developed are 90% of students who exceed the completeness limit of the predetermined interval that is equal to 70%.

Keywords - RME Theory, Mathematical Communication Skills.

I. INTRODUCTION

Mathematics is a lesson that is considered by many learners difficult subjects to learn, therefore many students do not like to learn mathematics, and student learning in learning mathematics is a problem that must be faced and think about the solution by educators [7]. Learning mathematics is expected that students can master a variety of mathematical abilities such as problem solving skills,

communication skills and reasoning abilities. If seen from the data provided by TIMSS in 2011 [8], the mathematical ability of students in Indonesia, especially students in class VIII, is still low which scores 386 on a scale of 500.

One of important mathematical ability is to learn and master in mathematics is the ability of mathematical communication, because with good communication students

can deliver a message to the recipient of the message to tell the behavior both directly and verbally.

Communication skills are an important part of every activity, especially in learning activities. Because with good communication can make students express mathematical ideas perfectly, both to friends, teachers and others.

Students who have communication skills are students, who can explain concepts into mathematical language can explain calculations, provide explanations of answers and can present ideas and opinions in sentences that are easy to understand. The results of the study pointed to low communication skills [2], [6].

The low results of students' communication skills can be seen from the initial test of communication skills that were carried out at SMP N 1 and SMP N 2 Padang Pariaman. The results of students' communication skills test can be seen in Table 1.

Table 1. Percentage of answers for grade VII students of SMP 1 and SMP 2 Padang Pariaman who answered correctly on the preliminary test of mathematical communication skills

Number Question	Students who answer correctly			
	SMPN 1		SMPN 2	
	Amount	%	Amount	%
1	32	43,75	21	57,14
2	32	68,75	21	33,33

Based on Table 1, it can be seen the comparison of students' answers in answering questions about mathematical communication skills, where there is a low mathematical communication ability of students.

The observations made by the researcher during the preliminary research show that students are less able to communicate the answers that have been made by students, where students cannot provide the right arguments for the answers that have been submitted. Based on the results of the researchers' interviews during the preliminary study it was found that students had difficulty in understanding the problems and giving answers in the form of mathematical language. Where these students understand the questions given but are unable to provide answers in the form of good

mathematical language, so the answers given are not able to be maintained by students.

Students here are only accustomed to write answers, but are not able to give reasons for answers that have been made by students. For that according to researchers as a teacher must innovate and adapt to developments that occur to be applied in classroom learning by not relying on the teaching sequence that is offhand or monotonous [11], [12]. So researchers provide solutions using the RME-based approach in order to improve students' mathematical communication skills. RME is an approach in learning especially mathematics that is integrated into the context of everyday problems that exist in the environment of students and change the paradigm from teacher orientation to student orientation [3].

RME focuses on the activities experienced and informal knowledge possessed by students themselves to build understanding of the concepts learned [1]. With RME students also not only accept material from teachers in learning but can learn mathematics in their own way [10]

The RME approach will be able to show different results, because it uses contextual problems that not only use illustrations but which are in the real lives of students. The context given here can be in the form of an image then represented in the form of lines, table ratios and so on [9].

RME has 5 characteristics, namely the use of context, the use of models, and the use of work results, interactivity and the interrelation between concepts. RME has the advantage of training students to mathematically the mathematical problem itself, where students will be able to develop intuition and imagination in describing a given problem.

II. METHOD

This type of research is a development study using the development model of Plomp and Nieveen which consists of 3 stages: the first stage of conducting preliminary research, the second stage of the development or prototype stage. And the third stage is the assessment phase (assessment phase) [4], [5].

The activity carried out in the development of this research was to develop a mathematics learning tool based on the RME approach. Learning devices that are designed are tested for validity by experts so they are declared valid. Furthermore, the validated devices are tested on students so that they can see their practicality and effectiveness.

III. RESULTS AND DISCUSSION

The process and results of this study are described in the stages of developing mathematics learning tools based on the Realistic Mathematics Education approach for grade VIII students and the results obtained. This development process is described in accordance with that described in Chapter III, which consists of the initial investigation phase, the development or manufacturing phase of the prototype and the assessment phase along with the products produced.

A. Requirements Analysis

Stages of needs analysis carried out gathering information about the problems contained in learning and existing mathematics learning tools. Information gathering is carried out by interviewing the teacher, observing the implementation of learning and analyzing the existing learning tools (RPP and LKPD). This activity was carried out at SINTOGA Junior High School 1 Padang Pariaman Regency.

Based on observations, the implementation of learning obtained information that learning has been carried out guided by the RPP and using LKPD as a learning medium. However, learning does not involve students actively in learning. In addition, the teacher also uses the 2013 Curriculum book. However, the book is not fully used by the teacher. The teacher only takes the material guidelines in the book because the teacher considers the activities and learning steps contained in the book are sometimes difficult to understand and cannot be carried out by students. Based on the results of the analysis of the lesson plan, information is obtained that the components of the lesson plan are complete, but what needs to be improved is the steps of learning activities that are not yet operational. The lesson plan has been in the form of reality, but the learning steps contained in the lesson plan have not been able to guide the implementation of learning realistically. Even the problems needed for learning have not been provided adequately.

The existing LKPD does not yet support the implementation of learning in the RPP. LKPD has not presented issues that are of a contextual nature that are close to the lives of students, so that they can build students' understanding on the subject of defense. The steps in the lesson plan have not directed the students to solve problems and are still general in nature. The problems presented in the example questions and practice questions also do not meet the requirements of the problem that challenges students to make maximum use of their thinking abilities.

Conclusion from the results of the needs analysis, information is obtained that the existing RPP and LKPD need to be refined to fit the demands of the 2013 curriculum. So that the RPP and LKPD can help teachers and students in learning and student learning outcomes can be obtained to the maximum. Besides LKPD also needs to be equipped with problems and activities of students in solving these problems so that it can help students understand the material being studied. LKPD also needs to contain mathematical communication practice questions so that students can practice developing their thinking skills.

B. Curriculum Analysis

This stage is examined in the curriculum used by schools for mathematics lessons in VIII grade junior high school for mathematics subject matter. Then the results of this analysis serve as a guideline in the development of Mathematics learning tools with Realistic Mathematics Education approaches.

Curriculum analysis has the aim to analyze the curriculum of two supporting aspects, namely KI and KD. In the curriculum analysis the information is obtained that SINTOGA 1 Junior High School has implemented the 2013 curriculum. This stage focuses on the KD and GPA analysis which will be described in the form of learning competency indicators. Learning competency indicators are developed based on BC.

Based on the results of the analysis of curriculum applied in schools, what is done in this study is KD 3.5, which explains the linear system of two variables and its solution which is connected with contextual problems. Described into 2 GPAs namely 3.5.1 Modeling contextual problems into PLDV and 3.5.2 Identifying PLDV in various forms and variables.

Whereas in KD 4.3 is namely solving problems related to relations and functions by using various representations. Describing into 6 GPAs is namely 4.3.1 Able to present a function with a set of sequential pairs, arrow diagrams, with function equations, with tables, and with graphs. 4.3.2 It can determine the formula of a function of the given problem. 3.5.7 Complete SPLDV with the Elimination method. 4.5.3 Solve the problem of SPLDV context using the elimination method. 4.5.8 Complete SPLDV using the joint method. 4.5.4 Resolve issues of SPLDV context using one of the methods.

C. Student analysis

Based on the student questionnaire, information was obtained that students in learning were more happy and liked to ask friends rather than the teacher, then preferred group learning or discussion. Students prefer to start the lesson with examples of problems or problems related to the material and theory. Then regarding LKPD students are expected to want LKPD that is pictorial, colorful, and attractive.

Based on observations during school research, many students do not pay attention to the delivery of the teacher in front of the class. When the learning process is seen the students' activities pay less attention and there are those who talk to their peers, there are also students who write other lessons.

D. Concept Analysis

Based on the analysis of the learning concept that will be applied to the research, it is found that the material learned during the odd semester is number patterns, Cartesian coordinates, relations and functions, straight line equations and two variable linear equations. The material chosen is the Two Variable Linear Equation System; this can be seen in Figure 5 of the concept map below.



Figure 1. Concept Map

Floating mathematics learning tools based on the RME approach was carried out as an effort to meet the needs of learning tools and media in schools. The device developed is expected to be able to help teachers and students improve the quality of learning in schools. In addition, this device is expected to help students in the practice of solving problems so that they can develop their mathematical communication skills.

In order to achieve a good device there are several characteristics, as expressed by [13], which states that there are three characteristics that need to be considered, such as: content, language, and aspects of appearance. The content aspect starts with giving contextual problems that exist in everyday life. In addition, student worksheets provide instructions to students that can help them solve problems. The first instruction asks students to understand the problem by identifying what is known and asked of the problem. The second instruction asks students to plan solutions by building mathematical models of the problem. The third instruction asks students to solve problems using models that have been found. At the end of each student worksheet, there is an exercise that students must do.

In order to get a valid, practical and effective learning device, several steps of research are carried out on the device. To find out the level of validity of the device, a self-evaluation of the device that has been developed is validated, validated by experts and carried out a one-on-one evaluation. Furthermore, to find out the practicality, small group trials and field tests were conducted on grade VIII students of SMP Negeri 1 SINTOGA, Padang Pariaman Regency. Furthermore, the affectivity is also seen from the results of tests on students who have learned to use these learning tools.

The learning tools developed in this study are the RPP and LKPD mathematics based on the RME approach. The steps of learning activities in the lesson plan are based on the steps of learning by mathematical communication, namely the cooperative learning model think pair shares type. Based on the validation process that has been carried out, then the level of validity of learning tools that have been developed is 89.29% for RPP with very valid criteria, while for LKPD with a percentage of 88.02%, with very valid criteria. For practicality and effectiveness of the products developed are explained as follows:

E. Practicality of Learning Tools

1) Practicality of Learning Tools by Teachers

Based on the teacher's questionnaire responses after learning in the field test activities, the practicality of the learning equipment was 88.75%, which was in the very practical criteria. The results of the questionnaire practicality RPP and LKPD by teachers can be seen in Table 2.

Table 2. Practicality of Learning Tools by Teachers in the Assessment Phase

No	Aspect	Value of Practicality	Criteria
1	Attractiveness	85%	Very Practical
2	Usage	80%	Practical
3	Ease of Use	80%	Practical
4	Time	80%	Practical
5	Equivalence	86,6%	Very Practical
Mean		82,32%	Practical

The results of the questionnaire above the acquisition of the value of the practicality of learning tools by the teacher are 82.32% which is within the practical criteria. So it can be concluded that the learning device can be implemented and used properly by the teacher in learning.

Furthermore, based on observations, the practicality of the lesson plan was obtained by the teacher at 87% or on very practical criteria. RPP practicality values based on observations can be seen in table 3

Table 3. Practices of RPP Based on Observation

No	Activity	Value of Practicality	Criteria
1	Introduction	92,22%	Very Practical
2	Core	90,23%	Very Practical
3	Closing	90,67%	Very Practical
Mean		91,04%	Very Practical

The results of observations above on the acquisition of the practicality value of the RPP by the teacher are 91.04% which is very practical criteria. From the data obtained, both through questionnaires and observations obtained the same results, namely learning tools, especially lesson plans have been practical. So it can be concluded that the learning activities in the lesson plan have been carried out well by the teacher in learning.

2) Practicality of LKPD by Students

Based on a questionnaire filled out by students after learning in the field test activities, the LKPD practicality score was 84.78% which is very practical criteria.

Furthermore, based on observations, the LKPD practicality value obtained for student activities by 84% or the practical criteria. LKPD practicality values based on observations of student activities can be seen in Table 24.

Table 4. LKPD Practices Based on Observation

No	Aspects Observed	Mean
1	Reading LKPD	25
2	Discuss with friends in working on LKPD and students ask the teacher	21,8
3	Perform mathematical communication activities that exist in LKPD	20,2
4	Work on the practice questions that are in the LKPD	20,4
Mean		21,85
Value of Practicality		84%
Criteria		Practical

The results of observations on the acquisition of LKPD practicality value by students is 84% which is in practical criteria. From the data obtained, both through questionnaires and observations obtained the same results, namely LKPD has been practical. So it can be concluded that the learning activities in LKPD have been carried out well by students in learning.

F. Effectiveness of Learning Devices

The effectiveness of the use of mathematics learning tools based on the RME approach that has been developed is seen by conducting tests to determine students' mathematical communication skills. The instrument used was a matter of essay test. Based on the results of tests that have been carried out by scoring mathematical communication skills of students, the average value obtained by students' mathematical communication skills is 70.46 which is in very good criteria.

The final test results of students' mathematical communication skills seen from the mathematical communication ability test conducted in class VIII.1 obtained 90% completeness percentage means it exceeds the completeness limit of the interval stated by [14]. This means that learning tools based on the RME approach can improve students' mathematical communication skills.

IV. CONCLUSION

Based on preliminary research results obtained that, the lack of teaching materials available to help students develop mathematical communication skills, it is necessary to increase the communication skills of students, students in learning are more happy and like to ask friends rather than the teacher, then prefer group learning or discussion .

Students prefer to start the lesson with examples of problems or problems related to the material and theory. Then regarding LKPD students are expected to want LKPD that is pictorial, colorful, and attractive.

The results showed that the mathematics learning tools based on the Realistic Mathematics Education approach developed in the category were very valid both in terms of content and construct with the characteristics (1) the learning device fulfilled all aspects of the characteristics of the RME approach. (2) learning tools in accordance with SK, KD, and indicators, (3) learning tools are consistent and support each other, (4) presentation of learning tools is correct in terms of format, content, presentation, language, and letters. With product validity provided by the valuers is a percentage of 89.29% for the RPP with very valid criteria, while for LKPD with a percentage of 88.02% that is with very valid criteria. The final test results obtained to see the effectiveness of the product being developed are 90% of students who exceed the completeness limit of the predetermined interval that is equal to 70%. And the practicality of the product obtained from the teacher's response questionnaire is 88.75% which is in very practical criteria. While the questionnaire responses of students obtained practicality value of 84% which is in the practical criteria.

REFERENCES

- [1] Fauzan, Ahmad and Yerizon. 2013. The Effect of the RME Approach and Learning Independence on Students' Mathematical Ability. Proceedings of Semirata FMIPA University of Lampung, 2013.
- [2] Izzati, Nur, DidiSuryadi. (2010). Mathematical Communication and Realistic Mathematics Education. Proceedings of the National Seminar on Mathematics and Mathematics Education, Yogyakarta UNY, 27 Nov 2010, ISBN: 978-979-16353-5-6.
- [3] Musdi, Edwin, (2016). Structural Mathematics Model Based on Realistic Mathematics Education to Improve Problem Solving Ability of Junior High School Padang. ALTA 'LI MJOURNAL, 23 (1), 2016, (6577).
- [4] Nieveen, (1999). Prototyping to reach product quality. In Van de Akker, J, et al., Design approaches and tools in education and training (pp.125-136). Dordrecht: Kluwer Academic Publishers.
- [5] Plomp, Tjeerd. (2013). Educational Design Research: an Introduction. In TjeerdPlomp and NienkeNieveen (Ed.). An Introduction to Educational Design Research. Enschede: SLO Netherlands Institute for Curriculum Development.
- [6] Rosnawati. (2013). The Mathematical Reasoning Ability of Indonesian Junior High School Students in the 2011 Team. Proceedings of the National Seminar on Research, Education and Application of Mathematics and Natural Sciences, Faculty of Mathematics and Natural Sciences, Yogyakarta State University, May 18, 2013.
- [7] Syarifuddin. H. 2018. The Effect of Using Concept Maps in Elementary Linear Algebra Course on Students' Learning. IOP Conference Series: Materials Science and Engineering. To cite this article: 2018 IOP Conf. Ser. : Mater. Sci Eng. 335 012107.
- [8] Y. Yerizon, A. A. Putra, and M. Subhan, 2018, Student Responses Toward Student Worksheets Based on Discovery Learning for Students with Intrapersonal and Interpersonal Intelligence, IOP Conf. Ser. Mater. Sci Eng., Vol. 335, no. 1
- [9] Wijayanti, Septiana. 2016. The Use of the Realistic Mathematics Education (Rme) Approach as an Effort to Increase Creativity in Mathematical Problem Solving of Students in Class X.7 of SMA Negeri 1 Pulokulon Magistra No. 95 Th. XXVIII March 2016 ISSN 0215-9511.
- [10] E Gee, A Fauzan and A Atmazaki, (2018), Designing learning trajectory for teaching sequences and series using the RME approach to improve students' problem solving abilities, IOP Conf. Series: Journal of Physics: Conf. Series 1088, 012096.
- [11] A Fauzan, A Armiati, C Cheers (2018) A Learning Trajectory for Teaching Social Arithmetic using RME Approach, IOP Conf. Series: Materials Science and Engineering 335 (2018) 01212.
- [12] A Fauzan, E Musdi and J Afriadi (2018). Developing learning trajectory for teaching statistics at junior high school using the RME approach, IOP Conf. Series: Journal of Physics: Conf. Series 1088 (2018) 012040.
- [13] Irwan, Asmar. A and Syarifuddin. H. 2018. The development of mathematical learning material based on model-eliciting activities (MEAs) approach to improve mathematical problem-solving skills of students of grade X of Senior High School Padang. International Conference on Mathematics and Natural Sciences (IConMNS 2017) IOP Publishing IOP Conf. Series: Journal of Physics: Conf. Series 1040 (2018) 012028 doi: 10.1088 / 1742-6596 / 1040/1/012028
- [14] Arikunto, S. 2012. Basics of Educational Evaluation. Jakarta: Earth Literacy.