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MATHEMATICS LEARNING INSTRUMENT DEVELOPMENT BASED ON RME ASSISTED BY LIVE WORKSHEET TO DEVELOP PROBLEM SOLVING SKILLS

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Abstrak

Pembelajaran matematika mengalami beberapa permasalahan, salah satunya terkait kemampuan penyelesaian masalah, peneliti menerapkan pendekatan RME yang menyajikan konteks dunia nyata agar siswa dapat mengkontruksi pemahamannya sendiri dengan bantuan *live worksheet* sebagai media pembantu pembelajaran matematika. Adanya pendekatan yang diterapkan menggunakan teknologi yang berkembang diharapkan mempu melatih siswa untuk menyelesaikan masalah dengan baik dan benar. Penelitian ini bertujuan untuk mengembangkan perangkat pembelajaran yang dapat melatih kemampuan pemecahan masalah matematika dengan pendekatan *realistic mathematics education* (RME) berbantuan aplikasi *live worksheet*. Jenis penelitian ini adalah penelitian pengembangan atau *Research and Development (R&D)* dengan model pengembangan ADDIE (*analysis, design, development, implementation* dan *evaluation*). Penelitian ini diterapkan kepada siswa kelas VIII-A di SMPN 1 Baureno Bojonegoro sebanyak 32 siswa. Data dikumpulkan dengan beberapa teknik yaitu catatan lapangan (*field note*), validasi, dan tes. Hasil analisis data menunjukkan bahwa berdasarkan indikator yang ditetapkan peneliti perangkat pembelajaran dinyatakan "valid" ditinjau dari (1) rata-rata total kevalidan RPP 3,93 yang termasuk dalam kriteria "valid", dan (2) e-LKPD sebesar 4,192 yang termasuk dalam kriteria "sangat valid". Perangkat pembelajaran dinyatakan "praktis" pada kriteria "B" dengan rata-rata total nilai kepraktisan sebesar 82,045 yang berarti dapat digunakan dengan sedikit revisi. Perangkat pembelajaran dinyatakan "efektif"' untuk melatih kemampuan penyelesaian masalah matematika dengan nilai rata-rata tes seluruh siswa sebesar 85,46 dengan persentase ketuntasan klasikal lebih dari 75% yaitu 81,25%. Penelitian ini menyarankan penggunaan RME berbantuan *live worksheet* untuk mengembangkan kemampuan pemecahan masalah khususnya pada siswa SMP.

Kata Kunci: *Live Worksheet*; Pemecahan Masalah; Pendekatan RME

Abstract

Learning mathematics experiences several problems, one of them is problems related to problem solving skills, the researchers applied the RME approach that presented a real-world context so that students could construct their own understanding with the help of live worksheets as an assisted media for mathematics learning. The existence of an approach that is applied using developing technology is expected to have trained students to solve problems properly and correctly. This study to develop learning tools that can develop mathematical problem solving skills with realistic mathematics education

(RME) approach assisted by live worksheet application. This type is a Research and Development (R&D) with the ADDIE model (analysis, design, development, implementation and evaluation). This research was applied to 8th-A grade students at SMPN 1 Baureno Bojonegoro as many as 32 students. Data were collected using several techniques, field notes, validation, and tests. The results of data analysis showed that based on the indicators determined by researchers, the learning device was declared "valid" in terms of (1) the total average validity of the lesson plan of 3.93 which was included in the "valid" criteria, and (2) e-LKPD of 4.192 which was included in the "very valid" criteria. The learning device is expressed as "practical" at criterion "B" with an average total practicality score of 82.045 which means it can be used with minor revisions. The learning device was expressed "effective" to develop mathematical problem solving skills based on the average test score of all students of 85.46 with a percentage of classical completeness of more than 75%, which is 81.25%. This study recommends the use of RME assisted by live worksheets to develop problem solving skills, especially for junior high school students.
Keywords: Live Worksheet; Problem Solving; RME Approach

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INTRODUCTION

Mathematics as one of the basic sciences nowadays has been rapidly developing both the content of the material and its importance. This can be seen from the many mathematical concepts that can be applied both in the development of science and technology and in everyday life (Irmawan et al., 2013). One of the purposes of giving mathematics is so that students can communicate mathematical ideas with symbols, graphs, tables, and diagrams or anything else to clarify the problem (Khadijah et al., 2018.) The fact, Indonesia ranked 73rd out of 79 countries in the 2018 PISA study, with an average score of 379 in math skills (Tohir, 2019). The results of this study, it is found that Indonesia has problems in learning mathematics, especially in problem solving skills.

Mathematics learning is intended to determine the final result, therefore students must be taught to know the steps in each process in solving or solving problems. Based on the document entitled "Curriculum and Evaluation Standards for School Mathematics" published by the National Council of Teachers of Mathematics

(NCTM) wrote "problem solving should be the main focus of the mathematics curriculum", therefore the problem solving process is important in learning mathematics. The ability to solve problems cannot be directly owned by each individual, it needs practice so that these abilities can be honed and developed. An approach is needed that helps students understand the concepts or problems given, mathematical modeling, and the process of solving mathematical problems by using the horizontal and vertical mathematization process. However, in realistic mathematics education (RME) in the learning process so that students understand the basic concepts and know how to solve questions about statistics.

RME is mathematics learning that involves students to implement the subject matter received into their daily lives. When delivering lessons, teachers do not immediately give formulas or concepts to students, students are directed to find or build their own concepts learned (Sari, 2017). RME not only associates mathematics with everyday life, but also teaches about the mathematization process. There are two mathematization processes, which include horizontal mathematization and vertical mathematization. As said by Freudenthal (Wijaya, 2012) that mathematics should not be given to students as a finished product that is ready to use, but as a form of activity in constructing mathematical concepts. Freudenthal introduced a process where students are active in discovering a mathematical concept with teacher guidance called "guided reinvention".

Horizontal mathematization is the process of students understanding contextual problem followed by visualizing the problem in various ways obtained, then various ways obtained, then transferring real problems to mathematical models. While vertical mathematization is the process of formalizing the mathematical model obtained into a rule that is then generalized, which is then generalized. Students are given the context of problems related to everyday life, so that students can build understanding based on experiences in the real world, then students reconstruct their understanding into mathematical form. After the implementation of horizontal mathematization students simplify the mathematical

form with the specified rules, this process is called vertical mathematization. The implementation of RME in learning requires tools that are often used by students to make it easier for students to understand the material or solve the problems given.

In solving problems, students usually need a worksheet. Trianto (2011) said, Learner Worksheets are worksheets that contain instructions for learning steps that students should participate in solving problems given by the teacher to get the most from all their learning. The application of e-LKPD in learning has an impact on student learning activities to be more pleasant, learning becomes interactive, provides opportunities for students to practice and motivate students in learning (Puspita & Dewi, 2021).

Rumonin (2023) that the learner worksheet is teaching material in the forms of a summarize material and steps of instructions for carrying out tasks and evaluations carried out by students. In this study, we will use electronic worksheets or e-LKPDs that can assist teachers in the learning implementation process. This is the difference and form of innovation from previous studies conducted by Rumonin. The study used ordinary worksheets while in this study it has used current technology, another difference lies in the approach and also the material used in the study. The technology utilized in the process of making e-LKPD in this study is the Live Worksheet application.

Furthermore, research conducted by Musthafa (2022) in his research used the STAD cooperative learning model assisted by the live worksheet application but there were features that were not used and in this study more features were used. Then in the research conducted by Fitriani et al. (2021) entitled “Live Worksheet Realistic Mathematics Education Assisted by Geogebra: Improving Mathematical Abstraction of Junior High School Students on Quadrilateral Material” the study used the same application and approach but the difference was the purpose of the research. In this study focuses on students' mathematical problem solving skills which are supported by the RME approach.

The problems that occur are student errors in understanding mathematical problems, modeling mathematics and errors in the process of solving mathematical problems in statistics material. Therefore, this research will be carried out by developing learning tools in the form of lesson plans and LKPDs that are electronically based using the live worksheet application which will make it easier for students and teachers in the learning process and using the RME approach which has the characteristics of using context to help students' understanding of problems, using the mathematization process both horizontally and vertically which will help students in the process of modeling mathematics and solving mathematical problems assisted by learning tools developed into technology-based tools in the learning process because as mentioned earlier, currently developing technology can facilitate the learning process for both teachers and students.

METHOD

This study used the Research and Development (R&D) method involving all 8^{th} grade students of SMPN 1 Baureno. The sample of this research is students of 8^{th}-A grade of SMPN 1 Baureno Bojonegoro with random sampling technique. The sample involved in this study was 32 students. This development uses the ADDIE development model which consists of Analysis, Design, Development, Implementation, and Evaluation. The ADDIE model can make it easier for researchers to carry out research because of its structured and consistent approach to learning design, efficient because it has five complex steps, there is feedback on each development process that is used to ensure the product made is in accordance with the desired objectives, and there is an evaluation step that is used to identify improvements for the future.

The stages of the ADDIE development model that will be carried out in this study are (1) the analysis stage to identify problems and find out the learning tools and curriculum used. (2) the design stage, this stage is used to create a learning device framework to be developed and a device assessment instrument developed. (3) the development stage is carried out by completing the device that has been

designed which is then validated by experts. (4) the application stage is carried out by applying the device made to students who are the object of research. (5) the evaluation stage which is an assessment related to the device that has been made and is used to determine the results of the stages that have been carried out. There are three data collection instruments used in this study, i.e. field note sheet, validation sheet, and test sheet.

There are four data analysis techniques used to make conclusions in this study, i.e., data analysis of the learning development process, data analysis of the validity of learning instruments, data analysis of the practicality of learning instruments and data analysis of the effectiveness of learning instruments. According to Nieveen (Nuryadi & Khuzaini, 2017), product quality, program design, development, and evaluation must meet the criteria of valid, practical, and effective. The quality of the product is said to be valid seen from its relationship with the purpose of the product development itself must be truly considered. In this study, the development of learning devices can be said to be valid if the total average of validation of learning devices meets the criteria of "valid" or "very valid".

Practicality is seen from the opinions of users, especially teachers and students who consider the products produced easy to use and also describe the actual learning process. . Learning devices are said to be practical if based on practicality criteria it states that this learning device can be used with "little revision" or "without revision". The level of effectiveness according to Nieveen describes the student experience and student learning outcomes. Learning is said to be effective if the object of research gets classical completeness which is seen from the number of students able to solve math problems by achieving a score equal to or more than the minimum learning completeness value (MLC) $\geq$ 76. The percentage of the class said to be complete is if at least 75% of the total students in the class reach the MLC value.

RESULTS AND DISCUSSION

Based on the related research procedures for developing learning instruments with the RME approach assisted by the live worksheet that has been carried out, the following results are obtained.

Analysis Stage

In the process of transitioning curriculum 13 to an "merdeka" curriculum, so that students can understand statistics material and determine the mode, median and mean values, a suitable approach is needed to make it easier for students to understand the material, the RME approach which provides learning with a real-world context that allows students to construct their own understanding, given steps with horizontal and vertical mathematization and group learning patterns that build student interactivity. Learning can also be more efficient by utilizing technology in the form of live worksheets, because with existing features it can create more interesting learning because many forms of questions can be given, ranging from multiple choice, essay, dropdown, join arrow, wordsearch drag and drop and can add material from YouTube videos. In addition, it can also shorten the time for teachers to correct, comment and assess student work.

At this stage there are two analyzes, the first is needs analysis. The results of interviews with subject teachers and observations to schools obtained the following information: (1) Data on the subject material used, which is statistics material on the mode, median and mean subchapters. (2) The learning resources used are only textbooks and worksheets from school. (3) Mathematics learning applied by teachers is less varied, teacher-centered learning, so that students only listen to explanations from the teacher. (3) The use of learning tools that are still monotonous so that students are passive in learning and do not use worksheets. The second is the curriculum analysis obtained information that the curriculum used at school is the 2013 curriculum.

Design Stage

Learning instruments for lesson plans and e-LKPD were made by researchers on April 6-May 15, 2023. The features used in E-LKPD are (1) inserting learning video links from YouTube (2) essay question form (3) drop down question form (4) check boxes question form (5) multiple choice question form (6.) join arrow question form (7) drag and drop question form (8) word search question form (9) features for correcting, commenting on answers from students. At this stage researchers also make validation sheets that are used to assess and evaluate the learning instruments that have been developed.

After the learning instruments have been designed, the learning instruments are consulted with the supervisor and then given to the validator for validation. The validation process is carried out by showing the product that has been made with an assessment form that has been prepared and consulted with the supervisor with a Likert rating scale with a value range of 1 to 5 (1: Not Good, 2: Less Good, 3: Quite Good, 4: Good, 5: Very Good); with aspects of assessment which include components, content, language, appearance, and use of the live worksheet application. The validators consisted of 3 people, 2 mathematics education lecturers and 1 junior high school mathematics teacher. Learning devices are made with a live worksheet website with the following appearance.

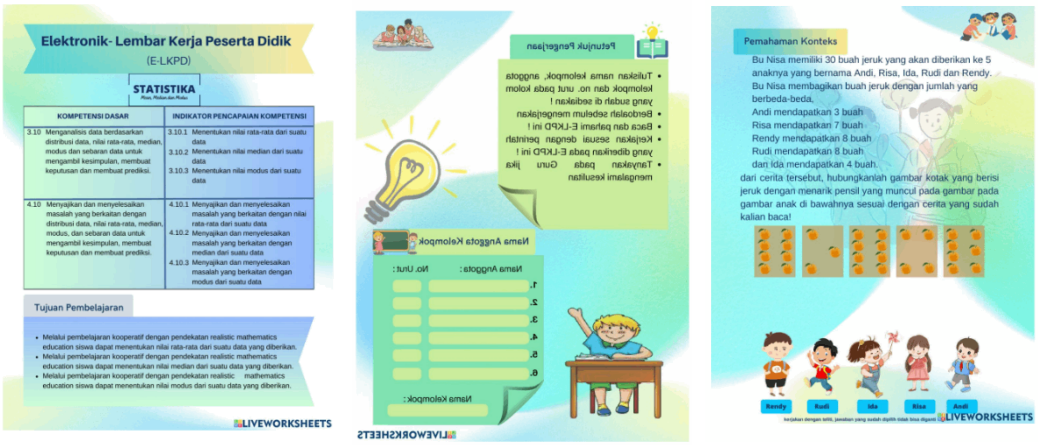


Figure 1. e-LKPD Home View

On the first page there are basic and core competencies and learning objectives. On the second page there are instructions for use and student identity and on the next page is given an understanding of the context which contains story problems related to everyday life as a characteristic of RME approach. On the next page, problems are given to train students' problem-solving skills and become a step for students to understand statistics on mode, median and mean materialThis instrument is made based on the RME approach, providing contextual problems, made to be done in groups to build student interactivity, and given a problem-solving process that is in accordance with horizontal and vertical mathematization, building student construction of the given problem which is then led to write it in the form of a mathematical model, and simplify it according to the specified rules.

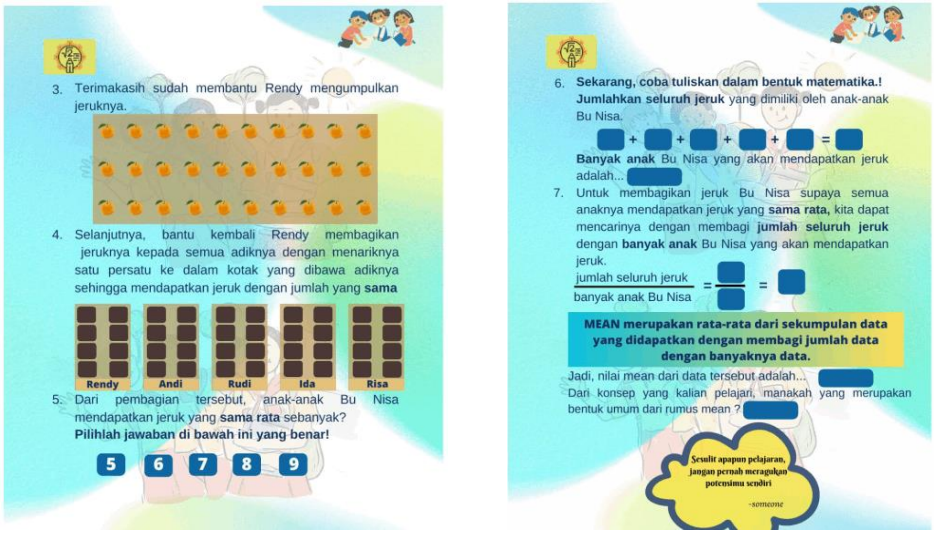
Development Stage

For meaningful learning to occur in a multi-media environment, the learner must engage in five cognitive processes: (1) selecting relevant words to process in verbal working storage (2) selecting relevant images to process in visual working memory, (3) organizing selected words into mental verbal models, (4) organizing selected images into visual mental models, and (5) integrating verbal and visual representations. Although I present these processes as a list, they are not necessarily in a linear order, so learners can move from one process to another in many different ways. (Mayer, 2009.)

The learning equipment design that has been made at the design stage will be realized with the RME approach assisted by the live worksheet application. The design made by researchers to be visualized in learning includes lesson plans and e-LKPD, the instruments are realized in real form through the live worksheet application to be ready for use by students as shown below.

Figure 2. e-LKPD Statistics and Test Questions

The learning tools are designed with the RME approach applying the use of context, and models to understand the problem which will lead students to model mathematically as shown below.



Model of **Model for**

Figure 3. RME Approach in e-LKPD

In the picture above of the model of, is a horizontal mathematization step by giving a picture of an orange as a given context, in the next step is a request for students to continue the solution process with the results of their construction. In the model for picture, students are asked to write what is done in the model of to the model for by writing it in the form of numbers and simplifying with the specified rules. After the instrument is completed, the learning instruments are then validated by three validators who state that this learning instrument is valid with some notes that must be revised before it is applied. The revisions given by the validators regarding writing, instructions that are unclear to understand and not enough contextual problems to exercise students' mathematical problem solving skills as below.

Before **After**

Figure 4. Revision

The learning tools developed by researchers were declared valid in accordance with the validity criteria with a value of 4.06. The results of previous studies that are relevant to the results of this study are studies conducted by Musthafa (2022) with the title "Development of Mathematics Learning Tools Using the STAD type Cooperative Model Assisted by Live Worksheet Applications to Improve Student Learning Outcomes" with the results of validity assessment valid. because it uses the same technology in the development of E-LKPD, namely using live worksheets, although there are differences in the features used. But in the process of getting the validity value of learning tools can be used as a reference. And in the research by Musthafa, the results of the validity assessment were valid.

The assessment of the practicality of learning instruments by validators obtained an average score of 82.045 with B criteria, which means that it can be used with minor revisions. The criteria for practicality are satisfied if the expert practitioner states that what was developed can be applied and in fact shows that what was developed can be applied (Putra, 2021). The results of previous studies that are relevant to the results of this study are studies conducted by Thalia (2022) with the title "Development of Brain Based Learning Model Learning to increase Interest and Motivation in Learning Mathematics for SMP Negeri 1 Jabon Students". This is because Thalia's research developed the same learning tools, namely worksheets, although in a different form. Thalia's research used ordinary worksheets while this research used electronic worksheets. However, in the process of getting a practicality score, research by Thalia can be used as a reference with the results of the practicality assessment from Thalia's research getting B criteria which means it can be used with minor revisions.

Implementation Stage

The learning tools that have been validated and revised are then applied at SMPN 1 Baureno school in two sessions. The first one, researchers applied learning with RME approach assisted by live worksheet application on mode and median material. Furthermore, at the second session, the researchers gave mean material, then continued with working on test questions individually using the live worksheet application. The test in this study was used to assess the effectiveness of this learning tool to train mathematical problem solving skills.

The applied learning tools are declared effective based on the data of the mathematics problem solving ability test conducted, getting the results that the number of students who completed as many as 26 students with a percentage of 81.25% and students who did not complete as many as 6 students with a percentage of 18.75%. Then for the percentage of completeness from the results of the student problem solving ability test, the value is 81.25% where the percentage is more than the percentage of classical completeness75%. As stated in the study (Musthafa,

2022; Prayitno et al., 2023) that a class is said to be complete if at least 75% of the number of students in the class reaches the score. The study that is relevant to this is research conducted by Wirdaningsih & Arnawa (2017) entitled "Development of Learning Tools with Contextual Teaching And Learning Approach to Improve Problem Solving Ability of Class XI Students" with the results of the devices developed effectively to improve mathematical problem solving skills.

Evaluation Stage

The results of the validation of this learning instrument are used to determine the validity and practicality of the learning instrument developed. The results of the student response questionnaire are used to determine the effectiveness of learning devices made with the RME approach assisted by the live worksheet application. Student test results are used to determine the effectiveness of learning devices made with the RME approach assisted by live worksheet applications to improve mathematical problem solving skills. The validation process of learning devices is carried out by three validators or experts by presenting a validation sheet that contains assessment indicators based on a Likert scale with a value range of 1 to 5 (1: Not Good, 2: Less Good, 3: Quite Good, 4: Good, 5: Very Good); with aspects of assessment that include components, content, language, appearance, and use of the live worksheet application.

As for some things that became notes from validators for researchers to make improvements to the lesson plan, a) in writing learning objectives to be given additional information, b) writing time allocations that must be adjusted to the lesson hours taken, c) writing learning resources written in more detail, and d) added skills assessment according to Polya's theory. From these notes, researchers made improvements in order to produce learning tools that were developed optimally to train mathematical problem solving skills .

Some things that became notes from validators to be used as improvement materials for researchers for the E-LKPD developed include a) providing instructions for using E-LKPD in more detail, b) adding contextual problems with

the problem solving process according to Polya's theory, and c) adding the general form of the mean and median formulas. From these notes, researchers have carried out comprehensive improvements to obtain learning tools in the form of E-LKPD that are maximized to help students understand the material and solve math problems. From the test results, it was found that of the 32 students who tested, 26 students were complete and 6 students were not complete. Students are said to be complete if they can achieve minimum learning completeness (KBM) ≥ 76 which is obtained by calculating the average score of students, so that the calculation of the percentage of completeness results in 81.25% of students complete.

CONCLUSION

The development of learning instruments was declared valid with an average total validity value of lesson plans of 3.93, E-LKPD of 4.192 where the lesson plan was said to be "valid", and e-LKPD was "very valid". The learning instruments were also declared practical at criterion "B" with an average total practicality score of 82.045 which can be interpreted that the learning instruments developed can be used with minor revisions. The application of learning tools was declared "effective" to train mathematical problem solving skills because it got an average test score of 85.46 with a very good category and the percentage of classical comprehension was more than 75%, which is 81.25%.

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