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The Development of Realistic Mathematics Education (RME) Based Mathematics Learning Tools to Improve Problem Solving Ability in Elementary School

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ABSTRACT

This paper examines the development and analysis of mathematics learning tools based on Realistic Mathematics Education (RME) to enhance problem-solving skills in elementary school students. The research follows a development methodology, utilizing the Plomp development model, which includes three phases: preliminary research, development or prototyping, and assessment. Data collection methods comprised validation sheets, practicality test questionnaires, and question sheets. Both qualitative and quantitative analyses were performed on the collected data. Validity was assessed using a Likert scale, while practicality was evaluated through descriptive techniques and a Likert scale, and effectiveness was measured using a specific formula. The categorized percentage values were based on modified exposure levels. Additionally, the effectiveness of the learning tools was analyzed using student test scores, with hypothesis testing conducted via a t-test at an α level of 0.05. The content and language validity, as evaluated by validators, achieved a score of 92.54%, indicating a very valid category. Teacher responses rated the practicality of the learning tools at 97.85%, and student responses rated it at 95.86%, both indicating high practicality. The average final test score for students' problem-solving abilities was 94.69. These results suggest that the RME-based learning tools developed are highly suitable for use in fifth-grade in elementary school.

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1. INTRODUCTION

Mathematics plays a very important role in science and technology, as it is a means of scientific thinking and is essential to reasoning and logical thinking skills, and criticism. Mathematics is important and necessary for everyone because it brings immense benefits to daily life. Given the importance of mathematics in life, mathematics subject is offered to all students from primary school.

The main objective of the study of mathematics at school is to develop in students the mathematical skills necessary for everyday problems. It is supported by (Ahmad Fauzan and Yerizon, 2013) who argued that the main objective of teaching is to foster the ability of students to use knowledge and their abilities to solve problems in daily life. The ability of students to solve mathematical learning problems is inseparable from the role of the teacher. The teacher must be able to create learning conditions and demand activity from students. To make this happen, the teacher in the classroom must be able to create a lesson that has a good and planned concept by designing learning tools so that students become active and can understand the concept well.

Learning tools in the form of lesson plans and worksheets in elementary schools are currently not fully able to meet the needs of students, so learning mathematics that is carried out tends to be the teacher giving formulas or the general form of a mathematical concept to students without involving students (Sari & Fitria, 2021). In addition, most of the learning tools used by teachers are downloaded from the internet or rely on files between fellow teachers, so they are not following class conditions, student characteristics, learning objectives, and the learning approach used (Nahdi & Cahyaningsih, 2019). Most of the learning methods are conventional methods which begin with the provision of material, sample questions, and exercises (Yerizon, 2018).

According to the results of a preliminary study on the primary school cluster No. 1 in Pangkalan Koto Baru District, Lima pulu Kota District, it was found that the learning tools used did not fully meet the learning needs of the students. This is evident from the needs analysis table in the form of a checklist, where the lesson plans do not motivate students to learn, and the steps included in the lesson plans are not connected to the students' real world. Or the method used does not follow steps - the steps included in the lesson plan and the stages of students' mathematical thinking are not yet visible, as evidenced by the indicators and questions created by the teacher in the lesson plan.

Meanwhile, the mathematics students' worksheet used in elementary schools was taken from a package book, which was only in the form of questions so that it did not lead students to discover for themselves the concepts of learning mathematics being studied, and students were less interested in the students' worksheet used. The tendency of teachers to teach material as stated in the book and students have not been given the opportunity by teachers to understand the rationale behind the formulas taught to them through the learning process and students only accept (as objects) in learning makes interactions between students less successful. Students only use mathematical formulas to solve a problem without knowing why (know why) they use these formulas. This causes students to not have the ability to think logically, analytically, systematically, critically, and creatively. Whereas learning will be more meaningful if students directly do and experience themselves an activity (Desyandri, Yohanda, 2020). It makes students bored with learning mathematics because they cannot understand the concept properly. Hence, it was also found that many students at every level of education did not like learning mathematics (Mentari & Syarifuddin, 2020; Fitria et al., 2019). It also lack of understanding of mathematics (Fernandes, M., & Syarifudin, 2019). Students' difficulties in using mathematical symbols cause them to experience errors when using concepts to solve problems (Kurani & Syarifuddin, 2020; Syarifuddin, 2018).

As a result of learning tools that are not optimal and learning processes that do not follow the learning characteristics of students expected in the 2013 curriculum, the effect on student learning outcomes which are considered unsatisfactory can be seen from the learning outcomes of students who have not fulfilled the Minimum Completeness Criteria set by the school. Based on the results of observations at school, for example, in Elementary School 07 the minimum completeness criterion base (KKM) set by the school is 70, there are still many students who do not reach the minimum completeness criteria.

These problems must be addressed immediately to improve student learning outcomes. If this problem continues, then students are always untrained in compiling their knowledge, so they become passive and just take what the teacher explains without understanding the meaning of the material being taught. They are also not trained to solve mathematical problems in everyday life. This will cause students to easily forget the learning material because the teacher does not direct students to find their concepts through problems related to students' real lives.

The right solution involves designing learning materials in the form of lesson plans and worksheets. Student worksheets are one of the learning tools that provide students with the greatest possible opportunity for direct and active participation in learning. Student worksheets can be activated for students. The worksheets provided to students must be carefully designed with the needs and characteristics of the students kept in mind. The author believes that student worksheet lesson plans and learning tools that can meet the needs of these students are learning tools based on Realistic Mathematics Education (RME).

The reason the author chose the RME approach is that through the RME approach, students are not just passive recipients of ready-to-serve mathematics material, but students need to be allowed to discover mathematics through practice that they experience themselves so that learning becomes meaningful in students' memories. In RME, mathematics is viewed as a human activity. Mathematics is not taught to students in a final form, but students must be able to build their knowledge by solving formal and informal interactive situational problems in order for students to discover the truth on their own or with the help of a teacher. Be able to clarify the concepts they are learning. Realistic Mathematics Education (RME) provides students with opportunities to gain experience directly from the learning process. Realistic mathematics learning is not only related to the real world or everyday life, but realistic terms are also related to what problems can be imagined and real in the minds of students (Rahmad & Wijaya, 2020).

Student worksheets based on Realistic Mathematics Education are worksheets that begin with giving contextual problems to be solved by students so they can find mathematical concepts from the problems given. Furthermore, the students' worksheet gives work steps that will guide students in finding the concept of the given problem. Contextual problem solving is done by modelling the problem given by providing programmed questions related to the problem given to make it easier for students to find concepts. In solving the problems given students are given the freedom to use problem solving strategies. Each student can have a different strategy so that they can construct their knowledge according to what they experience when solving a given contextual problem. This is relevant to the results of research by (Septian, Irianto, Andriani, & Purwokerto, 2019) which states that the development of worksheets with a realistic mathematics education approach in elementary schools is effective for use as complementary mathematics teaching materials because the RME approach is oriented to contextual problems so that it is easy for students to understand.

Previous studies have shown that mathematics learning tools based on the Realistic Mathematics Education (RME) approach are highly effective and engaging for students. Waluyo and Eko Sa'dijah (2016) found that RME-based learning tools are easy to use, useful, and attractive to students. Similarly, Septian et al. (2019) demonstrated that worksheets developed with a realistic approach to teaching mathematics were effective as supplementary teaching materials, with the RME approach's focus on contextual problems allowing children to easily grasp the concepts. Asfiranna and Dalimunthe (2019) also reported that lesson plans and worksheets developed with the RME approach met good criteria in validation and were effective in enhancing learning outcomes. The feasibility analysis of these worksheets further confirmed that they were well-suited for elementary school students, aligning with the characteristics of the RME method. Additionally, research by Sari and Fitria (2021) indicated that RME-based mathematics learning tools for topics like the perimeter and area of shapes were valid, practical, and effective. Herlina et al. (2022) also explained that RME-based learning tools for data collection and presentation materials were simple to implement, efficient in terms of time, and effective in enhancing students' problem-solving abilities. These findings collectively suggest that RME-based learning tools are highly suitable for use in elementary classrooms, particularly for improving students' conceptual understanding.

The key difference between this study and previous research lies in the development of mathematical content, the focus on mathematical skills, and the model used for development. While prior studies emphasized the ability to understand mathematical concepts, this research focuses on enhancing students' problem-solving skills. The material selected for this study is the volume of geometric shapes, in contrast to previous studies, which focused on data collection, data presentation, and the perimeter and area of flat shapes. Additionally, most previous research utilized the 4D development model, whereas this study employs the Plomp model.

The explanation above highlights that the RME (Realistic Mathematics Education) approach offers a valuable alternative for developing mathematics learning tools aimed at improving problem-solving abilities. Through RME, students can construct their own knowledge, making it easier to retain and apply when solving mathematical problems. This approach also encourages active student involvement and creates an engaging and enjoyable learning environment, as it integrates real-life contexts, reducing the monotony often associated with learning mathematics. Therefore, in this developmental research, the authors conduct a practical analysis of RME-based mathematics learning tools to enhance problem-solving skills in elementary school students.

2. METHODS

The paper employed research development or R&D. Development research is a research method used to develop new products (Sugiyono, 2015). The product developed in this study is a learning tool based on RME for learning Mathematics in Elementary Schools. The learning tools consist of lesson plans and student worksheets. This research was carried out using scientific procedures when designing a product. With the Plomp model, there are 3 stages, namely preliminary research including needs analysis, curriculum analysis, and concept analysis. The second stage of development is the process of designing and developing students' worksheets and lesson plans in stages using formative evaluation to improve the products made. The final stage is an assessment to formulate whether the students' worksheets and lesson plan are appropriate based on standard research rules. The subjects of this study were students of class V SD Negeri 07 Pangkalan.

This study utilized both qualitative and quantitative data to provide a comprehensive analysis. Qualitative data were gathered through observation sheets and interviews, offering insights into the experiences and perspectives of participants. Quantitative data were collected through questionnaires, validation sheets, and observation sheets that assessed the implementation of RME-based lesson plans. The data analysis involved both qualitative and quantitative descriptive techniques. The quantitative analysis focused on evaluating the validity of the developed product, providing measurable evidence of its effectiveness. In contrast, the qualitative analysis aimed to explore and explain the nuances of the product's development, offering a deeper understanding of how and why it functions as it does. Together, these methods allowed for a well-rounded assessment of the RME-based learning tools, ensuring that both the practical outcomes and the contextual factors influencing their use were thoroughly considered. This mixed-method approach enhances the reliability and richness of the research findings, making the results more robust and applicable to educational settings.

3. FINDINGS AND DISCUSSION

3.1 Findings

The study begins with preliminary research stages, namely needs analysis, curriculum, students, and conceptual. The results of the analysis are as follows: The needs analysis stage collects information about learning mathematics and its reasons, the implementation of learning, and the use of learning tools. The observation results obtained some information that teaching and learning activities are teacher-oriented. Students are not used to constructing their knowledge. Students tend to be introduced directly by providing formulas without involving students to be active in discovering the concept. This affects the ability of students to solve mathematical problems, where the learning process does not help students solve them. Then, the curriculum analysis was carried out, and a review of the 2013 curriculum for fifth-grade mathematics was carried out in semester II. The analysis is in the form of a formulation of competency achievement indicators (GPA) in the syllabus. The description of core and basic competencies and GPA is the reason for choosing the material. Analysis of students found that students prefer to learn with learning resources that have a combination of pictures and colours. In learning activities, students often feel bored because the teacherexplains the lesson for too long, so learning resources are needed to motivate them to learn. Then after the concept analysis, 5 main concepts were obtained, namely 1) the concept of volume, 2) finding the volume of a block, 3) solving the problem of volume of a block, 4) finding the volume of a cube, 5) solving the problem of volume of a cube. This information is taken into consideration in making learning tools, namely lesson plan and RME-based worksheets.

The process of validating RME-based learning tools involves testing their validity, practicality, and effectiveness. This validation process includes the validation of lesson plans and LKPD. To ensure the quality of the product being developed, experts in various fields were consulted for their expertise. These experts consisted of two mathematics lecturers, one Indonesian language lecturer, one arts and culture lecturer, and one elementary school teacher specializing in mathematics. The purpose of this validation is to seek consultation from experts in their respective fields to ensure the accuracy and appropriateness of the developed product.

The verification process for the lesson plan involved a panel of four experts, consisting of three math experts and one expert in the Indonesian language. The experts evaluated various aspects of the lesson plan, including its components and the learning activities based on the RME approach. During this stage, the validator provided suggestions and input, which led to several revisions being made. These suggestions primarily focused on improving the clarity of learning objectives and ensuring that all activities were student-centered rather than teacher-centered. As a result of the validation process, the lesson plan underwent further revisions. The analysis of the validity of each aspect of the lesson plan revealed that it is highly valid, with a component validity value of 93.75% for the lesson plan components and a validity value of 91.25% for the learning activities. The average validity of the results of the RME-based lesson plan is 92.50%. It is said that the RME-based lesson plan is valid. The results of the validation of the lesson plan can be seen in the diagram below:

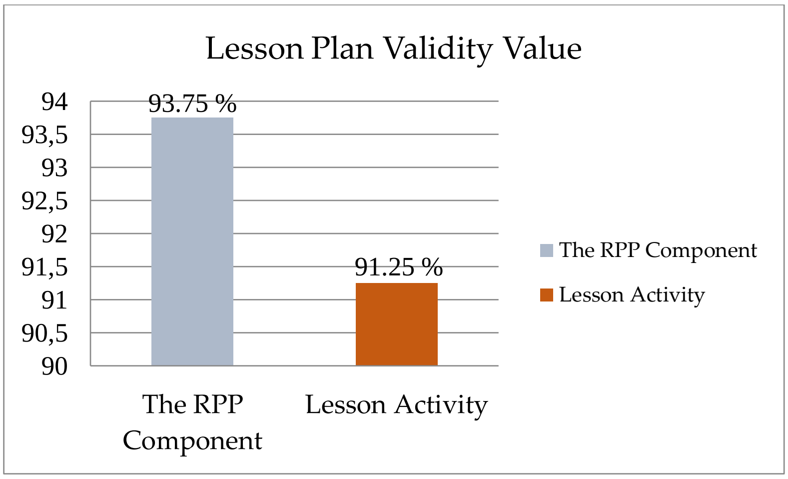

Figure 1. Lesson Plan Validity Value

To ensure the accuracy and quality of the students' worksheets, a team of 5 experts conducted a thorough validation process. This team consisted of 3 math experts, 1 Indonesian language expert, and 1 art and graphics expert. The validation process involved using both the students' worksheets and validation sheets as data collection methods. The aspects that were observed during this process included the didactic/content presentation, language usage, and graphic design. Throughout the validation stage, the students' worksheets underwent several revisions based on the suggestions provided by the validators. These suggestions included the importance of presenting the worksheets effectively, providing necessary tools and materials, adjusting the spacing and placement of writing, paying attention to the use of greeting words, and ensuring all elements on the cover were completed. Finally, the results of the validation were analyzed using a Likert scale. Then, after validating the students' worksheets, the results of the students' worksheets validation on the aspect of presentation and content feasibility were 92.63% which meant very valid, language 95% which meant very valid, graphics or display 90%. which means very valid. It was concluded that the RME-based students' worksheet was valid. The validation results can be seen below.

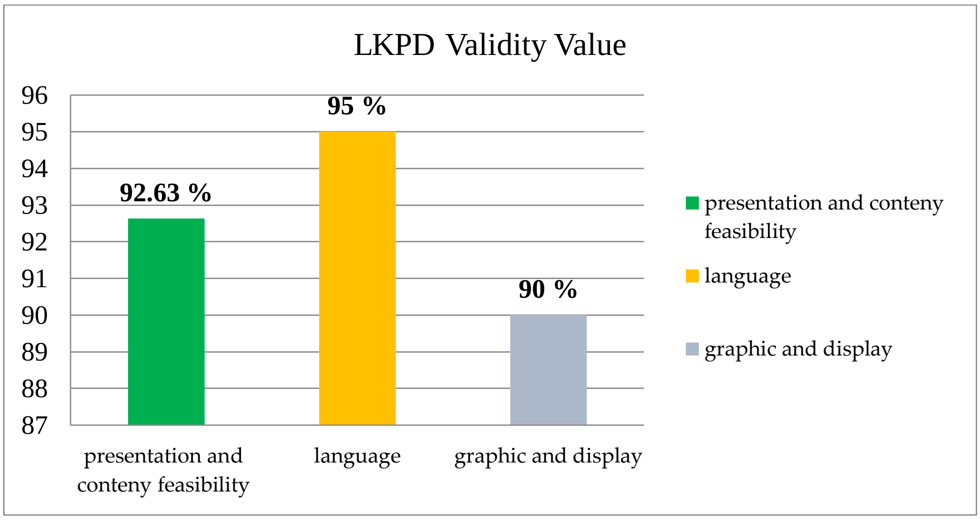

Figure 2. Students' Worksheet Validity Value

Based on this table, in terms of content and construct validity the lesson plans are valid. It can be used by teachers to carry out RME-based learning. Then the analysis of the validity of students' worksheets, in general, is 92.54% which means very valid. This proves that the Student Work Sheet made includes valid criteria. Student response students' worksheet practicality test scores can be seen below:

After the trial was carried out, the researcher gave practicality questionnaire sheets to teachers and students regarding learning tools in the form of lesson plans and students worksheets. Furthermore, an analysis of practicality data was carried out from observation sheets, teacher response questionnaires, and student response questionnaires. Researchers determine the practicality of learning devices using predetermined criteria.

The practicality test was carried out on 23 class V students. The practicality of the teaching materials consisted of several indicators, including attractive images and appearance, ease of reading, easier finding concepts, and easier understanding and solving problems. The RME-based mathematics learning tools used are practical, easy to use, and easily understood by students and teachers. The value of the practicality test of students' worksheets and the responses of students can be seen below:

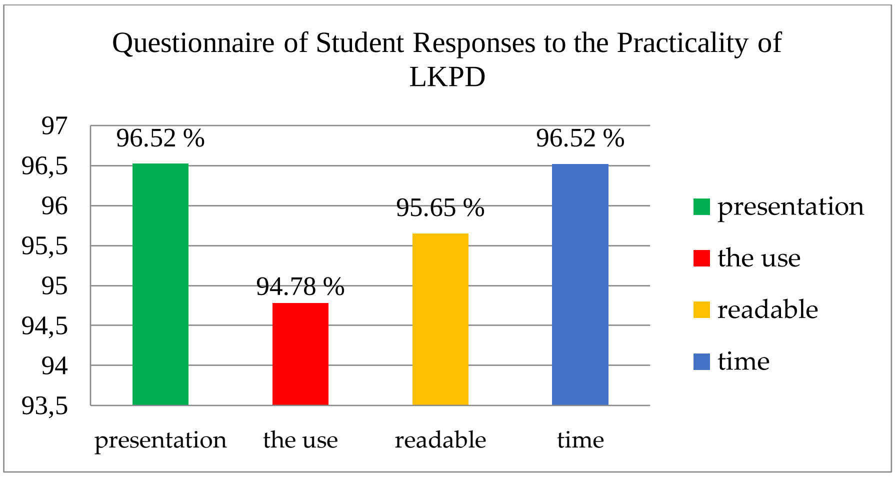

Figure 3. Questionnaire of Student Responses to the Practicality of Students' Worksheet

In order to find out the practicality of the Learning Implementation Plan and students' worksheets with class V teachers at SD Negeri 07 Pangkalan, it was carried out after learning was carried out. The practicality questionnaire for RME-based learning tools according to the teacher's response looks like the following:

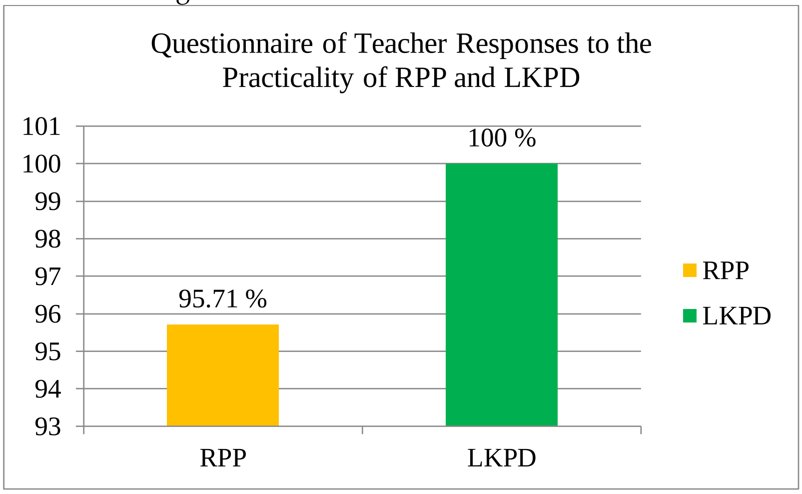

Figure 4. Questionnaire of Teacher Responses to the Practicality of Lesson Plan and Students' Worksheet

Based on this explanation, it can be seen that the percentage level of practicality of RME-based learning devices according to the teacher's response, is 95.71% in the lesson plan and 100% in students worksheets. The average practicality of the teacher's response is 97.85%. It was explained that RME-based learning tools are very practical from the teacher's perspective. The results of the analysis explain that the lesson plan is based on Realistic Mathematics Education (RME), and the volume material contains components that are easy to read and easy to use in the implementation of learning. Meanwhile, the results of the analysis explain that students' worksheets based on Realistic Mathematics Education (RME) on geometric volume material are easy to use, interesting, understandable well, and add to the enthusiasm of students learning.

The results of this product effectiveness test are measured based on student learning outcomes. Student learning outcomes are limited to aspects of problem-solving ability. It consists of 4 characteristics, namely understanding the problem, planning a settlement, carrying out the plan, and checking again. Assessment of problem-solving abilities was obtained from the analysis of students' post-test scores. The final exam is given to students after completing the learning process using lesson plans and RME-based students' worksheets. This effectiveness test begins with learning activities using learning tools based on Realistic Mathematics Education (RME), followed by tests on student learning outcomes, after which student answer sheets are assessed based on existing problem-solving skills rubrics, then analyzes student test results to determine the effectiveness of learning tools by comparing test results with KKM in schools. The percentage of completeness of learning outcomes can be seen in Table 1 below:

Table 1. Completeness of Learning Outcomes

Final Test	Completeness		Total
	Completed	Uncompleted	
Total number of students	22	1	23
Percentage	95,65 %	4,35 %	100 %

In Table 6, it can be seen that 22 out of 23 students passed. This indicates that students who have completed 95.65% and who have not completed 4.35%. The average student's final test was 94.69. Based on the learning outcomes criteria in Table 6, the RME-based mathematics learning tool is already effective. This can also be proven from the t-test analysis, which shows that there are significant differences in the problem-solving abilities of students in the two sample classes when using RME-based learning tools.

3.2 Discussion

3.2.1 Realistic Mathematics Education (RME) Based Learning Device Design

Based on the results of the research carried out, it is necessary to conduct a more in-depth discussion to strengthen the results found. The research results show that mathematics tools based on realistic mathematics teaching need to be developed. The results of the study also show that the mathematics learning tool based on realistic mathematics teaching is and effective to be used to improve the abilities of fifth graders. The research results were obtained in the stages of the Plomp development model which included preliminary stages of research, prototyping and evaluation. The discussion of each search result can be as follows:

3.2.2 Early Research

This stage is carried out to find out the need to develop mathematics learning tools based on RME. This initial research phase includes analysis of learning problems, student analysis, curriculum analysis, and concept analysis. The discussion at this initial research stage is as follows. The results of the first study indicate that there are problems in learning. These problems include learning tools in schools that have not facilitated students to have good problem-solving skills. The problems presented in the learning process of the lesson plan and students' worksheets learning tools used have not been linked to the real context of students' daily lives so students can solve or solve these daily problems. This results in students only being passive as recipients.

The use of learning devices is very necessary for the learning process. The learning tools in question include lesson plans and students' worksheets. The presented lesson plan and students' worksheets can have a positive impact on its users. The preparation of the lesson plan makes it easier for the teacher to teach because the teacher conveys the material coherently (Gustiansyah, Sholihah, & Sobri, 2021).

The student work sheets can help train students to find concepts at stages of work and provided problems and solutions. Additionally, students are also provided with study guides as they contain learning steps that must be done by the students (Ketut Sri Puji Wahyuni, 2021). The benefits of student work sheets are students in the learning process, helping them develop concepts, practicing discovery and process skills, and to serve as a guide for educators and students in carrying out the mathematics process (Umbaryati, 2016). RME-based mathematics learning tools are easy to use, useful, and interesting for students (Waluyo, Eko Sa'dijah, 2016). Thus, the lesson plan, students' worksheets, and learning tools need to be developed as important elements in the learning process. Based on the results of the research described above, it was found that the products developed were following the validity criteria. The results of the expert's assessment of the product in the form of a designed lesson plan and student's worksheets show that the product is suitable for use. Nieveen (Plomp, T., & Nieveen, 2013) stated that the aspect of validity includes two things, namely the learning tools that have been developed are following the theory, and have links between the various components that compose them. This proves that the validity of the developed learning tools must meet valid criteria in terms of content and construct.

3.2.3 Development Phase

This stage was carried out to design RME-based mathematics learning tools to improve problem-solving abilities and produce valid and practical tools. The results of the analysis at this development stage consist of the development stage and the prototype stage. The first result is the development of complete learning devices in following the standards for making learning devices. The components in the lesson plan learning tools are following the components in Permendikbud Number 22 of 2016. It is also based on RME to support students' problem-solving abilities. Thus, the design of the learning device is complete and based on RME

The developed RME-based students' worksheet is complete. It already contains the cover, preface, table of contents, instructions for use, objectives, tools and materials, problems, work steps, and exercises. This RME-based students' worksheet has a cover design that contains the title, supporting images, author's name, and class level. This is in line with research (Darling et al, 2019) stating that the cover in the students' worksheets at least contains the title, author's name and, supporting images. This also contains the activity title containing the activity topic according to the purpose, tools and materials, and the number of students' worksheets. This is following the students' worksheet systematics developed according to (Suyanto, Slamet, 2011). Thus, the developed students' worksheet has followed the existing guidelines.

Learning tools are developed according to the needs analysis that has been done. Based on the results of the needs analysis, it is necessary to develop RME-based mathematics learning tools to improve students' problem-solving abilities. The developed learning tools are based on RME. In the activity step, the characteristics of RME are described. The characteristics contained in the activity steps of this RME-based learning tool include the use of context, the use of models, the utilization of student contributions and interactivity, and linkages.

An RME-based lesson plan that is feasible to use consists of two indicators. The two indicators include components of lesson plans and learning activities. The component indicators contain complete identities, learning objectives, indicators, methods, learning resources, and assessment instruments. While the indicators of learning activities are following the characteristics of RME. The appropriate RME-based students' worksheet consists of four indicators. The four indicators include presentation, content feasibility, language, and graphics. Presentation indicators consist of cover displays, systematic material, and steps adapted to the characteristics of RME. Content feasibility indicators include the correctness of the material, interrelationships between materials, and student-centered activities. Language indicators are composed of the use of language, material illustrations, and communicative language. Graphic indicators consist of an attractive cover design, easy-to-read letters, and a proportional layout, as well as the use of attractive colors

Third, discussion of the results of the one-to-one evaluation (individual evaluation). At this stage an evaluation of learning devices is carried out for teachers and students. Evaluation of learning tools for teachers is carried out with a focus group discussion. The instrument used is an interview sheet. Based on the equalization of perceptions, learning tools are obtained that are practical for use by students. After that, an evaluation of learning tools was carried out for three students with low, medium, and high abilities. Based on the results of the analysis, it was found that the learning devices were practical to use and were in the very practical category. The learning devices were considered very practical because they were easy to use and could be used anywhere.

Fourth, discussion of small group test results (small group test). The small group test involved nine students with the same ability level as the individual evaluation. Based on the results of the analysis, it was found that the RME-based learning tools were practical to use and were in the very practical category. The use of learning tools should be able to make students interested and motivated to learn (Paramita et al, 2022; Triwulandari et al, 2022).

This is evidenced by the results of the practicality questionnaire analysis of students at the small group stage which stated that the students' worksheet learning tools were interesting and clear and made it easier to understand the subject matter. Learning tools are considered practical, not monotonous and interesting, and are supported by problems accompanied by pictures and work steps. Thus, learning tools can be considered practical in their use and can be continued at a later stage.

3.2.4 Assessment Phase

The third discussion is regarding the results of the analysis at the assessment stage. At this stage, valid RME-based mathematics learning tools are tested for practicality and effectiveness. The practicality of learning devices is obtained through the results of practicality questionnaire analysis by students and teachers. The effectiveness of learning devices that are measured is in the form of student learning outcomes which are limited to aspects of problem-solving abilities. The explanation of each discussion of the results of the analysis of this assessment stage is as follows.

The first aspect evaluated was the practicality of the product from the students' perspective. The practicality test was conducted with 23 fifth-grade students, focusing on several indicators, including the attractiveness of the visuals, readability, ease of finding concepts, and the ability to aid in understanding and solving problems. The results showed that the RME-based mathematics learning tools are practical, user-friendly, and easily comprehensible for both students and teachers. These tools effectively support students in navigating and understanding mathematical concepts while facilitating problem-solving.

The practicality of learning devices needs to be measured to determine the usefulness of these learning devices. Practicality is a criterion for the quality of the product used, and it is reviewed from four aspects, namely usability, ease of use, attractiveness, and cost-effectiveness. (Afrizon, R. Dewi, 2019). Practicality refers to the attractiveness of learning devices because they have an attractive appearance and are equipped with pictures and colors (Hanum, 2019). The efficiency of learning devices is seen based on learning, which means that they can be used anytime and anywhere and can use time effectively and efficiently (Sari & Fitria, 2021). The clarity of teaching materials can be measured by the objectives, materials, activity instructions, and the use of clear and proportional fonts. RME-based learning tools can provide opportunities for students to study material independently (Asrizal, 2020). Therefore, the use of RME-based mathematic learning tools in practical learning is used by teachers and students

Second, the results of testing the effectiveness of the product. The results of this product effectiveness test are based on student learning outcomes. The learning outcomes of students are limited to aspects of problem-solving ability. Problem-solving ability includes here 4 namely understanding the problem, planning an executing the plan and checking it again. The assessment of problem-solving abilities was based on the analysis of the students' post-test results. The explanation for each efficiency test result is the as follows.

The use of RME-based learning tools is effective for increasing students' knowledge. This can be proven by the t-test analysis shows that there are significant differences in the problem solving abilities of the students of the two classes samples the use of learning tools based on the RME. Based on the results of data analysis, it was found that the ability results of students in the experimental class had a high average than the results of the solving abilities control class. In the experimental class, students learn to use mathematics learning tools based on the RME, while in the control class, they only use the resources available at school.

In this study, the use of RME-based mathematics learning tools was considered effective in increasing students' problem-solving abilities. This is because the use of the RME approach in learning tools that relate the material to real-world problems can make it easier for students to acquire knowledge and mathematical concepts (Cedere, D., Jurgena, I., Birzina, R., & Kalnina, 2022). The development of worksheets with a realistic mathematics education approach in elementary schools is effective for use as complementary mathematics teaching materials because the RME approach is oriented towards contextual problems so that children can easily understand them (Asfiranna & Dalimunthe, 2019). Learning tools with RME on simple data collection and presentation materials in terms of implementation, convenience, time efficiency, and effectiveness in following students' mathematical problem-solving abilities (Herlina et al., 2022).

4. CONCLUSION

Based on the problem formulation and discussions regarding the development of learning tools, this research concluded that it successfully produced RME-based mathematics learning tools using the Plomp design model. These tools, including lesson plans and student worksheets, were developed through a systematic process that began with analyzing the program, students, and materials. In the second stage, a formative evaluation was conducted through self-assessments, expert validation, and testing in both small groups and field settings to ensure the tools were valid and practical for classroom use. The third stage involved testing students' problem-solving abilities to assess the impact of the developed learning resources. The learning tools were found to be valid based on content evaluation, and both teachers and students rated them as practical, with student test scores averaging 94.69, indicating their effectiveness. Therefore, the learning tools are deemed valid, practical, and effective for use in elementary mathematics education.

However, the study has limitations, primarily due to the small sample size, which may limit the generalizability of the results. Future research could expand the sample size and explore the long-term effects of using these tools in different educational settings. Additionally, further studies might examine how these tools can be adapted for students with varying levels of mathematical proficiency or in diverse socio-cultural contexts to enhance their broader applicability.

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