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The Effectiveness of Using Worksheets Characterized by Realistic Mathematics Education to Develop Student Mathematical Reasoning Abilities

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***Abstract*—The aim of this research is to describe the effectiveness of using worksheet characterized by RME to develop students' mathematical reasoning abilities. This research with quantitative approach. Quantitative data obtained from the results of the test scores of students who described qualitatively. The instrument that used in this research is student activity observation sheet and test sheet. Data analysis technique in this research is data reduction, data presentation, and conclusion. The test results showed 81% of the reasoning activity implemented by the students. While the observation of students' reasoning activity showed good category. Based on this it can be concluded that the use of LKS characterized by RME can effectively develop students' mathematical reasoning abilities.**

Keywords—worksheet, RME, Mathematical Reasoning Abilities

I. INTRODUCTION

The quality in mathematics learning can be improved through meaningful mathematics learning [1]. Reasoning is the ability of students to think and use mathematics in a meaningful way. So that mathematical reasoning is a mathematical ability that needs to be understood by students [2]. The ability of mathematical reasoning is one of the abilities students must possess in the standard of mathematics learning process [3]. Mathematical reasoning is central to the mathematical experience of students in every level of education [4].

One of the important things in learning is teaching materials [5]. [6] says that in order to develop students' reasoning abilities the teacher should design questions that guide students to think and give reasons for their answers. Questions can be implemented into worksheet form. Worksheet are sheets containing the problems that must be solved by the students [7]. In worksheet students can explore their ideas to solve the given problems [8], [9], [10]. Students can develop their reasoning abilities by exploring what they have in mind [11].

The result of observation at SMAN 3 Malang shows that the teaching materials used by students are textbooks. However, in the textbook students are given less opportunity to explore a series of knowledge discovery activities. According to researcher the teaching materials such as these that cause less development of students' reasoning abilities. Students can develop their reasoning abilities by pouring out what they have in mind [11].

The principles in RME can increase the students' reasoning level [12]. This is because in learning of RME students can develop the important mathematical ideas through challenging problems and relate to the daily life of students. That is one of the principles of learning RME is the guiding discovery principle that emphasizes the provision of opportunities for students to find their own mathematical concepts through the solving of contextual problems. [13] stated that in learning of RME, contextual issues close to the student's daily life become the starting point of learning. This not only motivates students to learn, but also improves student participation in learning, resulting in a process of constructing knowledge meaningfully [14]. It is this factor that triggers better the influence of the RME approach than the conventional approach in developing students' mathematical reasoning.

Based on some explanations above the aim of this research is to describe the effectiveness using of worksheet characterized RME to develop student's mathematical reasoning ability. RME worksheet said to be effective if students' mathematical reasoning satisfies good criteria. Mathematical reasoning is measured through students' ability (1) making conjectures, (2) verifying conjectures, and (3) drawing logical conclusions. The students' mathematical reasoning is said to develop when students are capable of performing activities: (1) making conjectures, (2) verifying conjegtures, and (3) drawing logical conclusions with an average of not less than 70%, and for each reasoning indicator the level of implementation is not less than 60%.

II. METHODOLOGY

The type of this research is descriptive with quantitative approach. The subjects of the research were students of grade XC SMAN 3 Malang. This research was conducted through 3 stages: preliminary study, planning, and action implementation. Activity in the preliminary research is to give 3 pieces of test in the form of description to the students to know the level of students' mathematical reasoning ability. At the planning stage, the analysis of the test results and drafting the action in the form of making of worksheet is characterized by RME and research

instrument. The instrument that used in this research is student activity observation sheet and test sheet. Activities at the implementation stage of the action are the implementation of the worksheet characterized by RME to develop students' mathematical reasoning at the learning stage.

III. Result and Discussion

Worksheet is implemented in third meetings. The activities that contained in the worksheet relate to the reasoning indicator that is to make conjegtures, to verify conjegtures and to draw logical conclusions. There are several problems contained in the worksheet namely the problem of oranges, the preparation of matchsticks, stairs and salary. Here is presented the results one of the groups on oranges problem.

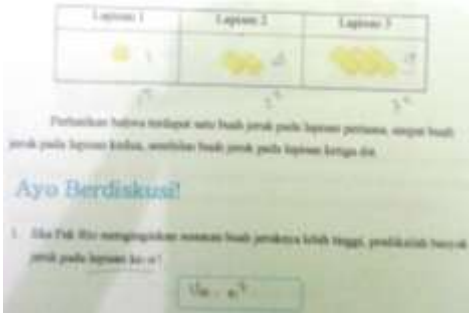

fig 1. Student Activity of Making Conjugtures on Oranges Problem

The picture above shows that in predicting a lot of oranges in the n-th layer the students make observations on the given pattern. This can be seen in the stroke of students in the table contained in the worksheet. Then the students get the assumption that many layers of oranges in the n-th layer is n^2. Indirectly in these activities students mathematically model the problems given. The next activity is students are asked to verify the conjegtures that they have earned. Here are the results of student verification.

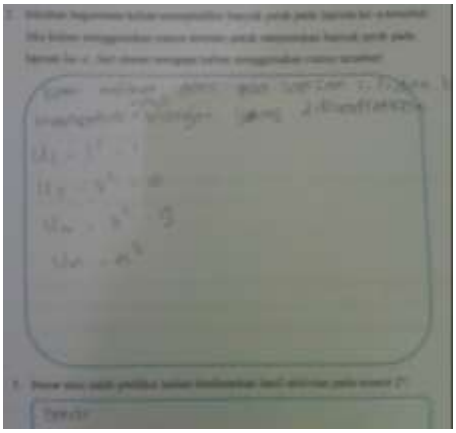

fig 2. Student Activity of Verfying Conjegtures and Drawing Conclusions on Orange Problem

The second picture shows that students use empirical facts to verify conjegtures. The empirical facts students use are facts given when problems arise. That is the drawing of orange. Because the empirical facts are in accordance with the assumptions made by the students then the students receive the conjegtures they have made by giving the "right" answer on the activity of drawing the conclusion that is activity third number.

The next problem is the problem of "composing matchsticks". On the problem students are given several arrangement of skeleton pattern match frame. The first activity of the students is asked to predict the many matches needed to construct the n-th frame. The following results of the making conjegtures and verifying that obtained by the students.

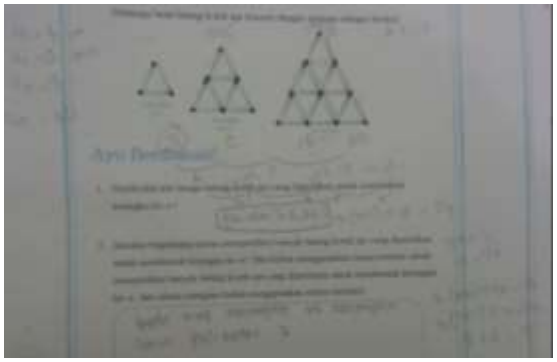

fig 3. Student Activity of Making Conjegtrues on Composing Matchisticks Problem

The third picture shows that first of students in making conjegtures construct the first frame, the second frame and the third frame. This is seen from the graffiti that students write on the side of the match frame. From this activity students can determine many matchsticks needed to compile the fourth pattern frame that is as much as 30 matchsticks. From the results of these observations the students also obtained that many matchsticks that are patterned into patterns are forming a multilevel arithmetic sequence. This can be seen from the graffiti of students under the framework of the arrangement of matches. Through these arguments the student finally assumes that many matchsticks needed to form the nth skeleton are $U_n = 3(n+1) + 3(n-1)$

As shown in third picture the next student activity is to verify their conjegtures. The verification results indicate that using empirical facts ie the patterns that are given at the time the problem is given, the conjegtrues $U_n = 3(n+1) + 3(n-1)$ is obtained by reason of difference of many matchsticks required between patterns of 3.

In the problem of "composing matchsticks" this activity consists of two kinds of verification. The first verification is done individually by the students themselves. This results as shown in third picture above. The second verification is done by the students but with the help of some inducement questions. Here are the results of the verification of the two students using the landing questions contained in the worksheet.

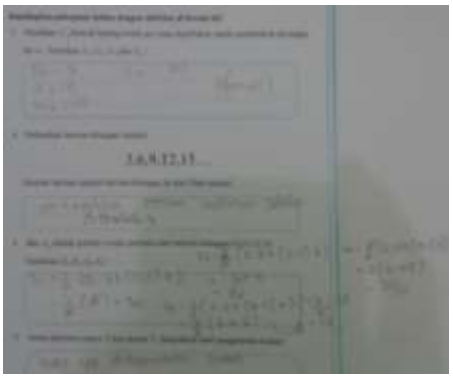

fig 4. Student Activity of Verifying Conjegtures on Composing Matchisticks Problem

The activities shown in fourth picture above help students to verify. Activity third number students are asked to redefine the many matchsticks required to create the first, second, third and fourth skeletons by symbolizing each as and. Students get these values and are calculated manually. Subsequent activities students are given a sequence of numbers and asked to determine what number sequence is given. Students answer the sequence of numbers given is the sequence of arithmetic numbers with the reason each tribe has a difference of 3.

The students were then asked to determine the first number of tribes, the first two tribes, the first three tribes, and the first four tribes and were asked to compare with the activity at third number. Seen in fourth picture the students used the first-n sum (Sn) to determine the first number of tribes, the sum of the first two terms, the sum of the first three terms, and the sum of the first four terms. And the students concluded that the results of activities on number 3 and 5 are the same.

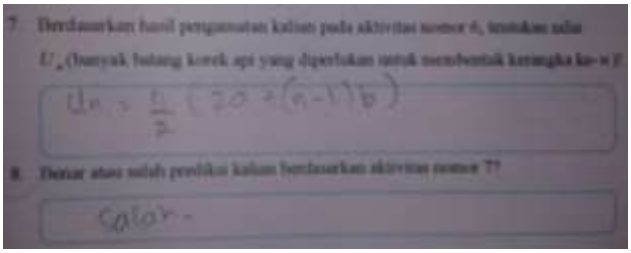

fig 5. Student Activity of Second Verifying Conjegtures on Composing Matchisticks Problem

The final stage verification activity and conclusion are shown in fifth picture above. Based on the second stage verification process the student can get the result of many matchsticks required to form the n-th framework of Un = Sn of the given arithmetic sequence. However, students still symbolize Un in the form of a and b. Up to this point the student verification activity has been completed. The student's last reasoning activity is a logical conclusion. Broadcast verification results they refuse to accept their previous guess. This is seen in activity number 8 that they answer "wrong".

Trial on the second day is the students working on problem 6 to problem 10. Here will be described in the student work on the worksheet is held on the second day.

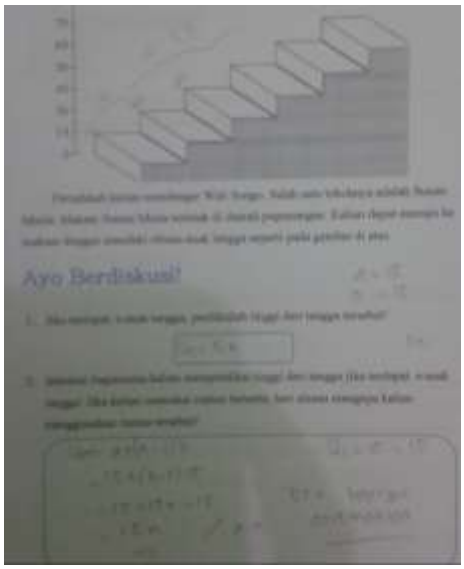

fig 6. Student Activity of Making Conjegtures and Verifying Conjegtures on Stairs Problem

One of the issues discussed at the second meeting was the problem of "stairs". In the activity of making conjegtures students are required to predict the height of the stairs if there are n-stairs. Seen in the picture the student calculates the height of each step by giving a scribble on the available ladder image. By observing the height of each ladder the student makes an assumption that if there is a n ladder the height of the ladder is 15n.

Student verification by using arithmetic formula. Students observe empirical facts in the form of the difference from each step height is the same. They conclude that to determine the height of the ladder it can use the n th term formula of the arithmetic sequence. Based on the results of the verification students draw conclusions by accepting the conjegtures they made on the first activity.

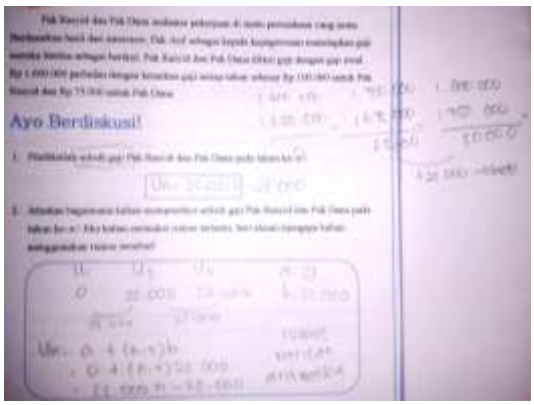

fig 7. Student Activity of Making Conjegtures on Salary Problem

The activity in seventh picture is that students are asked to predict Mr. Rashid's salary increment with Mr. Dana in the n-th year. From the student's work it is seen that the students observed the salary increment of Mr. Rashid and Mr. Dana every year. Based on the results of their observations the students gave a presumption that to calculate the difference in salary Mr.Rasyid and Mr. Dana is 25000 n-25000.

Students verify their conjegtures by observing empirical facts. It is seen from the students mention that. By observing these facts the student concludes that the above problems can be solved by the arithmetic sequence formula. Using the arithmetic sequence formula students can find that Mr. Rashid's and Mr. Dana's salary increment in the nth year is 25000 n- 25000. This is consistent with their allegations. Based on this the students draw conclusions by accepting their previous guess.

Based on observation result of student activity, reasoning activity contained in LKS is done by student. This is indicated by each reasoning activity obtaining a score T_i> 3. Activity made the conjegtures of obtaining a score of 3.3, the activity of verifying the conjegtures score of 3.8, and the activity drawing the conclusion earned a score of 3.3. Based on the results of the analysis, students' mathematical reasoning activity showed good category.

The result of the student's test score analysis shows the average student can perform the activity making the guess with the value 1.8. This means that 90% of students can do reasoning activities making a conjegture of what previously only ranged 48%. The average student in performing verification activities against their conjegtures is 2.2. This means the students' ability to verify the conjegtures increase from the previous range of 27.7% to 73%. Conclusion withdrawal activity 80% of students can do it. Based on these three things can be concluded that the activity of reasoning done by students is 81%.

Based on the results of the analysis of the use of worksheet characterized RME can effectively develop students' mathematical reasoning abilities.

IV. CONCLUSION

The effectiveness of worksheet characterized by RME to develop students 'mathematical reasoning ability can be seen from students' reasoning activities when using worksheet and test results. Based on observation result of student activity, reasoning activity contained in worksheet is done by student. This is indicated by each reasoning activity obtaining a score T_i> 3. Activity made the conjegtures of obtaining a score of 3.3, the activity of verifying the conjegtures score of 3.8, and the activity drawing the conclusion earned a score of 3.3. Based on the results of the analysis, students' reasoning activity showed good category.

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