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Implementation of RME-based student worksheets on plane figure area material for students of phase b elementary school

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Abstract: *The purpose of this research is to find out the activities of students in determining the area of flat shapes through drawing and constructing knowledge on student worksheets and to find out the effectiveness of the RME based student worksheets used. Qualitative descriptive method with design research was chosen in this study. This method is carried out by collecting data to obtain factual information that will be used to explain the process and information obtained in depth. The results showed that the RME approach based on local wisdom could be used to understand students material about the area of plane figure and the RME-based student worksheets was considered effective for use in learning. So that educators can apply the RME approach with student worksheets to teach students about the area of plane figures.*

Keywords: *Plane Figure; Realistic Mathematics Education; Student Worksheets*

Introduction

Realistic Mathematics Education (RME), here in after referred to as RME, is an approach that emphasizes the concept of thinking in stages and tends to place students as active participants in the learning process (Afriansyah, 2016). RME it self can be applied in learning by associating mathematical concepts with students daily lives (Ningsih, 2014). RME aims to teach students about mathematical concepts by constructing their own based on what they find (Elwijaya, Aaron, & Helsa, 2021). There are five stages in the learning process using the RME approach. According to Hobri in Salamah & Kelana (2020), these stages include: (1) Understanding contextual problems, (2) Explaining contextual problems, (3) Solving contextual problems, (4) Comparing and discussing answers, and (5) Concluding. In its application, RME can be juxtaposed with the iceberg theory. Iceberg theory is a description of students' thinking processes in learning using the RME approach, which is formed from the seabed which is increasingly conical up to the surface. There are four stages of thinking in this iceberg theory, namely: (1) situational, (2) model of, (3) model for, and (4) formal mathematics. The RME approach itself has advantages, especially in increasing student understanding. One of the advantages is in teaching students (Catrining & Widana, 2018). This is done by adjusting the stages of the RME approach and the stages of thinking in the iceberg theory that have been described previously.

The application of RME in learning mathematics needs to be supported by appropriate learning tools. Student worksheets are one of the appropriate tools for implementing mathematics learning with the RME approach (Meilina, Mariana, & Rahmawati, 2023). Student worksheets is a tool to help construct student activities through the stages of activities written in it (Umbaryati, 2016). RME-based worksheets, namely worksheets created with the aim of constructing student knowledge through the steps contained in the RME

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approach (Gustin, Sari, Putri, & Putra, 2020). This worksheet is adapted to the ability of students' thinking stages at certain grade levels. In its application, student worksheets can be paired with the Hypothetical Learning Trajectory or HLT. HLT is a learning design that contains learning objectives, learning activity plans, and estimates of the learning process that occurs in the classroom (Wijaya, 2015).

There are several previous studies that discuss the implementation of student worksheets through the RME approach. One of the studies with the title. Implementation of the Realistic Mathematics Education (RME) approach in Elementary Schools by Elwijaya et al (2021) obtain results in the form of data on improving student learning outcomes through the RME approach. Furthermore, research entitled Implementation of PMRI student worksheets in the Material of Counting Up to 20 for Phase A Students of Elementary Schools conducted by Meilina et al. (2023) obtained the result that the application of RME-based worksheets with a traditional game culture can bring student learning from contextual to more formal situations and is successfully implemented in elementary schools. In addition, several studies have shown that phase B students are still confused in understanding flat shape material in mathematics learning. This becomes an urgency to carry out an innovation in order to understand students about the material (Arnidha, 2017). Students' mathematical reasoning in solving problems in the field is also still in the low or less category (Yanti, Nurva, & Fikriani, 2022).

Based on the description above, the researcher is interested in conducting research in the form of the implementation of RME-based worksheets on the area of plane figure in elementary schools. This research is important to do in order to understand students in studying the area of plane figure through the RME approach with the help of worksheets made based on iceberg theory. Implementation is carried out side by side with HLT to help construct students' mathematical ideas with the learning objectives being carried out (Afriansyah, 2022). The novelty in this study is that the material chosen for research involving RME-based worksheets, namely the area of a plane figure, has never been raised in previous research.

The purpose of this study is to find out how students' activities determine the area of a plane figure through drawing and constructing knowledge on student worksheets. In addition, this study also aims to determine the effectiveness of using RME-based worksheets in learning mathematics in elementary schools.

Method

The research method used is descriptive qualitative using design research. This qualitative descriptive research method is carried out by collecting data to obtain factual information that will be used to explain the process and information obtained in depth (Hardani, 2020). The explanation process is carried out based on inductive data analysis (Abdussamad, 2021). This research is part of design research which aims to design learning that can make students understand mathematics through local wisdom in the form of historic

buildings. Design research consists of 3 stages proposed by Gravemeijer and Cobb, namely experimental preparation, experimental implementation, and retrospective analysis (Safaredha, 2014). Data analysis was carried out retrospectively using content analysis techniques. Content analysis technique is one of the data analysis techniques carried out with the aim of producing an objective and systematic description of the content contained in the data being analyzed.

Experimental preparation was carried out by making instrument research in the form of student worksheets, HLT, and learning media. All research instruments have been validated by experts and are suitable for field trials. The experiment was carried out by implementing student worksheets into the learning process and collecting data. The data collection process is carried out by observing during the learning process and poured in the form of Actual Learning Trajectory or ALT. Questionnaires were also distributed to determine the effectiveness of using student worksheets. The data obtained was then analyzed retrospectively using content analysis techniques to find out whether it was in accordance with the design that had been made (Fauzi & et al, 2022). If it is appropriate, the research stops with appropriate results, but if it is not appropriate, the research will continue by making a new HLT based on the previous ALT.

The subjects in this study were grade 4 students at Gempol 2 Public Elementary School, Ngawi Regency, East Java. The subjects consisted of 8 students who were taken from all 4th grade students. The research was carried out for one month, namely in March 2023 with one implementation.

Results and Discussion

This study obtained results in the form of data on the course of the learning process in the classroom and the effectiveness of using RME-based worksheets in mathematics in elementary schools. In this case, the observer acts as a researcher and teacher. Before taking action, the researcher prepared the instruments to be used, in the form of student worksheets, HLT, and learning media. The researcher begins the activity by explaining the learning activities to be carried out. Then, the researcher distributed student worksheets to the subjects to work on according to the activities listed.

Figure 1. Observer Explains Activities to be Performed and Distributes Student Worksheets

The student worksheets consists of several activities that students will carry out. Student activities begin with understanding contextual problems according to the first stage of the RME approach. The activity carried out was observing pictures of the Van Den Bosch fort which is a local wisdom in the form of buildings in Ngawi Regency. Then the students answered questions related to the Van Den Bosch fort. Students read problems related to everyday life and are still related to Fort Van Den Bosch. This problem is a concrete problem which is part of iceberg theory in the form of a real or situational problem.

The next activity is explaining contextual problems according to the RME approach. In explaining contextual problems, the teacher asks students to convey what they can absorb from the reading and existing problems.

Figure 2. Students Begin to Read the Problems

The next activity in the RME approach is solving contextual problems. In solving this problem, students will be assisted by the stages of iceberg theory that have been compiled into student worksheets. Students draw a window to then be given information that refers to solving the problem. This activity is part of iceberg theory in the form of a model of.

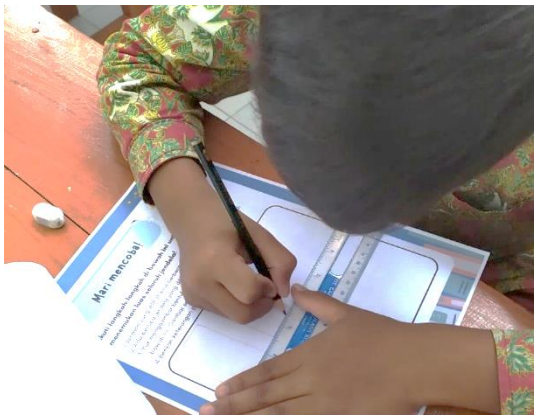

Figure 3. Students Solving Problems

Furthermore, students determine answers by calculating the window area through assistance in the form of steps on the student worksheets which is part of iceberg theory in the form of a model for. Then students conclude the results of their work. This activity is a formal stage in iceberg theory.

After the iceberg theory stage was completed, students were asked to compare and discuss the results of their work with their peers and then conclude the results of the discussion in front of the class. This is the last activity contained in the RME approach. The examples of the results of student worksheets work carried out by students are as follows.

Figure 4. Student Answers

In carrying out learning activities, researchers adhere to the HLT design that has been made based on the student worksheets. The following HLT design is used.

Table 1. Hypothetical Learning Trajectory

Activity	Levels	Stages of Student Thinking and Learning
Students predict the area of the window that the character sees.	*Situation*	Students immediately calculate the area of the window seen by the character.
Students were asked the question "The window that Rina saw was in the shape of..."	*Model Of*	Students can determine the shape of the window that the character sees.
Students are given a stimulus question "How many windows did Rina see?"		Students count the number of windows the character sees.
Students draw all the windows that the character sees.		Students draw all the windows seen by the characters with the right shape and number.
Students provide information about the length and width of the window.		Students write a description of the length and width of the window on each picture.
Students calculate the area of each window.	*Model For*	Students calculate the area of each window using the rectangular area formula and complete the available points.
Students calculate the area of all the windows seen by the character.		Students calculate the area of all the windows seen by the character by completing the available dots.

Activity	Levels	Stages of Student Thinking and Learning
Students determine the area of all the windows seen by the character.	*Formal*	Students determine the area of all the windows seen by the character by filling in the available dots.

From the learning activities given by the researcher to the subjects, the results were obtained in the form of worksheets that had been worked on by students and the results of observations as outlined in the form of ALT. The following ALT has been compiled based on the activities carried out by students.

Table 2. Actual Learning Trajectory

Activity	Levels	Stages of Student Thinking and Learning
Students predict the area of the window that the character sees.	*Situation*	Students calculate the area of the window directly.
Students were asked the question "The window that Rina saw was in the shape of..."	*Model Of*	Students determine the shape of the window that they see in the picture.
Students are given a stimulus question "How many windows did Rina see?"		Students count the number of windows in the image.
Students draw all the windows that the character sees.		Students draw windows with the appropriate shape and number.
Students provide information about the length and width of the window.		Students write length and width information on each window.
Students calculate the area of each window.	*Model For*	Students calculate the area of each window with the help of the dots provided.
Students calculate the area of all the windows seen by the character.		Students calculate the area of the entire window with the help of the dots provided.
Students determine the area of all the windows seen by the character.	*Formal*	Students write down the area of all windows correctly at the points provided.

From the ALT that has been prepared, the researcher matches the HLT design. The results of the researcher's analysis using content analysis techniques show that ALT is in accordance with HLT. From this suitability, it is not necessary to remake the HLT and student worksheets.

After the learning activities were completed, the researcher distributed questionnaires to students to find out the effectiveness of the student worksheets that had been made. The following are the results of the questionnaire that have been arranged in the form of a diagram.

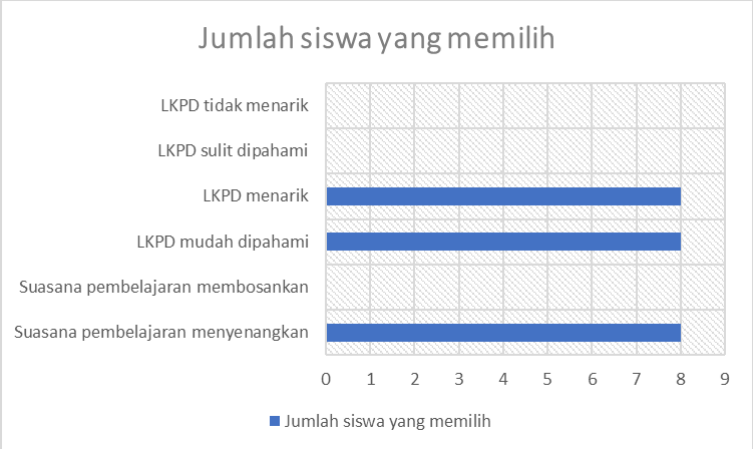

Figure 5. Questionnaire Results

The results of the questionnaire showed that 100% of students enjoyed participating in learning mathematics using RME-based worksheets. Students find the use of RME-based student worksheets by raising local wisdom very interesting and easy to understand.

The results of the student worksheets analysis show that students can construct their own knowledge according to the instructions on the student worksheets. In solving existing problems, students think gradually with daily knowledge that has previously been embedded in their minds. The thinking stage of students in solving problems begins with reading the problems given, in this case it can be seen that they want to try to solve them immediately, but are still not successful. Then the researcher led the students to open the next page and read the instructions. From these instructions students begin to try to solve problems with the stages of Iceberg theory. In the final stage, students can conclude the results of problem solving from the results of the knowledge construction they are doing (Setyawan & Rahman, 2013).

The compatibility of HLT with ALT also shows that the learning process is effective and can achieve its goals, namely understanding students about the material of plane figure through local wisdom in the form of historic buildings with learning designs that have been made. This is in line with previous research which stated that the achievement of learning objectives can be seen from the compatibility between HLT and ALT (Widyawati, Indra Putri, & Somakim, 2016).

Analysis during the learning process carried out by the researcher and the results of the questionnaire that had been processed showed that the student worksheets made was feasible and effective for use in learning mathematics in grade 4 elementary schools. Not only at SDN Gempol 2, but also applicable to other elementary schools. This is in line with previous research which stated that RME-based student worksheets is feasible and effective for use in learning because it can construct students' knowledge independently and according to students' wishes (Kartikasari, 2020). The suitability of the wishes of these students is indicated by the feedback given by students by filling out a questionnaire (Muncarno & Astuti, 2018).

Conclusion

From the description and analysis of the data that has been done, it can be concluded that in understanding students' material about the area of plane figure, they can use the RME approach. This approach can slowly lead students to construct their own solutions to existing problems through drawing activities. This approach is also able to shape student knowledge through the stages of knowledge construction or the stages of student thinking contained in iceberg theory.

The RME-based student worksheets themselves are also considered feasible and effective in learning mathematics on flat shapes in elementary schools. Activities carried out in student worksheets adjacent to students, namely in the form of local wisdom can encourage students' reasoning abilities. This student's reasoning ability can slowly shape students' knowledge about the material of plane figure so that students can solve existing problems. Local wisdom that is close to students can add to the effective value of the RME-based student worksheets that has been made because it is able to make students remember how they understand the solid material through solving problems.

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