

DEVELOPMENT OF MATHEMATICS TEACHING MATERIAL BASED ON REALISTIC MATHEMATICS EDUCATION IN ELEMENTARY SCHOOL

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Abstract

This study aims to develop teaching material based on Realistic Mathematics Education (RME) on fractions for grade 4 students in elementary schools so as to produce teaching material that is valid and practical to use in learning. This type of research is Research and Development (R&D). Research applies the ADDIE development model which consists of 5 stages such as analysis, design, development, implementation, and evaluation. This research is conducted at Islamic Elementary School of Raudhah BSD Palembang. Based on the results of validation by material experts that the development of realistic mathematics teaching material based on mathematics education is considered valid with a high score of 88.63%. The results of the validation by media experts were also considered valid with a high score of 87.22%. This teaching material also has practical value as the results of the product test on students obtained a high score of 91.94%. This research proves that the development of mathematics teaching material based on realistic mathematics education is very feasible and practical to use in learning mathematics in elementary school.

Keywords: Developmen, Mathematics, Realistic Mathematics Education, Teaching Material

Abstrak

Penelitian ini bertujuan untuk mengembangkan bahan ajar berbasis Realistic Mathematics Education (RME) pada materi pecahan untuk siswa kelas 4 di Sekolah Dasar sehingga menghasilkan bahan ajar yang valid dan praktis digunakan dalam pembelajaran. Jenis penelitian ini adalah penelitian Reasearch and Development (R&D) dengan menggunakan model pengembangan ADDIE yang terdiri dari 5 tahapan yaitu analysis, design, development, implementation, dan evaluation. Penelitian ini dilakukan di SD Islam Raudhah BSD Palembang. Berdasarkan hasil validasi oleh ahli materi bahwa pengembangan bahan ajar matematika berbasis realistic mathematics education dinilai valid dengan skor yang tinggi yaitu 88.63%. Hasil validasi oleh ahli media juga dinilai valid dengan skor yang tinggi yaitu 87,22%. Bahan ajar ini juga bernilai praktis sebagaimana hasil uji prodak terhadap siswa diperoleh skor yang tinggi yaitu 91,94%. Penelitian ini membuktikan bahwa pengembangan bahan ajar matematik berbasis realistic mathematics education sangat layak dan praktis digunakan dalam pembelajaran matematika di sekolah dasar.

Katakunci: Pengembangan, Matematika, Pembelajaran Matematika Realistik, Bahan Ajar

INTRODUCTION

Education is a very important thing that can support a person's survival in prospering his life, especially formal education. Formal education means that a structured and tiered type of

education is carried out in various schools with certain provisions which have been set by the government. Therefore, everyone has an obligation to attend this type of education.

Susanto (2013) said that the purpose of education is to increase one's potential to become a person who has a good life direction. To achieve these educational goals, a good learning process is needed that leads to students' independent learning. According to the law, the National Education System no. 20 of 2003 stated that learning is a process of student interaction with teachers and learning resources in a learning environment.

Mathematics is a subject which always exists and is available at various levels of education in Indonesia (Piyanti & Tastin, 2016). The targets of learning mathematics include developing students' mathematical thinking skills (Purnamasari, 2011). Mathematics lesson are lesson which is needed in everyday life by students as a provision for them to live life in society in the future (Muhammad, 2017). Therefore, with mathematics learning, it is expected to be able to develop students' thinking logically, critically and systematically. The fact which is still encountered is that there are still many students who have difficulty in learning mathematics. One of the problems faced is the bad response from students themselves who think that mathematics is the most difficult subject to learn. Nasution (2017) states that field facts show that students' problem-solving abilities are still low, one of which is based on the Program For International Student Assessment (PISA) test in which Indonesia is one of the PISA participating countries. The distribution of students' mathematical abilities in PISA is level 1 (49.7% of students), level 2 (25.9%), level 3 (15.5%), level 4 (6.6%), level 5-6 (2.3%). At level 1, students are only able to solve math problems that require one step. According to Hidayati & Afifah (2020) said that each student has different thinking abilities in solving mathematical problems and the methods used by students are still not consistent in solving these problems.

One of the most widely applied mathematical materials in everyday life is fraction. In addition, fraction is also the basis for further learning mathematics. Based on the results of interview and observation with teacher in grade IV Islamic Elementary School of Raudhah BSD, it states that there are still many students whose scores are still below the minimum completeness criteria (KKM), which is 70. The number of students stated from 33 students is about 70% mathematics score above the KKM and 30% mathematics score under KKM. Especially in fractional material, students still have difficulty understanding the concept of fractional material.

There are several reasons behind all these reasons, namely when learning takes place, there are still many students who are less focused on learning. Suggestions of students who always state that learning mathematics is very difficult so that these suggestions affect students' interest in learning mathematics to decrease. Students find it difficult to work on story problems based on everyday life. Mathematics learning is still conventional with the status of the teacher as Teacher Centered. The teaching materials used by teachers also do not support what characteristics are needed by students in helping to understand mathematical concepts, especially the concept of fractional material. This is the same as what is revealed in the study, Fadzila (2019) states that teachers at MI Ma'arif Giriloyo 2 still use less varied methods (teacher centered) which seem monotonous and cause the learning process to look monotonous, resulting in students ignoring the teacher's orders, playing alone, falling asleep in class, the assignments given are not completed.

Based on the causes of the existing problems, it can be proposed alternative actions which can be taken by the teacher to help students understand mathematical concepts. One alternative is the use of teaching materials developed based on Realistic Mathematics Education (RME). The development of teaching material is an effort to develop teaching material which is regulated completely and systematically (Samiha, 2020). As stated by Rosilia et al (2020), teaching material has various benefits such as supporting the learning process and helping students understand the material provided by the teacher. Wijaya (2012) suggests that Realistic Mathematics Education is an approach to learning mathematics in the Netherlands. The word "realistic" is often misunderstood as

"real-world", that is the real world. Many people think that Realistic Mathematics Education is an approach to learning mathematics that must always use everyday problems.

Purnamasari (2015) states that the use of realistic-based teaching materials can product mathematics more interesting, relevant, and meaningful, not too formal and not too abstract. Realistic learning also really considers the level of students' abilities, emphasizes learning mathematics "learning by doing", facilitating mathematical problem solving without using standardized solutions (algorithms) and using context as a starting point for learning mathematics. According to Freudenthal quoted by Pebrian (2017), RME has characteristics, namely: (1) starting mathematics learning with real problems, (2) using problem solving models constructed by students through teacher guidance, (3) using student contributions , (4) maximize the interaction of students, teachers, and learning resources, (5) link the material with other math topics.

RESEARCH METHOD

This study applies the Research and Development (R&D) method. R&D research in Sugiono (2017) is a research method used to produce certain products and test the effectiveness of these products. The product which is developed and tested for its effectiveness in this study is a student worksheet based on Realistic Mathematics Education in learning mathematics in the form of fractions.

The research is carried out in Islamic Elementary School of Raudhah BSD Palembang and the subject of the product trial is grade 4. The method applies in this development used the ADDIE development model. A model whose procedure consists of 5 steps, such as (1) analyze, (2) design, (3) development, (4) implementation, and (5) evaluation. In the implementation stage, the product was tested on a small scale to 5 students and on a large scale to 12 in grade 4 after the product is validated by experts. At the evaluation stage, it is conducted by analyzing the data from filling out the evaluation sheet obtained from material experts, design experts, and students after the trial.

The measuring instrument in this research is the research instrument. The instrument used to reveal the data in this study is a questionnaire in the form of a Likert scale with five answer choices, namely multiple choice. Sugiono (2017) reveals that the Likert scale is applied to measure attitude, opinion, and perception of a person or group of people about social phenomena. After the data is obtained, the next step is to analyze the data by presenting it in tabular form, then interpreting it by calculating the frequency and percentage and then interpreting it with a sentence as an explanation. To see the level of feasibility of teaching materials from the data from the assessments of experts and students, a rating scale is used.

The ratingscale calculation can be determined using the following formula:

$$P = \frac{\text{Data Collection Result Score}}{\text{Ideal Score}} \times 100\%$$

The last step is to conclude the calculation results based on aspects by looking at the table below:

Table 1. Percentage Range and Product Quality Criteria

Score	Information
81 – 100%	Very Worthy/Very Good
61 – 80%	Worthy/Good
41 – 60%	Worthy Enough/Good Enough
21 – 40%	Low/Poorly
0 – 20%	Not Worthy/Not Good

RESULTS AND DISCUSSION

Development of Realistic Mathematics Education Based ON Mathematics Teaching Material

Teaching material is a series of presentations of material which are systematically arranged in which there is an adapted learning model that can facilitate student and teacher in the implementation of the teaching and learning process in order to achieve the expected educational goals. According to Prastowo (2018), teaching material is all materials whether it's information, tool, or text which is systematically arranged that display a complete figure of competencies that will be mastered by students and used in the learning process with the aim of planning and reviewing in implementation of learning.

Zulkifli and Royes state that in an effort to develop teaching materials, teachers' ability and skill are needed in mastering and designing learning material and in selecting material, the best way is to help students achieve core competencies and basic competencies (Zulkifli & Royes 2018). According to Mudlofir in Saidah, et al said that teaching material is a set of materials which is systematically arranged so that an environment or atmosphere appears that allows students to learn (Saidah & Damariswara, 2019). Teaching materials should be has principles in its preparation. The principles that need to be considered in preparing teaching materials include the principles of relevance, consistency, and adequacy (Saodah, 2016). In accordance with the ADDIE development model, the procedures carried out in research development of teaching material include 5 stages, namely:

Firstly, the Analysis Phase includes (curriculum analysis) in which the material presented in the teaching materials is based on the Basic Competencies in accordance with the 2013 Curriculum. Core Competencies (KI) and Basic Competencies (KD). For the fractional material, it includes KI 3: Understanding factual and conceptual knowledge by observing, asking, and experimenting based on curiosity about himself, God's creatures and their activities, and the objects is encountered at home, at school, and at the playground. KI 4: Presenting factual and conceptual knowledge in clear, systematic, logical and critical language, in aesthetic work, in movement which reflect healthy children, and in actions reflecting the behavior of children playing with noble character. Meanwhile, KD 3.1: Explaining equivalent fraction with picture and concrete model. KD 3.2: Explain the various forms of fractions (ordinary, mixed, decimal, and percent) and the relationship between them. KD 3.3: Explain and perform estimations of the number, difference, product, and quotient of two whole numbers as well as fraction and decimal. KD 4.1: Identify equivalent fractions with picture and concrete. KD 4.2: Identify various forms of fractions (ordinary, mixed, decimal, and percent) and the relationship between them. KD 4.3: Solve problems of interpretation of the number, difference, product, and quotient of two whole numbers as well as fractions and decimals.

Next is characteristic analysis. Characteristic analysis is carried out on 4 grade students of Islamic Elementary School of Raudhah BSD. Based on observations, the 4 grade students of Islamic Elementary School of Raudhah BSD are on average between 9-10 years old. Based on the literature review which has been described previously, students' cognitive development begins to enter the concrete operational stage. In this concrete operational phase, children have started to use clear and logical rules. Children already have logical thinking skills, but only with concrete objects. Therefore, we need a teaching material that is concrete or realistic and uses real pictures.

Secondly, in the Design Phase, The results of the analysis phase are used as the basis for designing teaching material. Things which are conducted at the design stage are compiling a map of teaching material needs, determining the structure of teaching material, compiling research instrument, and presenting material. At this stage, the researchers design mathematics teaching material on fractional material based on realistic mathematics education by mapping the composition of the material and the design of the images.

Thirdly, the Development Phase includes writing teaching material. Writing teaching material applies several computer application programs, namely Microsoft Office 2013, Corel

Draw, and Microsoft Paint. The process of writing this teaching material produces a draft of teaching material which is then validated by experts before being implemented to students. The following is an explanation of the parts of the teaching material developed. Introduction section consists of: (1) front cover page; (2) Back cover page; (3) foreword page; (4) Core Competency, Basic Competency, and Indicator; and (5) Table of Content. The book content section consists of: (1) learning objectives; (2) learning systematics; (3) Learning material; (4) Discussion; (5) Information column; (6) Discussion; and (7) Exercise. The closing section of the book consists of: (1) bibliography; and (2) Author biography

Furthermore, the validation of teaching material. The resulting draft of teaching materials is then validated by two experts consisting of six material experts (3 lecturers and 3 mathematics teachers) and six design experts (3 lecturers and 3 teachers). Then, the last is the revision of teaching material. After the teaching material is validated and declared worthy to be tested, the draft teaching material is revised according to suggestions and input from material experts and design experts.

Fourthly, the Implementation Phase. Teaching material product which has been validated by experts are then tested in the field. The product is tested on a small scale to 5 students and on a large scale to 12 students to determine students' assessment of the practicality of the teaching material that is been developed. Fifthly, Evaluation Phase, At this stage, the researchers analyze the data from filling out the evaluation sheet obtained from material experts, design experts, and students. This analysis is based on the results of questionnaires that have been filled out by material experts, design experts, and students.

Product Trial Result Data Description and Analysis

The results of the validation of teaching material based on Realistic Mathematics Education are described through the presentation and analysis of the validation results by material experts and design experts as follows:

Table 2. Aspects of Material Expert Assessment

No.	Rated aspect	Score (%)	Criteria
1.	The suitability of the material in teaching material	90,48%	Very good
2.	RME-based material development	88,75%	Very good
3.	Use of grammar and writing technique in teaching material	86,67%	Very good
Overall Rating		88,63%	Very good

Table 3. Aspects of Design Expert Assessment

No	Rated aspect	Score (%)	Criteria
1.	Development of image design on teaching material	90%	Very good
2.	Development of color design on teaching material	86,67%	Very good
3.	Development of letter design on teaching material	85%	Very good
Overall Rating		87,22%	Very good

Based on tables 2 and 3 and looking at the percentage range and product quality criteria in table 1, it can be concluded that the validation of teaching material tested to material experts and design experts met the criteria very good with a score of 88.63% material experts and 87,22% design experts.

The results of the product trial on a small scale, 5 students are obtained a score of 88%, which means that mathematics teaching material based on realistic mathematics education is considered Very Worthy and practical by students. Likewise, the results of product trials on a large scale, 12 students are obtained a very high score of 91.94% which means that mathematics teaching material based on realistic mathematics education is considered very Worthy and very practical by students to be used in the mathematics learning process in elementary school.

Based on the research data obtained, the development of mathematics teaching material based on realistic mathematics education is considered very good and practical by the students because the material presented in the teaching material is related to students' daily lives. The students find it easier to understand the material because it is integrated with various activities that students have seen and even experienced in their daily lives. The examples presented are also integrated with aspects that exist in the students' real world.

This fact is relevant to the research of Bujuri (2018) which states that in the learning process, elementary school students must be given real examples related to the material being taught so that it is easy to understand. This is because the cognitive development of students in the elementary school level is still in the concrete operational phase which requires empirical and contextual evidence from the material being taught (Bujuri & Baiti, 2018) as a realistic mathematics education model that integrates facts in everyday life. Therefore, it is natural for students to assess mathematics teaching material based on realistic mathematics education as very practical and Worthy.

CONCLUSION

This study proves that the development of mathematics teaching material based on realistic mathematics education can be carried out on mathematics material IN the elementary school level. As the results of the research, the development of mathematics teaching material on fractional material in grade 4 is assessed by valid experts with a very good category and according to the aspect of the content of the material with a score of 88.63% and in the design aspect a score of 87.22% is obtained. The results of the product trial for the development of mathematics teaching material based on realistic mathematics education for students also obtain a very good score of 91.94%. This means that the development of mathematics teaching material based on realistic mathematics education is proven to be practical and worthy to use in the learning process in elementary school.

However, this research is quietly limited, both in the scope of the material which only develops mathematics material, namely fraction, and is carried out in grade 4. Therefore, this research needs to be developed and perfected by subsequent studies by developing other mathematics material and in other grade levels in elementary school in order to obtain answers regarding the breadth and limits of any mathematics material which can be developed based on realistic mathematics education at the elementary school level.

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