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Development of Student's Worksheet Based on Realistic Mathematics Education (RME) Approach to Know Students' Mathematical Problem Solving Abilities

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Abstract. This research is development research to produce student's worksheet based on a valid, practical and effective realistic mathematics education (RME) approach to know the mathematical problem solving abilities of vocational students in geometry transformation material of the translation sub topic. Thiagarajan's 4-D model was chosen as the research design to be used in this study. The 4-D model consists of 4 steps named define, design, develop and disseminate. The theme that chosen as a topic in development of student's worksheet was Batik Bondowoso. Based on the results of the study, it can be seen that (1) the development of student's worksheet has been valid based on validation by experts; (2) The development of student's worksheet can be effective and practical based on trials, where the learning objectives have been achieved and the student responses are positive.

INTRODUCTION

The development of science and technology in the 21st century or we known as the industrial revolution 4.0 demands change through various challenges that must be passed, including the world of education. The world of education is required to produce a generation that can be globally competitive with all the skills and abilities that must be possessed and mastered. These skills can be achieved by education that includes technology-based learning and problem solving related to everyday life.

Education is a effort to create an atmosphere and learning process so that students can improve and develop their understanding and potential. Own national education role is to develop and form the character and peradaban dignified nation in the context of the intellectual life of the nation. However, in practice, education is not suitable with expectation. One example is in learning mathematics.

Mathematics is a scientific discipline that develops and grows side by side with human development. Mathematics itself has been given to students at every level of education, this aims to equip students to have the ability to think logically, analytically, systematically, critically, creatively and the ability to work together [3]. The main purpose of learning mathematics is to make students can to solve problems in everyday life [14]. However, students often feel less capable and less proficient in solving a problem or solving problems. This is caused by several factors such as students do not understand the material, do not focus on learning, forget the formula, the teacher is not clear in explaining the material, the selection of learning strategies is not appropriate and others.

REALISTIC MATHEMATICS EDUCATION (RME)

To help students understand a problem more easily, teaching materials are needed that relate the problems given to life in the environment around students. One of them is by using the Realistic Mathematics

Education (RME) approach in learning mathematics in the classroom. The use of the RME approach can take advantage of the culture around students to be raised as a topic in learning mathematics.

Realistic Mathematics Education (RME) is a learning approach that directs students to learn meaningfully by relating problems to everyday life and in accordance with students' thinking abilities. The relevance of the problems given will lead students to the understanding that mathematics is not only a symbolic science but also a science that can be used in everyday life to help and facilitate humans in solving their problems [1]. The RME approach, places students' realities and experiences as the starting point of learning. This RME approach also emphasizes the principle that mathematics must always be meaningful to students and the problems given must be based on real experience so that they are easily understood and imagined by students [8].

The RME approach can also be interpreted as a learning approach where in the learning process students find ideas and concepts again through exploration of various knowledge and facts. This RME approach encourages students to play an active role in rediscovering mathematical ideas and concepts as well as exploring real problems. In its application in the classroom, the teacher does not fully provide information to students but the teacher only helps and guides students if the students really need the information. Students also have broad opportunities to find ideas and concepts again [2].

Freudenthal say that there are three principles that be a based of RME including: (1) guided rediscovery through progressive mathematization, (2) didactic phenomenology, and (3) emerging models [13]. There are also several characteristics of the RME approach according to Hobri, including using contextual problems (*the use of context*), using models (*use models*), using student contributions (*student contributions*), interactivity (*interactivity*) and integrated with other topics (*intertwining*). While the steps in learning using the RME approach are understanding contextual problems, explaining contextual problems, solving contextual problems, comparing and discussing answers, and concluding. Based on the steps, principles and characteristics of RME, learning that uses the RME approach is basically the use of reality and the environment that students understand to facilitate the mathematics learning process so as to achieve the goals of mathematics education that is better than before [9].

STUDENT'S WORKSHEET

Student's Worksheet are printed teaching materials in the form of sheets of paper containing material, summaries and instructions or directions in carrying out assignments so that students understand the material provided in the hope that students can learn independently. Prastowo said that this worksheet is contain of theoretical and/or practical and refers to the Basic Competencies (KD) that students must achieve [4]. LKS also means learning tools as a bridge for delivering information in the form of subject matter by teachers to students through tasks or activities that students must do, which can be developed with approaches that are relevant to the characteristics of students [7].

LKS contains activities that must be carried out by students to achieve indicators of achievement of learning outcomes. LKS can be used as a guide so that students can carry out activities actively in learning and help direct students to construct the knowledge that has been learned to solve a mathematical problem, especially those related to everyday life. On average, worksheets are printed on opaque paper, the prints are colorless and look boring. There are not many worksheets that can encourage students to connect the knowledge they have with its application in their daily lives [6].

Around the school area where the study is located, there is a batik production house, namely Daweea Batik Bondowoso. Therefore, researchers are interested in raising the theme of Bondowoso batik from the production house to be used as a topic in developing student's worksheet. Because the activity of making batik is a real and relevant to students' lives. Student's worksheet developed is expected to make learning more meaningful and students can more understand the material being studied. So that students are able to solve the mathematical.

PROBLEM SOLVING SKILL

Problem solving is a mental process that requires a person to think critically and creatively, looking for alternative ideas and specific steps to overcome obstacles or shortcomings [5]. Meanwhile, mathematical problem solving ability can be defined as the ability of students to understand problems, plan problem solving strategies, implement the selected solution strategies, and re-examine problem solving to make solutions in other ways or develop problem solving when students are dealing with mathematical problems [11].

Sumarmo states that the mathematical problem solving a having two meanings, namely: (1) Solving the problem as an approach to learning that is used to find kembali and understand the concepts, principles and materials of

mathematics. Where learning begins with presenting a contextual problem or situation then through induction students find mathematical concepts/principles; (2) As a goal or capability that must be achieved, which includes five indicators, namely: identifying the adequacy of data for problem solving; create a mathematical model of a situation or everyday problem and solve it; choose and apply strategies to solve math problems and/or outside mathematics; explain or interpret the results according to the original problem, and check the correctness of the results or answers; and apply mathematics in a meaningful way [12].

There are several steps that can be used to solve a problem, according to Polya there are 4 steps that must be passed in problem solving including: (1) understanding the problem; (2) draw up a settlement plan; (3) resolve the problem according to the plan that has been made; and (4) re-check the answers. In the first step we must understand by the given problem and see what is required of the problem. Then, in the second step we have to look at how things are connected, how the unknown is connected to the data, to get an idea of a solution, to plan a solution. In the third step we carry out the plan and in the fourth step we review the solutions that have been obtained, then we review them again and discuss them [11].

METHODS

The development model used in this research is Thiagaran's 4-D development model, which consists of four steps there are define, design, develop and disseminate [10]. This model was choose to produce a product in the form of student's worksheet which were developed and then tested for validation, practicality, and effectiveness. The research instruments used validation student's worksheet, learning implementation observation sheets, student activity observation sheets and student response questionnaires.

The define step is intended to determine and define the requirements needed in developing worksheets, which include the following stages: preliminary analysis, student analysis, concept analysis, task analysis, and specification of learning objectives. The design step is intended to design worksheets while the develop step is intended to produce a final worksheet that is good, valid, effective and practical and has been revised according to suggestions or input from experts and data from trials consisting of 2 steps, namely expert assessment and trials. The disseminate step is intended to disseminate student's worksheets based on the RME approach to the sub topic translation geometry transformations material.

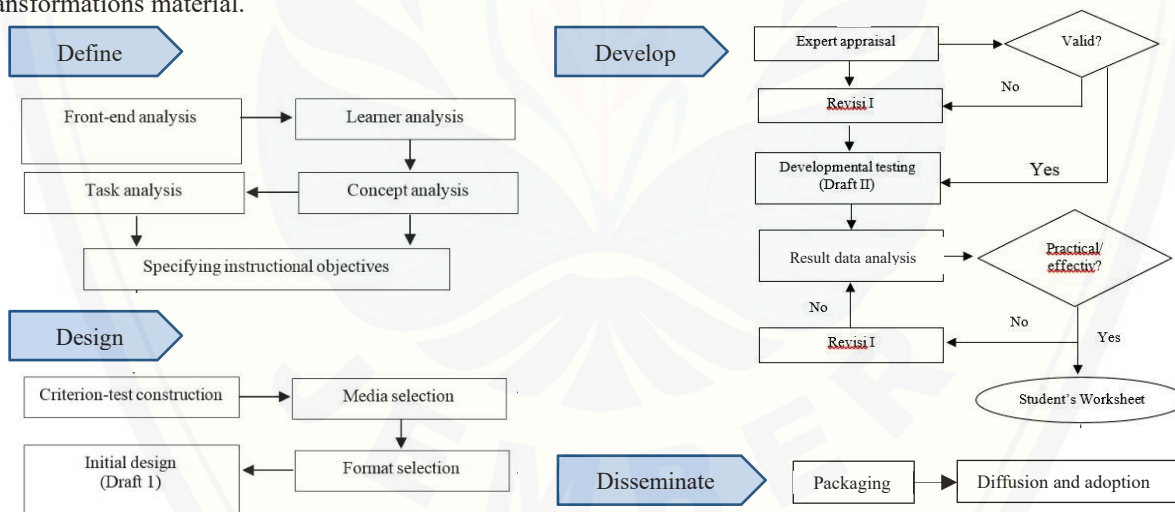


FIGURE 1. 4-D Development Model

RESULTS AND DISCUSSION

The final product of this research is student's worksheets based on the RME approach. This development research begins with the define step. At the step of defining through preliminary and final analysis, student analysis, concept analysis, task analysis, and specification of learning objectives, the material for the transformation of the geometry sub-subject of translation is selected as a topic in the worksheet. After that, at the next step namely design, draft 1 of the student's worksheet was developed. Then proceed to the development step by testing the level of validity,

effectiveness and practicality of the student's worksheets. At the student's worksheet validation step, there little revisions in the form of less effective sentence changes from the experts and this did not change the entire content of the student's worksheet. After revision, the student's worksheet is said to be valid with a valid category and ready to be tested in the field.

Based on the student's worksheet trial, it was found that the student's worksheet developed had met the practical criteria. This can be seen from the results of the analysis of student activity observations and observations of the implementation of the use of student's worksheets in learning. The results of the analysis of student activity observations showed that students were active in learning with an average score of 89% in the 'active' category and the results of the analysis of student response data showed a positive response from students in learning using student's worksheet based on RME approach that had been developed. This can be seen in the figure below.

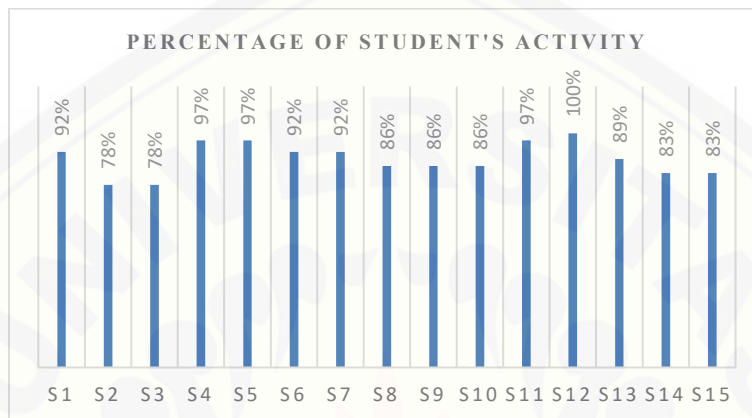


FIGURE 2. Result of Students Activity Observastion Analysis

After participating in learning using student's worksheet based on the RME approach, students become more understand with the translation material given because the learning is associated with life around students. In addition, students are also more enthusiastic and happy to take part in learning because the student's worksheet display is attractive, learning is not boring, and students are also given the opportunity to ask questions or discuss with their friends. Based on the results of observations on the implementation of the use of learning worksheets, the steps of learning have been carried out by the teacher in accordance with the RME approach, the teacher provides opportunities for students to ask questions and discuss with their friends, students are actively involved in learning, and the teacher also relates learning to the lives around students. Student's worksheet is said to be practical with very good criteria, which can be seen in the following table.

TABLE 1. The Practicality of Student's Worksheet Based on RME Approach

Rated aspect	Average Score		Information
	Observer 1	Observer 2	
1 Learning Stages	91%	94%	Very Good
2 Social System			
3 Reaction and Processing Principle			
Total	92%		

This is shows that the use of worksheets developed with the RME approach can be applied to know mathematical problem solving abilities. The student response was also positive because all students were interested in participating in learning activities using the developed student's worksheet. This is in suitable with the theory of the RME approach which states that learning using the RME approach is basically the use of reality and the understanding environment by students to the learning process of mathematics fluently so as to achieve the goals of mathematics education that is better than before. Where the reality in question is a real thing or can be observed and understood by students by imagining the environment where students are or students' daily lives [9]. The Realistic Mathematics Education (RME) approach places students' realities and experiences as the starting point of learning. This RME approach also

emphasizes the principle that mathematics must always be meaningful to students and the problems given must be based on real experience so that they are easily understood and imagined by students [8]. This RME approach encourages students to play an active role in rediscovering mathematical ideas and concepts as well as exploring real problems. In its application in the classroom, the teacher does not fully provide information to students but the teacher only helps and guides students if the students really need the information. Students also have broad opportunities to find ideas and concepts again [2].

From learning using students worksheet, students are actively involved in learning and are expected to rediscover mathematical ideas or concepts to solve the problems. Where the problems are contextual problems that exist in the environment around students. In the student's worksheet developed contextual problems related to batik. Based on the results of students' work in solving problems contained in the student's worksheet, most students understand and know the meaning of the questions because the questions given are associated with the environment around students. Students become more aware of what is known from the problem, what is asked of the problem, and how to solve it using the formulas they understood.

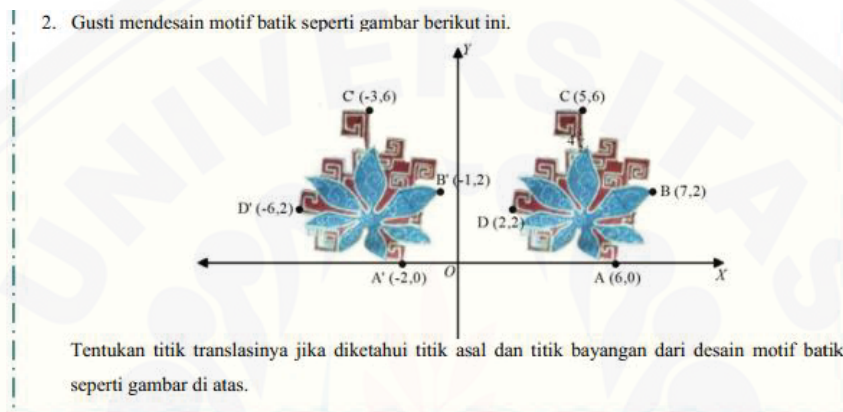


FIGURE 3. Question on Student's Worksheet

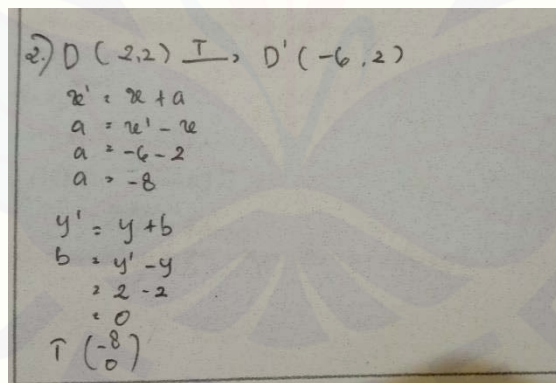


FIGURE 4. The Student's Answers

From the questions in Figure 3 and the students' answers in Figure 4 above, it can be seen that from the questions given students know the origin and shadow points. Students also understand that what is being asked is the point of translation, so students use the formula that has been understood and then apply the formula to find the point of translation by taking one of the points contained in the problem.

Based on the results of student's work in problems solving, students complete classically with a percentage of 87%. So that student's worksheet can be said to be effective. Based on student's answers, it can be seen that in problem solving students have gone through 4 stages of Polya which include: understanding the problem, developing a plan for solving the problem, solving the problem according to the plan and re-examining the answers. After student read the questions, student understand the questions and know what is being asked and what is known. Then students think of a plan to solve the problem by thinking and remembering the formula that will be used. After that, student answer the questions by applying the formulas they already know. However, there are still some students who pass the last

step, which is re-checking the answers. This is because students are sure of the answers they have received. So that students feel no need to re-check their answers.

The last step of this research is disseminate. After the student's worksheet is said to be valid, practical and effective, the student's worksheet is ready to be used and distributed. The student's worksheet will be distributed through blogs and mathematics teachers in other schools.

CONCLUSION

Based on the research using Thiagarajan's 4-D development model, it is found that the student's worksheet developed has met the criteria of being valid, practical and effective. This can be seen from the expert's assessment, the results of observations of student activities, the results of observations of the use of student's worksheet, and student responses in classroom learning. Students show a positive response and are more understanding, enthusiastic and interested in participating in learning because the problems given by the teacher in learning activities are contextual or close to students' daily lives. From the results of the research, suggestions to other researchers is to apply the student's worksheet based on the RME approach in other mathematics materials. Other researchers can also see the effect of using student's worksheet based on RME approach on the abilities or skills possessed by students and can develop other learning tools based on the RME approach.

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