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# Development of RME-based Teaching Modules to Improve Problem-Solving Skills and Mastery of IPAS Concepts for Junior High School Students

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**Abstract:** This research aims to develop a teaching module based on RME that is valid, practical, and effective for class VII SMP, with a focus on improving the ability to solve problems with mathematical students. We developed the modules by considering the local context and culture, adhering to RME measures, and emphasizing the use of relevant and conceivable situations for students. We utilized the Plomp development model, which encompasses the stages of investigation, creation, and evaluation. We tested the prototype and assessment of this teaching module on participants enrolled in class VII at SMP N 1 Ranah Batahan. The research results demonstrate that the developed teaching modules have high validity (89.33%), practicality (89.60%), and proven effectiveness, as evidenced by an average score of 85.50% among the test study students. In addition to enhancing the mathematical skills of students, the RME approach also enhances the study of IPAS (Natural and Social Sciences). The development of problem-solving and critical thinking skills through this module enhances students' understanding of natural and social phenomena. Therefore, this teaching module not only promotes mathematical achievement but also fosters integrative and holistic learning within the framework of IPAS.

**Keywords:** IPAS concept; Module; RME

## Introduction

In the Independent Curriculum, Mathematics (MTK) and Natural and Social Sciences (IPAS) subjects have complementary roles but with different focuses. (Novitasari et al., 2023). Mathematics focuses on developing students' cognitive abilities and logical skills through learning about numbers, algebra, geometry, and statistics. Mathematics in the Independent Curriculum aims to form critical thinkers who can solve problems systematically. Meanwhile, IPAS integrates aspects of natural and social sciences to provide a holistic understanding of the physical and social world around students. IPAS aims to build awareness and knowledge of the natural environment, scientific phenomena, and social and cultural dynamics. These two subjects, although different in their approaches and specific objectives, contribute to the development of students' overall competencies, equipping them with the knowledge and skills needed to face challenges in an increasingly complex world.

Mathematics is one of the sciences that plays a very important role in the development of science and technology and the improvement of human resources (Li & Schoenfeld, 2019). One of the goals of learning mathematics that must be achieved by students is the ability to solve mathematical problems. The importance of mathematical problem-solving skills is also conveyed by Nanang et al. (2022), and Fadillah et al. (2022), who states that mathematical problem-solving skills are very

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important for every student to have because mathematical problem-solving is the general goal of teaching mathematics; mathematical problem-solving, including methods, procedures, and strategies is the main process of the mathematics curriculum, and mathematical problem solving is a basic skill in learning mathematics (Utami et al., 2022). Thus, mathematical problem-solving skills are very important for students to have. This is in line with the opinion of Arifin et al. (2019), that mathematical problem-solving is the main goal of learning mathematics because problems are facts that cannot be avoided in human life.

One of the important skills that junior high school students are expected to master is solving linear equations and inequalities of one variable (Lehtonen et al., 2020). Linear equations of one variable and linear inequalities of one variable are important for students to master because they are prerequisites for subsequent materials, such as systems of linear equations of one variable, quadratic equations, quadratic inequalities, limits, and so on. In addition, many problems in everyday life can be solved with the concept of linear equations and inequalities of one variable. The fact found by Jupri et al. (2016), states that many students find it difficult to work on story problems on the topic of linear equations and inequalities of one variable. So, it can be concluded that in reality, many students have difficulty in solving mathematical problems solving problems related to the material of linear equations and inequalities of one variable (Panjaitan & Juandi, 2024).

Emanuel et al. (2021), and Daroczy et al. (2015), stated that the most basic difficulty experienced by students is translating problems in story problems into mathematical form, such as what is known, what should be assumed in variables, what operations are used in the problem, and the solution process. If students make a mistake in making a mathematical model of a story problem, certainly, the next solution process will also be wrong. Gijsbers et al. (2020), stated that many students only memorize the material in mathematics lessons, but cannot apply it in everyday life. To improve students' understanding, it is necessary to consider the learning decisions that will be applied in the classroom. Educators are required to present learning strategies that are oriented towards student activities, educators only act as good facilitators, motivators, and managers in learning activities in the classroom. This is so that students can play an active role in exploring their abilities and not only have a role as objects receiving lessons. Therefore, a mathematics learning plan is needed which is manifested in a mathematics learning design that uses the right learning approach and methods and must be optimized to achieve the learning objectives that have been set (Jonsson et al., 2014).

Realistic Mathematics Education (RME) is a mathematics learning approach that utilizes the reality and environment understood by students to facilitate the mathematics learning process so that it can achieve better learning outcomes than before (Hidayat & Sariningsih, 2018). Several studies show an increase in students' mathematical problem-solving abilities with the application of the RME approach (Oktavianingsih, 2022), research concluded that the increase in mathematical problem-solving abilities of students who received learning with the PMR Approach was better than students who received learning with a conventional approach. In addition, in research (Armiati & La'ia, 2020; Taufiqurrahman & Hidayat, 2023), it was found that the RME approach can trigger the development of students' mathematical problem-solving abilities. The teaching module is an implementation design of the learning objective flow developed from learning achievements, which is equipped with learning steps, assessment plans, and the facilities needed to carry out learning in an organized manner.

The teaching module has a primary role in supporting educators in designing learning (Korsager et al., 2022; Moldavan et al., 2022). Furthermore, according to Gervais (2016) and Lidyasari et al. (2023), a teaching module is a learning tool or learning design based on the applicable curriculum that is applied to achieve the established competency standards. Through this research, a mathematics teaching module based on Realistic Mathematics Education has been developed. (Hanipah et al., 2022). The purpose of this study is to obtain a mathematics teaching module in the form of a learning plan for educators and worksheets for students that can overcome the difficulties of mathematics educators and students. This tool is expected to contribute to improving the quality of education, especially in efforts to improve students' mathematical problem-solving abilities.

## Method

This study refers to the Plomp model development research Thalhah et al. (2022), which has three stages in this study, namely the preliminary research stage, the design stage, and the assessment stage. The assessment of the impact is part of the design stage, namely in the formative evaluation section. Formative evaluation is carried out after the initial prototype of the designed device is obtained and the device is declared valid and suitable for use based on the opinions of experts, in this case, three mathematics experts, one language expert, and one educational technology expert. The formative evaluation stage includes several activities, namely self-evaluation, one-on-one evaluation, small groups, and field tests. Testing of the impact is carried out on small

group activities and field tests on limited groups. In small group activities, 6 students with different abilities are involved, namely students with high, medium, and low abilities. Field trials (Field test), consisting of class VII SMP N 1 Ranah Batahan.

The data analysis technique used is descriptive statistics, namely by describing student achievement based on indicators of mathematical problem-solving abilities. The data obtained from the results of the mathematical problem-solving ability test are grouped into several criteria according to Chairuddin et al. (2022) These are presented in the following table:

**Table 1.** Completion Criteria

| Interval (%) | Criteria |
|---|---|
| $80 \leq E \leq 100$ | Very Good |
| $65 \leq E < 80$ | Good |
| $55 \leq E < 65$ | Enough |
| $40 \leq E < 55$ | Less |
| $E < 40$ | Failed |

## Result and Discussion

The teaching module developed in this study is by the Realistic Mathematics Education approach. There are five steps in the Realistic Mathematics Education approach. Mutaqin et al. (2021), and Edo et al. (2019), namely: Understanding contextual problems, explaining contextual problems, Solving contextual problems, Comparing and discussing answers, Conclude. The contextual problems given to students are: A box car can carry a load of no more than 1.900 kg. The weight of the driver and assistant is 150 kg. The box car will carry several boxes of goods. Each box weighs 50 kg.

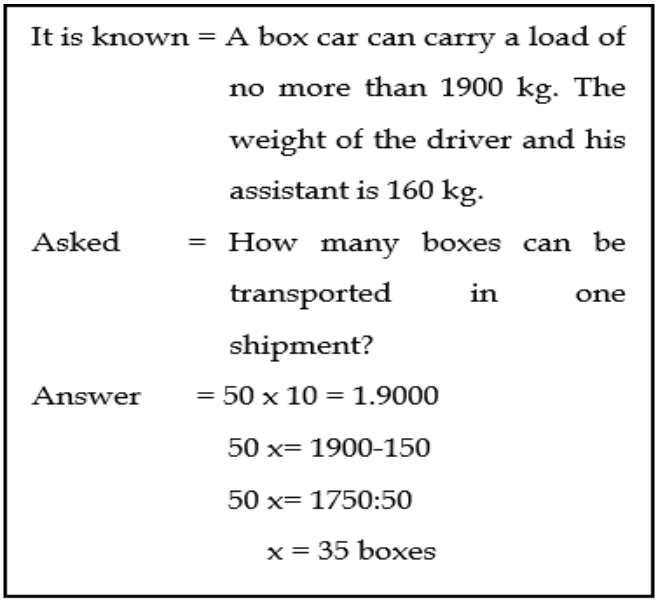


**Figure 1.** Student answers before RME

Based on the student's answers in Figure 1, it is still not quite right, the student has not made a mathematical model. In the solution, the sign "≤" should not be "=". The student has also not made a conclusion from the problem given. Then with the Realistic Mathematics Education approach, students are directed to find the right solution to the problem.

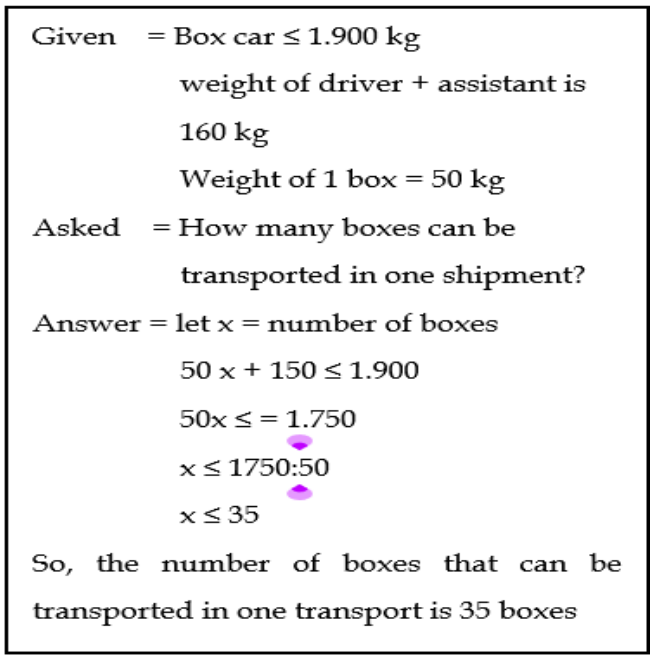


**Figure 2.** Student answers after RME

Based on Figure 2, the student answers are correct. Then students who have answered correctly are asked to explain their answers to the front of the class. So that students can discuss and correct answers that are still not quite right. Based on the responses and solutions of students to the problems given, it can be concluded that contextual problems with Realistic Mathematics Education that are submitted can stimulate students' ability to determine the solution to linear equations and inequalities of one variable. So, the learning process using the RME approach will make learning more meaningful for students (Elpina et al., 2020; Gistituati & Atikah, 2022). This trains students' mathematical problem-solving abilities.

**Table 2.** Results of the Problem-Solving Ability Test in the Small Group Evaluation

| Learners | Test Results | Description |
|---|---|---|
| T1 | 89 | Completed |
| T2 | 82 | Completed |
| R1 | 85 | Completed |
| R2 | 84 | Completed |
| S1 | 78 | Completed |
| S2 | 76 | Completed |

The effectiveness of the RME-based teaching module for the material on linear equations and inequalities of one variable is measured from the results of the student's mathematical problem-solving ability test (Umar & Zakaria, 2022). In the implementation of learning, students have been introduced to examples of mathematical problem-solving questions, this can be seen from the problems in the LKPD. The effectiveness test was carried out after students had participated in learning for 8 meetings in the small group evaluation and field test (Boström & Palm, 2023; Mundelsee & Jurkowski, 2021; Kintu et al., 2017; Montenegro-Rueda et al., 2023). The small group evaluation activity was carried out on January 11, 2024 - January 19, 2024, consisting of 6 people with different abilities, namely 2 low-ability students, 2 medium-ability students, and 2 high-ability students. For the selection of six students, assistance and input from mathematics educators were requested. Table 2 presents the results of the mathematical problem-solving ability test at the small group evaluation stage.

Based on Table 2, the average score of the six students was 82.33. It can be seen that the six students have obtained results above the KKM. By the effectiveness criteria, the RME-based mathematics learning design is said to be effective if the number of students who achieve the KKM is ≥ 75%. After the small group evaluation stage was carried out, the field test was continued which was carried out on January 22, 2024 - February 13, 2024. This evaluation was carried out in class VII of SMP Negeri 1 Ranah Batahan.

**Table 3.** Mathematical Problem-Solving Ability Test Scores Per Indicator

| Problem-Solving Indicators | Percentage (%) | Description |
|---|---|---|
| Understanding the problem (identifying known elements, those asked, and the adequacy of the required elements) | 89 | Very Effective |
| Preparing a solution plan | 84 | Very Effective |
| Problem | 85 | Very Effective |
| Solving the problem | 87 | Effective |
| Average Percentage | 86.25 | Very Effective |

Based on Table 3, the indicator that is most mastered by students is the first indicator, namely the ability to understand problems, which is 89%, which means that almost all students who are the subjects of the study have been able to understand the problems given in the questions. The indicator of compiling a problem-solving plan obtained is the indicator with the lowest percentage, which is 84%, this condition occurs because students are not used to making conclusions when answering, if this kind of design is widely applied, students will become accustomed to it and students' problem-solving abilities are expected to be better. Based on Table 3, it can be seen that students' mathematical problem-solving abilities are good for all indicators (Husna & Hanggara, 2022; Soebagyo et al., 2022; Hidayat et al., 2021; Susandi, 2021).

When compared to the initial conditions, there was a significant increase. Thus, it can be concluded that the RME-based teaching module for the material on linear equations and inequalities of one variable based on RME can be said to be effective or have a positive impact on the mathematical problem-solving abilities of grade VII junior high school students. Table 3 presents a general description of the results of the mathematical problem-solving ability test for each indicator. The results of the study Septianisha et al. (2024) and Laurens et al. (2017), found that the RME approach can trigger the development of students' mathematical problem-solving abilities. This is also to the findings that state that RME helps students develop their potential in mathematical problem-solving (Lestari & Rosdiana, 2018; Rakhmawati, 2020; Ndiung, 2021).

## Conclusion

Based on the research results, students' mathematical problem-solving abilities at the beginning of the study showed significant deficiencies, where many students immediately provided results without writing down problem information, a solution plan, or rechecking. However, after implementing learning based on the Realistic Mathematical Education (RME) approach, there was a significant increase in this ability. Most students now write down relevant information, plan solution steps, and check the results obtained. RME-based learning has proven to be more effective than direct methods in improving students' mathematical problem-solving skills. The RME-based teaching module for grade VII of junior high school, which includes the material of one-variable linear equations and one-variable linear inequalities, has been validated by experts and proven to be practical and effective through questionnaires and tests. The use of the RME approach also makes it easier for students to apply mathematics to solve their daily problems. In the context of Natural and Social Sciences (IPAS), this approach is relevant because it facilitates critical thinking and problem-solving skills which are also important in

studying natural phenomena and social dynamics. The strong integration of mathematics with the RME approach enriches students' understanding and prepares them to face challenges in various disciplines, including IPAS.

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**Conflicts of Interest**
The authors declare no conflict of interest.

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