


DEVELOPMENT OF STUDENT BOOKS CHARACTERIZED BY INDONESIAN REALISTIC MATHEMATICS EDUCATION TO SUPPORT MATHEMATICS PROBLEM SOLVING ABILITY

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Development of Student Books Characterized by Indonesian Realistic Mathematics Education to Support Mathematics Problem Solving Ability

ABSTRACT

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This study aims to produce a student's book characterized by the Indonesian Realistic Mathematics Education Approach (PMRI) on fractional arithmetic operations material for grade V Elementary School that is valid, practical, and effective. This Research and Development uses the ADDIE development model (Analysis, Design, Development, Implementation, Evaluation). The analysis phase consists of an analysis of student needs and curriculum analysis. At the design stage, namely the preparation of a map of student book needs, determining the structure of student books and making research instruments. At the development stage, namely preparing student books and validating student books to experts. The implementation phase includes teaching experiments to 3 students (one on one), small groups (small groups) and field tests. Then, at the evaluation stage includes the assessment of student books with teachers and students. This study uses the Indonesian Realistic Mathematics Approach (PMRI) in the matter of fractional arithmetic operations. The results showed that the average percentage of student book validity according to experts was 79.4% with the assessment criteria being valid or could be used with revisions. Meanwhile, the average percentage of practicality of student books according to students is 75.7% with the assessment criteria being practical or can be used with revisions. Meanwhile, the average percentage of the effectiveness of student books according to students is 77.5% with the assessment criteria being effective in supporting students' mathematical problem solving abilities.



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A. INTRODUCTION

The use of teaching materials in the form of student books is very important in the learning process because it can make students more interested in class, become more active in discussions, do more exercises according to the quality of individual learning, experience real learning, get opportunities to collaborate, think critically, and improve problem solving (Koparan, 2017). Mathematics student books are concrete materials used to help students form a clear understanding of mathematical concepts and not only facilitate students in learning the material but also assist teachers in teaching mathematics (Asih et al., 2017; Ulandari et al., 2019). Student books are used to organize mathematical concepts that will be studied by students and those that have been studied by students so that each student has a systematic set of knowledge (Asriani et al., 2017; Waluyo et al., 2016). Therefore, making mathematics into a student's book is one component that has an influence in the learning process.

Mathematics makes student books as a support for learning in the classroom, requires students to be active in learning so that learning will be more student-centered and all activities can be carried out optimally and actively involved (Manopo et al., 2018). Teaching materials in

the form of mathematics student books are needed to improve students' mathematical reasoning skills through several learning activities and can deepen students' understanding of the material presented (Maulana et al., 2018). Based on some of these opinions, it can be concluded that the use of student books in mathematics is very important to do because it is able to make students more interested in class, become more active in discussions, experience real learning, get opportunities to collaborate, think critically, and improve problem solving. problem effectively.

Based on several international mathematics tests, it shows that the problem-solving ability of Indonesian students is still in the low category. In the 2015 international for student assessment program (PISA) test, information was obtained that Indonesian students ranked in the low category below the 450 PISA standard with a value of 395.3 (PISA, 2015). Meanwhile, in the trends international mathematics and science study (TIMSS) test, information was obtained that students got the lowest position with a math score of 397 (Frey, 2018). Illustrates that students who take PISA and come from various regions in Indonesia have low problem-solving abilities after being tested with mathematical literacy questions and differences in categories and learning facilities in each school are factors that influence it (Masjaya & Wardono, 2018; Rahmawati & Mahdiansyah, 2014). Data from the 2019 Ministry of Education and Culture Puspendik in shows that the mathematical ability of Indonesian students is still in the less category of 77.13%. Meanwhile, the data of students' mathematical ability in East Java is less than 71.35%. The results above provide information that the mathematical ability of Indonesian students internationally and nationally is still low.

The results of a preliminary study conducted in 3 (three) schools through direct observation of the learning process and unstructured interviews with fifth grade teachers and school principals obtained information that in general, the three schools have the same characteristics.

Other characteristics possessed by the three schools are: *First*, the results of direct observations of the learning process in the classroom that in general the series of mathematics learning processes are still carried out using conventional methods, meaning that the entire series of learning consists of opening, explanation of concepts and procedures for subject matter on the blackboard, practice questions and assignment. *Second*, the results of the interview obtained information that the mathematics learning process rarely uses learning media in the form of teaching aids or the like due to the limited ability of teachers in making teaching aids and the use of teaching aids requires quite a lot of time. *Third*, the results of the interview obtained information that the teacher had never developed student books and applied learning models in the 2013 curriculum for the following reasons (1) the teacher directly used student books in the form of mathematics textbooks from the Ministry of Education and Culture and mathematics modules compiled by the working group of elementary school teachers in the city of Malang , and (2) the use of the learning model requires a lot of time so that the complete learning is not completed.

Based on the results of the preliminary study above, it is necessary to develop a student book in the form of a student book equipped with a teacher's book as a guidebook in carrying out learning activities. Student books are developed based on the results of a study of the weaknesses or shortcomings of the student books used in schools. This means that student book products are developed or created to complement the shortage of student books that are already used by schools. This development step is called the third level development step, namely developing a product or adaptation of an existing product. Student books in the form of student books equipped with books were developed based on a mathematics learning approach with the aim of supporting students' mathematical problem-solving abilities. So, one of the

student books that supports students' mathematical problem-solving abilities is a student book based on the Indonesian Realistic Mathematics Education Learning Approach (PMRI).

Indonesian Realistic Mathematics Education Learning Approach (PMRI) or more known realistic mathematics education is a learning approach that have influence on student's mathematics ability. Realistic mathematics education can give a positive response to mathematics teachers because it provides opportunities for exploration of learning resources from the environment of everyday life (Palupi, 2018; Paterson & Sneddon, 2011). Mathematical processes in realistic mathematics education provide basic concepts for students to master mathematics learning materials for the next school level (Deniz, 2017). Implementation of realistic mathematics education needs to be applied in mathematics classrooms because it provides a change in the learning culture in the classroom (Arsoetar, 2019; Revina, 2019; Sembiring, 2010).

Realistic mathematics education teaching materials can make students find their own mathematical concepts and contain contextual problems that are close to students and facilitate students' learning flow in finding theoretical concepts (Yarman, 2021). When applying realistic mathematics education approach, and the result showed significant differences between the realistic mathematics education approach and the traditional approach in terms of achievement (Dawkins, 2015; Irawan, 2018).

Student books containing realistic mathematics education are adapted to the applicable curriculum. Students' books based on mathematical reality must be adapted to the curriculum and characteristics of students (Khikmiyah, 2016; Sembiring, 2010; Winarti et al., 2012). Other than that, also emphasized that student books with the PMRI approach need to meet the following standards: (1) student books are adapted to the curriculum; (2) realistic problems to support mathematical problem solving abilities; (3) contains interrelated mathematical concepts so that learning becomes meaningful; (4) the material arranged in students' books can accommodate differences in ways and abilities of thinking; and (5) able to motivate students to think critically, creatively, innovatively, and interact in learning so that students have mathematical problem solving abilities (Sembiring, 2010).

Based on the problems above, in this article, the researcher will describe an article with the title: "Development of student books characterized by Indonesian Realistic Mathematics Education (PMRI) Using the ADDIE Development Model". The purpose of this research and development is to produce student books that are valid, practical, and effective based on Indonesian Realistic Mathematics Education (PMRI).

B. METHODS

The type of research used is research and development of the ADDIE Model (Analysis, Design, Development, Implementation, Evaluation). The product produced in this study is a student book in the form of a student book characterized by the Indonesian Realistic Mathematics Education Approach (PMRI).

Data collection techniques in this study consisted of walkthrough, documentation, and tests. Walkthrough is carried out on experts and is used to validate student books which include content, constructs, and language. Suggestions and comments during the Walkthrough at the expert review stage are used to revise prototype 1 and are combined with suggestions and comments at the one-to-one stage to produce prototype 2. This documentation is carried out by collecting data obtained in the form of written documents and pictures that support the research. Documentation in the form of images and videos is carried out at the one to one, small group, and field test stages. The test is used to collect data on student learning outcomes based on the field tests carried out and used to measure the effectiveness of the developed student book.

The data analysis technique used consisted of walkthrough data analysis, document data analysis, and test data analysis. The walkthrough data analysis aims to analyze expert validation data. Expert validation data analysis used descriptive analysis by revising student books based on suggestions and comments from experts. Suggestions and comments from experts are used to revise student books combined with student suggestions and comments at the one-to-one stage. Document analysis was used to analyze data on the validity and practicality of student books. Descriptive analysis was used. Data analysis is based on written documents and pictures obtained by researchers during the study. Then, test data analysis was used to analyze the effectiveness data from the developed student book.

C. RESULTS AND DISCUSSION

This development research resulted in a student book in the form of a student book based on the PMRI approach (Indonesian Realistic Mathematics Approach). This study uses the ADDIE development model, and the procedures carried out in this study include 5 stages, namely analysis, development, design, implementation, and evaluation. Each stage of this research is described as follows:

1. Analysis Stage

At this stage the activities carried out include analysis of research subjects, curriculum analysis, analysis of student books that are being used, and making instruments. The following is a discussion of each stage in the analysis:

a. Research Subject Analysis

At this stage the researcher conducted an analysis of the students who would be the subject of the research and was also a test class for the use of student books which were developed based on the PMRI approach. The students who were used as the subjects of this research were the fifth-grade students. The analysis of the subject of this study aims to determine the number of students and information that class V has never received or used student books based on the PMRI approach and from the teacher obtained information that the level of student ability in class V is heterogeneous. In the analysis of the research subject, the criteria for students who will be selected to be carried out in the one-to-one stage are also determined, namely 1 low-ability student, 1 medium-ability student and 1 high-ability student.

b. Curriculum Analysis

Curriculum analysis aims to determine Competency Standards (SK), Basic Competencies (KD), and indicators used in developing student books based on the PMRI approach. The curriculum used in the development of this student book is the 2013 curriculum. From the analysis of the curriculum, the aspects developed in the student book based on the PMRI approach are fractional arithmetic operations material. The Basic Competencies (KD) and Indicators for class V fractional arithmetic operations can be seen in table 1 below:

Table 1. KD & Operation Material Indicators Counting Fractions

Basic Competence (KD)	Indicator
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3.1 Explain and perform addition and subtraction of two fractions with different denominators	3.1.1	Explain the concept of adding two fractions with different denominators
	3.1.2	Explain the concept of subtracting two fractions with different denominators
	3.1.3	Adding two fractions with different denominators
	3.1.4	Subtracting two fractions with different denominators
3.2 Solve problems involving addition and subtraction of two fractions with different denominators	3.2.1	Solve problems involving the addition of two fractions with different denominators
	3.2.2	Solve problems involving the subtraction of two fractions with different denominators
4.1 Explain and perform multiplication and division of fractions and decimals	4.1.1	Understand the concept of multiplication of fractions
	4.1.2	Understand the concept of decimal multiplication
	4.1.3	Understand the concept of division of fractions
	4.1.4	Understand the concept of decimal division
	4.1.5	Doing fraction multiplication
	4.1.6	Doing decimal multiplication
	4.1.7	Doing fraction division
	4.1.8	Doing decimal division
4.2 Solve problems related to multiplication and division of fractions and decimals	4.2.1	Solve problems related to multiplication of fractions
	4.2.2	Solving problems related to decimals
	4.2.3	Solve problems related to division of fractions
	4.2.4	Solve problems related to decimal division

Source: Prepared by the author based on Candy 37 of 2018

c. Analysis of Student Books in Use

The results of the analysis of student books obtained information that the student book used was a student book entitled Mathematics Learning for SD/MI Grade 5 by Moch Amiruddin Ichda, S. Pd, Rudita Anes Candra Negara, S. Pd and Mohammad Laila Ussyarif, S. Pd. The results of the analysis show that the student's book has several shortcomings. The disadvantages of student books are as follows:

First, it is seen from the material aspect that the student's book has several shortcomings, such as (1) the material that is compiled is still not in accordance with the specified competency standards, such as in chapter I material, the application of addition and subtraction of fractions, which discusses adding and subtracting arithmetic operations. Fractions with the same denominator are compared with the addition of fractions with different denominators; (2) the material that is arranged is still not in depth, such as adding and subtracting fractions, only discussing operations on ordinary fractions with ordinary fractions, while ordinary fractions with mixed fractions and mixed fractions with mixed fractions have not been discussed in detail; (3) there is a discrepancy between the material, tasks, exercises, and questions such as the addition and subtraction of fractions that discuss the subject of addition and subtraction of ordinary fractions with ordinary fractions, while in assignments, exercises and questions there are operations of adding common fractions with mixed fractions and mixed fractions with mixed fractions; (4) there is still a lack of student

activity in groups, communicating activities and concluding material activities together in accordance with the demands of the scientific approach in the 2013 curriculum; (5) it still does not include problems that are close to students' lives and there are materials that do not use real problems to start learning so that learning is still less meaningful for students such as multiplication and fraction division operations;

Second, it is seen from the linguistic aspect that students' books have several shortcomings, such as (1) the use of sentences in paragraphs is not in accordance with the level of development and understanding of students, causing students' difficulties in understanding the concepts of learning materials; and (2) there are still some long illustrations and unclear pictures.

Third, it is seen from the aspect of material presentation that student books have several shortcomings, such as: (1) the material presented is not coherent and difficult for students to understand, causing the meaning of the material to have not been conveyed; (2) the presentation of the material has not been able to support the ability to solve problems and think creatively according to the level of student development; and (3) it still lacks contextual insight in accordance with the variety of Indonesian culture and characteristics and encourages students to find their own meaning of the material to be applied in everyday life.

Fourth, it can be seen from the graphic aspect that the student books (1) the size of the letters and the type of letters used are not in accordance with the age, characteristics, and development of students; (2) not using illustrations that clarify the message conveyed; and (3) the color display in the image used is still not clear.

2. Design Stage

The results of the analysis stage are used as the basis for designing student books. Things that are done at the design stage are compiling a map of student book needs and validating to experts.

The processes carried out at this stage are:

a. Prepare a map of student book needs

The preparation of the student book needs map is carried out by considering the Competency Standards and Basic Competencies as well as indicators of competency achievement. This map of student book needs was compiled to facilitate researchers in sorting the material to be presented in student books.

b. Validation of experts

At this stage, the researcher re-evaluated the student books that had been made both in terms of material, media, and language used. After being read and evaluated, it produces the first prototype that is focused on content, constructs, and language.

1) Expert Review

After the first prototype is finished, the next stage is an expert review. This stage aims to obtain a valid student book. Prototype 1 given was then validated in terms of material, media, and language. The comments from the experts as validators are as follows:

- a) Prof. Dr. Cholis Sa'dijah., M.Pd., MA. Lecturer of Mathematics Education, State University of Malang.
- b) Dr. Dedi Kuswandi, M.Pd. Lecturer of Learning Technology, State University of Malang.
- c) Dr. Intan Dwi Hastuti, M, Pd. PGSD Lecturer at Muhammadiyah University of Mataram

The comments and suggestions from experts as validators of researchers are summarized in table 2 as follows:

Table 2. Validator's Suggestions and Feedback

No	Validator	Suggestions and feedback
1.	Prof. Dr. Cholis Sa'dijah, M.Pd., MA	<ol style="list-style-type: none"> 1. Contextual problems are still lacking and not clearly visible in student books. 2. contextual problems are not in accordance with the editorial questions entered, such as the image of a ribbon with a length of $2+1/3$ meters is the same as an image of a ribbon with a length of $2/5$ meters and an image of an onion $3+1/4$ kg is the same as an image of an onion $2+2/5$. 3. still does not involve the natural and cultural characteristics of Indonesia and it is advisable to use problems involving arts and culture in East Java or the area where the research is conducted. 4. use the same sample questions to find the concept of fractions (page 17) so that the material is structured. 5. added learning video barcodes for learning at home to match the novelty of the research.
2.	Dr. Intan Dwi Hastuti, M.Pd	<ol style="list-style-type: none"> 1. Corrected the use of punctuation, and conjunctions 2. There are several sentences that must be replaced to clarify the meaning of the question 3. The use of words and sentences adapted to the characteristics of elementary school students 4. The words and sentences used need to be adapted to the KBBI and in accordance with standard language standards.
3.	Dr. Dedi Kuswandi, M.Pd	<ol style="list-style-type: none"> 1. redesign using a design application such as corel draw or the like. 2. change the color of the fractional count operation writing realistically on the cover page so that it looks clear and not the same as the background color. 3. zoomed out photo realistic sequence on the cover page or placed on the back cover. 4. The author's name is stored in the lower left corner. 5. remove the frame on each sub or make it more interesting, reduce the frame on the header and footer, and the page number is not italicized so that it can be read clearly

2) *One to One*

This stage was carried out on March 11, 2019. In this one to one stage, prototype 1 was tested on three fifth grade students at SDN Sukoharjo 2 Malang City with student criteria: 1 high-ability student, 1 medium-ability student and 1 low-ability student. . This trial was conducted to see student difficulties that might occur during the process of using student books based on the PMRI approach in learning.

After studying using a student book based on the PMRI approach, the three students were asked to provide their comments. Comments and suggestions at the one-to-one stage can be seen in table 3 below.

Table 3. Student Comments

No	Student	Comment
1.	Student 1	<ol style="list-style-type: none"> 1. Interesting student books, so you know the use of fractions in everyday life. 2. Too many colors, so, a little dizzy in learning. 3. The picture is too small 4. The material accompanied by pictures made us understand the material for counting fraction operations in everyday life.
2.	Student 2	<ol style="list-style-type: none"> 1. The student books are colorful, making them easier to study. 2. Practice questions are also related to everyday life, so I realized that math lessons can be used in everyday life.
3.	Student 3	<ol style="list-style-type: none"> 1. An exciting book full of pictures and colors, so excited to learn the material. 2. The material is related to everyday life.

Based on comments and suggestions from experts as validators and three students one to one, the first prototype student book was revised again so as to produce *second prototype*. The revision decisions can be seen in table 4 below.

Table 4. Revision Decision

No	Validators and Students	Comments, Suggestions and Feedback (prototype 1)	Revision Decision
1.	Prof. Dr. Cholis Sa'dijah, M.Pd., MA	<ol style="list-style-type: none"> 1. Contextual problems are still lacking and not clearly visible in student books. 2. contextual problems are not in accordance with the editorial questions entered, 	<ol style="list-style-type: none"> 1. Given contextual and realistic problems for each sub-chapter of fractional arithmetic operations material 2. Contextual problems have been adapted to the editor of each sub-chapter. 3. Entering

	<p>such as the image of a ribbon with a length of $2\frac{1}{3}$ meters is the same as an image of a ribbon with a length of $\frac{2}{5}$ meters and an image of an onion $3\frac{1}{4}$ kg is the same as an image of an onion $2\frac{2}{5}$.</p> <p>3. still does not involve the natural and cultural characteristics of Indonesia and it is advisable to use problems involving arts and culture in East Java or the area where the research is conducted.</p> <p>4. use the same sample questions to find the concept of fractions (page 17) so that the material is structured.</p>	<p>appropriate contextual issues natural and cultural characteristics of Indonesia, especially in the area of Malang, East Java or the research area.</p> <p>4. Arrange for structured materials.</p>
<p>2. Dr. Intan Dwi Hastuti, M.Pd</p>	<p>1. Corrected the use of punctuation, and conjunctions</p> <p>2. There are several sentences that must be replaced to clarify the meaning of the question</p> <p>3. The use of words and sentences adapted to the characteristics of elementary school students.</p> <p>4. The words and sentences used need to be adapted to the KBBI and in accordance with standard language standards.</p>	<p>1. Improve the use of punctuation, and conjunctions</p> <p>2. Change the sentence to clarify the meaning of the question.</p> <p>3. Using words according to the characteristics of elementary school students</p> <p>4. Using words according to KBBI</p>
<p>3. Dr. Dedi Kuswandi, M.Pd</p>	<p>1. redesign using a design application such as corel draw or the like.</p> <p>2. change the color of the fractional count operation writing realistically on the</p>	<p>1. Cover design using the Corel Draw application</p> <p>2. Clarify the color of the cover and the writing.</p>

	<p>cover page so that it looks clear and not the same as the background color.</p> <ol style="list-style-type: none"> zoomed out photo realistic sequence on the cover page or placed on the back cover. The author's name is stored in the lower left corner. remove the frame on each sub or make it more interesting, reduce the frame on the header and footer, and the page number is not italicized so that it can be read clearly 	<ol style="list-style-type: none"> Reducing the image according to the context of problems in everyday life. Put the author's name in save in the bottom left corner. Makes the appearance of the sub chapters more attractive.
4. Student 1	<ol style="list-style-type: none"> Interesting student books, so you know the use of fractions in everyday life. Too many colors, so, a little dizzy in learning. The picture is too small The material accompanied by pictures made us understand the material for counting fraction operations in everyday life. 	<ol style="list-style-type: none"> Reducing too much color. Enlarge image size
5. Student 3	<ol style="list-style-type: none"> The student books are colorful, making them easier to study. Practice questions are also related to everyday life, so I realized that math lessons can be used in everyday life. 	Revise according to input
6. Student 2	<ol style="list-style-type: none"> An exciting book full of pictures and colors, so excited to learn the material. The material is related to everyday life. 	Revise according to input

3. Development Stage

After the student's book was revised through the stages of expert review and one-to-one evaluation, it can be concluded that the first prototype developed was classified as valid. The results of this first prototype improvement obtained a second prototype. The description of the development results in the form of a second prototype is as follows:

This student book discusses 4 subject matters, namely: (1) fractional addition operations in everyday life, (2) fraction subtraction operations in everyday life counting, (3) fractional multiplication operations in daily life arithmetic, and (4) fraction division operations in daily life.

The developed student book consists of: (1) the beginning; (2) the content section; (3) the final part. The following will explain in more detail the parts of the student book that have been developed.

a. Description of the Beginning of the Student Book.

The initial part of the student book consists of: (1) cover page (cover), (2) introduction, (3) table of contents, (4) exposure to learning activities, (5) presentation of basic competencies & indicators, (6) learning objectives, (7) concept maps, (8) a glimpse of math figures, and (9) crossword puzzles.

b. Description of the Student Book Contents

The contents of the student book consist of 4 (four) sections consisting of lesson 1, lesson 2, lesson 3, and lesson 4. The material in lesson 1 is the operation of adding fractions in everyday life. The material in lesson 2 is fraction subtraction operations in everyday life. The material in lesson 3 is fraction multiplication operations in everyday life. The material in lesson 4 is fraction division operations in everyday life. Each lesson contains learning steps, namely (1) introductory activities; (2) let's observe; (3) let's ask; (4) let's try; (5) let's reason; (6) let's communicate; (7) let's conclude; (8) practice questions; (9) study with parents at home; (10) summary of the material; and (11) parental records containing messages and suggestions from parents.

c. Description of the End of the Student Book

The final part of the student book consists of: (1) Daily Test Questions, (2) Glossary, (3) notes, (4) bibliography, and (5) author's biodata.

4. Implementation Stage

At this stage, the revised student books were based on suggestions and comments from experts, so the student books were then tested at SDN Sukoharjo 2 Malang City. The stages of implementation are as follows:

a. Small Group

At this stage, the second prototype produced from the previous two stages was tested on six fifth grade students at SDN Sukoharjo 1 Malang City who were not research subjects in a group with heterogeneous abilities. Students are asked to work on student books that have been made from the results of their work they can use the student books. The use of student books at the small group stage shows that this student book can be said to be practical. After studying using this student book, students were asked to provide their comments on the student book using the PMRI approach.

The results of student comments can be seen in table 6 below:

Table 6. Small Group Student Comments on Prototype II and Revision Decisions

Comment	Revision Decision
I'm still confused with the mixed fraction arithmetic operations using the context of everyday problems.	Student books are made in the context of daily life problems related to collecting data
The material for division operations and practice questions is too much so it doesn't focus on working on the problem	Reduced contextual issues as per comments
The second problem in the question instructions is not clear	Revise according to input

After the small group stage is implemented, then the second prototype is evaluated and improved according to comments and suggestions during the small group. The results of this second prototype improvement obtained a third prototype.

b. Field Test

After conducting a small group trial, the next step is the field test stage in the real class. The field test was carried out in class V. Totaling 20 students, who were divided into 5 groups with different abilities. The data collection process in this study was carried out in 4 meetings starting on April 25, 2019. In each lesson, each group was given a student book which students would complete through group discussion and the results were presented alternately by group representatives.

5. Evaluation Stage

At this stage, an evaluation of the results of expert assessments, student book users, and student learning outcomes from the developed book is carried out. The following are the results of the validation, practicality, and effectiveness assessment results.

Table 7. Validity, Practicality, and Effectiveness of Student Books

No	Rated aspect	Average Percentage	Validity Criteria
1	Validity	79.4%	Valid
2	Practicality	75.7%	Practical
3	Effectiveness	77, 5%	Effectiveness

Source: Processed by the Author

Based on the description of the three aspects above, it can be obtained that the average percentage of student book validity according to experts is 79.4% with the assessment criteria being valid or can be used with revisions. Meanwhile, the average percentage of practicality of student books according to students is 75.7% with the assessment criteria being practical or can be used with revisions. Meanwhile, the average percentage of the effectiveness of student books according to students is 77.5% with the assessment criteria being effective in supporting students' mathematical problem-solving abilities.

Based on the process of developing teaching materials that has gone through several stages starting from the preliminary stage to the prototyping stage with a formative evaluation flow which includes self evaluation, expert review, one-to-one, small group, and field test, a student book set has been produced. which is characterized by a realistic Indonesian mathematics education approach that has been declared valid, practical, and effective to support the mathematical problem-solving abilities of fifth grade elementary school students.

The developed student book adopts the ADDIE development procedure which consists of the analysis stage, the design stage, the development stage, the implementation stage, and the evaluation stage. To determine the effectiveness of students' books using the Indonesian Realistic Mathematics Approach (PMRI), then the student's book is implemented in learning mathematics in elementary schools. Before being implemented (tested), the student's book is first validated by experts. After being validated by the experts, the student book was revised according to the advice of the experts, then the revised teaching materials were tested at the one-to-one stage and produced prototype 2. The results from prototype 2 were then tested again at the small group stage and produce prototype 3. The revised results of prototype 3 are tested in the real class or what is called the field test stage.

Based on the description of the three aspects above, it can be obtained that the average percentage of student book validity according to experts is 79.4% with the assessment criteria being valid or can be used with revisions. The results of this study are in accordance with the results of several previous studies. Research by (Harahap, 2017) shows: 1) The validity of RME-based geometry teaching materials is very valid. This can be seen from the results of the mathematical problem-solving ability test using This teaching material is complete because 80% of the test subjects meet learning mastery on average-average score more than KKM 75. The development of teaching materials in the form of the development of teaching materials in the form of thematic comics based on Android with the RME approach is declared valid by meeting a score of 3.67 (Latif et al., 2019). Then research on the development of teaching materials shows that the development of teaching materials based on Realistic Mathematics Education (RME) for prism and pyramid material is declared valid with a score of 3.36. Indonesian realistic mathematics education-based student book (Fuadiyah, 2015).

Meanwhile, the average percentage of practicality of student books according to students is 75.7% with the assessment criteria being practical or can be used with revisions. This is in accordance with the results of research that development of realistic mathematics education (rme) based teaching materials by meeting criteria 3.38 with practical criteria (Yunita, 2017). Development of realistic mathematics education (RME)-based teaching materials to support students' mathematical literacy skills, shows that these teaching materials meet the practical criteria with a score of 91.3% (Mardiana, 2019). Teaching materials for Android-based mathematics teaching materials with a realistic mathematics education (rme) approach to Cartesian coordinates were carried out through a small group trial of 5 students at SMP Negeri 1 Kotagajah, the average percentage was 83.50% in the very practical category (Sari et al., 2021).

Then, the average percentage of the effectiveness of students' books according to students is 77.5% with the assessment criteria being effective in supporting students' mathematical problem-solving abilities. The results of this study are that a small group trial (10 students per school) was conducted in three schools. The results of the evaluation the teaching materials produced are declared valid, practical, and effective by the validators and research respondents (Yerizon, 2014). The results of the trial by all validators who got an average score of 3.44 and the results of the user responses (users) conducted to 10 students of class VIII got an average score of 3.8. So that interactive teaching materials based on Realistic Mathematics Education which contain Strengthening Character Education (PPK) and 21st Century Competencies in class VIII statistics material can be declared valid and suitable for use (Murniati, 2020).

In developing these teaching materials, it is necessary to pay attention to conceptual aspects, to be understood by students according to their level of development, and to motivate students. Developed that teaching in the form of books students need to pay attention to the following things: 1) material with RME can be implemented with conceptual questions to generate metacognitive activities, critical thinking, creative, and higher order thinking with

teacher guidance; 2) RME materials can be implemented in teaching texts as media that are easy to understand, provide useful problems related to the real world, so that they can help students solve learning problems, and provide useful information to solve real-world problems; 3) the teacher's role in the learning process with RME material as a facilitator and motivator for students (Sunismi, 2015).

D. CONCLUSION AND SUGGESTIONS

The development of teaching materials characterized by an Indonesian realistic mathematics education approach to support students' mathematical problem-solving abilities can be declared valid, practical, and effective. The average percentage of student book validity according to experts is 79.4% with the assessment criteria being valid or can be used with revisions. Meanwhile, the average percentage of practicality of student books according to students is 75.7% with the assessment criteria being practical or can be used with revisions. Meanwhile, the average percentage of the effectiveness of student books according to students is 77.5% with the assessment criteria being effective in supporting students' mathematical problem-solving abilities.

Suggestions from researchers for future researchers must pay attention to several things: 1) the results of developing teaching materials are expected to be able to serve as alternative teaching materials on fractional arithmetic operations material for grade V elementary school so that it is hoped that there will be the development of similar teaching materials for other materials. Teaching materials are expected to be considered in developing similar teaching materials; 2) for further researchers and developers to be able to consider large-scale trials to determine the level of effectiveness of the teaching materials developed using either experimental research or CAR; and 3) pay attention to the presentation of material and questions that need to be adjusted to the characteristics of students.

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Development of Student Books Characterized by Indonesian Realistic Mathematics Education to Support Mathematics Problem Solving Ability

ABSTRACT

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This study aims to produce a student's book characterized by the Indonesian Realistic Mathematics Education Approach (called PMRI) on fractional arithmetic operations material for grade V Elementary School that is valid, practical, and effective. This Research and Development uses the ADDIE development model (Analysis, Design, Development, Implementation, Evaluation). The analysis phase consists of an analysis of student needs and curriculum analysis. At the design stage, namely the preparation of a map of student book needs, determining the structure of student books and making research instruments. At the development stage, namely preparing student books and validating student books to experts. The implementation phase includes teaching experiments to 3 students (one on one), small groups (small groups) and field tests. Then, at the evaluation stage includes the assessment of student books with teachers and students. This study uses the Indonesian Realistic Mathematics Approach (PMRI) in the matter of fractional arithmetic operations. The results showed that the average percentage of student book validity according to experts was 79.4% with the assessment criteria being valid or could be used with revisions. Meanwhile, the average percentage of practicality of student books according to students is 75.7% with the assessment criteria being practical or can be used with revisions. Meanwhile, the average percentage of the effectiveness of student books according to students is 77.5% with the assessment criteria being effective in supporting students' mathematical problem solving abilities.



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A. INTRODUCTION

The use of teaching materials in the form of student books is very important in the learning process because it can make students more interested in class, become more active in discussions, do more exercises according to the quality of individual learning, experience real learning, get opportunities to collaborate, think critically, and improve problem solving (Koparan, 2017). Mathematics student books are concrete materials used to help students form a clear understanding of mathematical concepts and not only facilitate students in learning the material but also assist teachers in teaching mathematics (Asih et al., 2017; Ulandari et al., 2019). Student books are used to organize mathematical concepts that will be studied by students and those that have been studied by students so that each student has a systematic set of knowledge (Asriani et al., 2017; Waluyo et al., 2016). Therefore, making mathematics into a student's book is one component that has an influence in the learning process.

Mathematics makes student books as a support for learning in the classroom, requires students to be active in learning so that learning will be more student-centered and all activities can be carried out optimally and actively involved (Manopo et al., 2018). Teaching materials in

the form of mathematics student books are needed to improve students' mathematical reasoning skills through several learning activities and can deepen students' understanding of the material presented (Maulana et al., 2018). Based on some of these opinions, it can be concluded that the use of student books in mathematics is very important to do because it is able to make students more interested in class, become more active in discussions, experience real learning, get opportunities to collaborate, think critically, and improve problem solving. problem effectively.

Based on several international mathematics tests, it shows that the problem-solving ability of Indonesian students is still in the low category. In the 2015 international for student assessment program (PISA) test, information was obtained that Indonesian students ranked in the low category below the 450 PISA standard with a value of 395.3 (PISA, 2015). Meanwhile, in the Trends International Mathematics and Science Study (TIMSS) test, information was obtained that students got the lowest position with a math score of 397 (Frey, 2018). Illustrates that students who take PISA and come from various regions in Indonesia have low problem-solving abilities after being tested with mathematical literacy questions and differences in categories and learning facilities in each school are factors that influence it (Masjaya & Wardono, 2018; Rahmawati & Mahdiansyah, 2014). Data from the 2019 Ministry of Education and Culture Puspendik in shows that the mathematical ability of Indonesian students is still in the less category of 77.13%. Meanwhile, the data of students' mathematical ability in East Java is less than 71.35%. The results above provide information that the mathematical ability of Indonesian students internationally and nationally is still low.

The results of a preliminary study conducted in 3 (three) schools through direct observation of the learning process and unstructured interviews with fifth grade teachers and school principals obtained information that in general, the three schools have the same characteristics.

Other characteristics possessed by the three schools are: *First*, the results of direct observations of the learning process in the classroom that in general the series of mathematics learning processes are still carried out using conventional methods, meaning that the entire series of learning consists of opening, explanation of concepts and procedures for subject matter on the blackboard, practice questions and assignment. *Second*, the results of the interview obtained information that the mathematics learning process rarely uses learning media in the form of teaching aids or the like due to the limited ability of teachers in making teaching aids and the use of teaching aids requires quite a lot of time. *Third*, the results of the interview obtained information that the teacher had never developed student books and applied learning models in the 2013 curriculum for the following reasons (1) the teacher directly used student books in the form of mathematics textbooks from the Ministry of Education and Culture and mathematics modules compiled by the working group of elementary school teachers in the city of Malang , and (2) the use of the learning model requires a lot of time so that the complete learning is not completed.

Based on the results of the preliminary study above, it is necessary to develop a student book in the form of a student book equipped with a teacher's book as a guidebook in carrying out learning activities. Student books are developed based on the results of a study of the weaknesses or shortcomings of the student books used in schools. This means that student book products are developed or created to complement the shortage of student books that are already used by schools. This development step is called the third level development step, namely developing a product or adaptation of an existing product. Student books in the form of student books equipped with books were developed based on a mathematics learning approach with the aim of supporting students' mathematical problem-solving abilities. So, one of the

student books that supports students' mathematical problem-solving abilities is a student book based on the Indonesian Realistic Mathematics Education Learning Approach (PMRI).

Indonesian Realistic Mathematics Education Learning Approach (PMRI) or more known realistic mathematics education is a learning approach that have influence on student's mathematics ability. Realistic mathematics education can give a positive response to mathematics teachers because it provides opportunities for exploration of learning resources from the environment of everyday life (Palupi, 2018; Paterson & Sneddon, 2011). Mathematical processes in realistic mathematics education provide basic concepts for students to master mathematics learning materials for the next school level (Deniz, 2017). Implementation of realistic mathematics education needs to be applied in mathematics classrooms because it provides a change in the learning culture in the classroom (Arsoetar, 2019; Revina, 2019; Sembiring, 2010).

Realistic mathematics education teaching materials can make students find their own mathematical concepts and contain contextual problems that are close to students and facilitate students' learning flow in finding theoretical concepts (Yarman, 2021). When applying realistic mathematics education approach, and the result showed significant differences between the realistic mathematics education approach and the traditional approach in terms of achievement (Dawkins, 2015; Irawan, 2018).

Student books containing realistic mathematics education are adapted to the applicable curriculum. Students' books based on mathematical reality must be adapted to the curriculum and characteristics of students (Khikmiyah, 2016; Sembiring, 2010; Winarti et al., 2012). Other than that, also emphasized that student books with the PMRI approach need to meet the following standards: (1) student books are adapted to the curriculum; (2) realistic problems to support mathematical problem solving abilities; (3) contains interrelated mathematical concepts so that learning becomes meaningful; (4) the material arranged in students' books can accommodate differences in ways and abilities of thinking; and (5) able to motivate students to think critically, creatively, innovatively, and interact in learning so that students have mathematical problem solving abilities (Sembiring, 2010).

Based on the problems above, in this article, the researcher will describe an article with the title: "Development of student books characterized by Indonesian Realistic Mathematics Education (PMRI) Using the ADDIE Development Model".^[13] The purpose of this research and development is to produce student books that are valid, practical, and effective based on Indonesian Realistic Mathematics Education (PMRI).

B. METHODS

The type of research used is research and development of the ADDIE Model (Analysis, Design, Development, Implementation, Evaluation)^[14]. The product produced in this study is a student book in the form of a student book characterized by the Indonesian Realistic Mathematics Education Approach (PMRI).

Data collection techniques in this study consisted of walkthrough, documentation, and tests. Walkthrough is carried out on experts and is used to validate student books which include content, constructs, and language. Suggestions and comments during the Walkthrough at the expert review stage are used to revise prototype 1 and are combined with suggestions and comments at the one-to-one stage to produce prototype 2. This documentation is carried out by collecting data obtained in the form of written documents and pictures that support the research. Documentation in the form of images and videos is carried out at the one to one, small group, and field test stages. The test is used to collect data on student learning outcomes based on the field tests carried out and used to measure the effectiveness of the developed student book.

The data analysis technique used consisted of walkthrough data analysis, document data analysis, and test data analysis. The walkthrough data analysis aims to analyze expert validation data. Expert validation data analysis used descriptive analysis by revising student books based on suggestions and comments from experts. Suggestions and comments from experts are used to revise student books combined with student suggestions and comments at the one-to-one stage. Document analysis was used to analyze data on the validity and practicality of student books. Descriptive analysis was used. Data analysis is based on written documents and pictures obtained by researchers during the study. Then, test data analysis was used to analyze the effectiveness data from the developed student book.

C. RESULTS AND DISCUSSION

This development research resulted in a student book in the form of a student book based on the PMRI approach (Indonesian Realistic Mathematics Approach). This study uses the ADDIE development model, and the procedures carried out in this study include 5 stages, namely analysis, development, design, implementation, and evaluation. Each stage of this research is described as follows:

1. Analysis Stage

At this stage the activities carried out include analysis of research subjects, curriculum analysis, analysis of student books that are being used, and making instruments. The following is a discussion of each stage in the analysis:

a. Research Subject Analysis

At this stage the researcher conducted an analysis of the students who would be the subject of the research and was also a test class for the use of student books which were developed based on the PMRI approach. The students who were used as the subjects of this research were the fifth-grade students. The analysis of the subject of this study aims to determine the number of students and information that class V has never received or used student books based on the PMRI approach and from the teacher obtained information that the level of student ability in class V is heterogeneous. In the analysis of the research subject, the criteria for students who will be selected to be carried out in the one-to-one stage are also determined, namely 1 low-ability student, 1 medium-ability student and 1 high-ability student.

b. Curriculum Analysis

Curriculum analysis aims to determine Competency Standards (SK), Basic Competencies (KD), and indicators used in developing student books based on the PMRI approach. The curriculum used in the development of this student book is the 2013 curriculum. From the analysis of the curriculum, the aspects developed in the student book based on the PMRI approach are fractional arithmetic operations material. The Basic Competencies (KD) and Indicators for class V fractional arithmetic operations can be seen in table 1 below:

Table 1. KD & Operation Material Indicators Counting Fractions

Basic Competence (KD)	Indicator
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3.1 Explain and perform addition and subtraction of two fractions with different denominators	3.1.1	Explain the concept of adding two fractions with different denominators
	3.1.2	Explain the concept of subtracting two fractions with different denominators
	3.1.3	Adding two fractions with different denominators
	3.1.4	Subtracting two fractions with different denominators
3.2 Solve problems involving addition and subtraction of two fractions with different denominators	3.2.1	Solve problems involving the addition of two fractions with different denominators
	3.2.2	Solve problems involving the subtraction of two fractions with different denominators
4.1 Explain and perform multiplication and division of fractions and decimals	4.1.1	Understand the concept of multiplication of fractions
	4.1.2	Understand the concept of decimal multiplication
	4.1.3	Understand the concept of division of fractions
	4.1.4	Understand the concept of decimal division
	4.1.5	Doing fraction multiplication
	4.1.6	Doing decimal multiplication
	4.1.7	Doing fraction division
	4.1.8	Doing decimal division
4.2 Solve problems related to multiplication and division of fractions and decimals	4.2.1	Solve problems related to multiplication of fractions
	4.2.2	Solving problems related to decimals
	4.2.3	Solve problems related to division of fractions
	4.2.4	Solve problems related to decimal division

Source: Prepared by the author based on Candy 37 of 2018

c. Analysis of Student Books in Use

The results of the analysis of student books obtained information that the student book used was a student book entitled Mathematics Learning for SD/MI Grade 5 by Moch Amiruddin Ichda, S. Pd, Rudita Anes Candra Negara, S. Pd and Mohammad Laila Ussyarif, S. Pd. The results of the analysis show that the student's book has several shortcomings. The disadvantages of student books are as follows:

First, it is seen from the material aspect that the student's book has several shortcomings, such as (1) the material that is compiled is still not in accordance with the specified competency standards, such as in chapter I material, the application of addition and subtraction of fractions, which discusses adding and subtracting arithmetic operations. Fractions with the same denominator are compared with the addition of fractions with different denominators; (2) the material that is arranged is still not in depth, such as adding and subtracting fractions, only discussing operations on ordinary fractions with ordinary fractions, while ordinary fractions with mixed fractions and mixed fractions with mixed fractions have not been discussed in detail; (3) there is a discrepancy between the material, tasks, exercises, and questions such as the addition and subtraction of fractions that discuss the subject of addition and subtraction of ordinary fractions with ordinary fractions, while in assignments, exercises and questions there are operations of adding common fractions with mixed fractions and mixed fractions with mixed fractions; (4) there is still a lack of student

activity in groups, communicating activities and concluding material activities together in accordance with the demands of the scientific approach in the 2013 curriculum; (5) it still does not include problems that are close to students' lives and there are materials that do not use real problems to start learning so that learning is still less meaningful for students such as multiplication and fraction division operations;

Second, it is seen from the linguistic aspect that students' books have several shortcomings, such as (1) the use of sentences in paragraphs is not in accordance with the level of development and understanding of students, causing students' difficulties in understanding the concepts of learning materials; and (2) there are still some long illustrations and unclear pictures.

Third, it is seen from the aspect of material presentation that student books have several shortcomings, such as: (1) the material presented is not coherent and difficult for students to understand, causing the meaning of the material to have not been conveyed; (2) the presentation of the material has not been able to support the ability to solve problems and think creatively according to the level of student development; and (3) it still lacks contextual insight in accordance with the variety of Indonesian culture and characteristics and encourages students to find their own meaning of the material to be applied in everyday life.

Fourth, it can be seen from the graphic aspect that the student books (1) the size of the letters and the type of letters used are not in accordance with the age, characteristics, and development of students; (2) not using illustrations that clarify the message conveyed; and (3) the color display in the image used is still not clear.

2. Design Stage

The results of the analysis stage are used as the basis for designing student books. Things that are done at the design stage are compiling a map of student book needs and validating to experts.

The processes carried out at this stage are:

a. Prepare a map of student book needs

The preparation of the student book needs map is carried out by considering the Competency Standards and Basic Competencies as well as indicators of competency achievement. This map of student book needs was compiled to facilitate researchers in sorting the material to be presented in student books.

b. Validation of experts

At this stage, the researcher re-evaluated the student books that had been made both in terms of material, media, and language used. After being read and evaluated, it produces the first prototype that is focused on content, constructs, and language.

1) Expert Review

After the first prototype is finished, the next stage is an expert review. This stage aims to obtain a valid student book. Prototype 1 given was then validated in terms of material, media, and language. The comments from the experts as validators are as follows:

- a) Prof. Dr. Cholis Sa'dijah., M.Pd., MA. Lecturer of Mathematics Education, State University of Malang.
- b) Dr. Dedi Kuswandi, M.Pd. Lecturer of Learning Technology, State University of Malang.
- c) Dr. Intan Dwi Hastuti, M, Pd. PGSD Lecturer at Muhammadiyah University of Mataram

The comments and suggestions from experts as validators of researchers are summarized in table 2 as follows:

Table 2. Validator's Suggestions and Feedback

No	Validator	Suggestions and feedback
1.	Prof. Dr. Cholis Sa'dijah, M.Pd., MA	<ol style="list-style-type: none"> 1. Contextual problems are still lacking and not clearly visible in student books. 2. contextual problems are not in accordance with the editorial questions entered, such as the image of a ribbon with a length of $2+1/3$ meters is the same as an image of a ribbon with a length of $2/5$ meters and an image of an onion $3+1/4$ kg is the same as an image of an onion $2+2/5$. 3. still does not involve the natural and cultural characteristics of Indonesia and it is advisable to use problems involving arts and culture in East Java or the area where the research is conducted. 4. use the same sample questions to find the concept of fractions (page 17) so that the material is structured. 5. added learning video barcodes for learning at home to match the novelty of the research.
2.	Dr. Intan Dwi Hastuti, M.Pd	<ol style="list-style-type: none"> 1. Corrected the use of punctuation, and conjunctions 2. There are several sentences that must be replaced to clarify the meaning of the question 3. The use of words and sentences adapted to the characteristics of elementary school students 4. The words and sentences used need to be adapted to the KBBI and in accordance with standard language standards.
3.	Dr. Dedi Kuswandi, M.Pd	<ol style="list-style-type: none"> 1. redesign using a design application such as corel draw or the like. 2. change the color of the fractional count operation writing realistically on the cover page so that it looks clear and not the same as the background color. 3. zoomed out photo realistic sequence on the cover page or placed on the back cover. 4. The author's name is stored in the lower left corner. 5. remove the frame on each sub or make it more interesting, reduce the frame on the header and footer, and the page number is not italicized so that it can be read clearly

2) *One to One*

This stage was carried out on March 11, 2019. In this one to one stage, prototype 1 was tested on three fifth grade students at SDN Sukoharjo 2 Malang City with student criteria: 1 high-ability student, 1 medium-ability student and 1 low-ability student. . This trial was conducted to see student difficulties that might occur during the process of using student books based on the PMRI approach in learning.

After studying using a student book based on the PMRI approach, the three students were asked to provide their comments. Comments and suggestions at the one-to-one stage can be seen in table 3 below.

Table 3. Student Comments

No	Student	Comment
1.	Student 1	<ol style="list-style-type: none"> 1. Interesting student books, so you know the use of fractions in everyday life. 2. Too many colors, so, a little dizzy in learning. 3. The picture is too small 4. The material accompanied by pictures made us understand the material for counting fraction operations in everyday life.
2.	Student 2	<ol style="list-style-type: none"> 1. The student books are colorful, making them easier to study. 2. Practice questions are also related to everyday life, so I realized that math lessons can be used in everyday life.
3.	Student 3	<ol style="list-style-type: none"> 1. An exciting book full of pictures and colors, so excited to learn the material. 2. The material is related to everyday life.

Based on comments and suggestions from experts as validators and three students one to one, the first prototype student book was revised again so as to produce *second prototype*. The revision decisions can be seen in table 4 below.

Table 4. Revision Decision

No	Validators and Students	Comments, Suggestions and Feedback (prototype 1)	Revision Decision
1.	Prof. Dr. Cholis Sa'dijah, M.Pd., MA ^[15]	<ol style="list-style-type: none"> 1. Contextual problems are still lacking and not clearly visible in student books. 2. contextual problems are not in accordance with the editorial questions entered, 	<ol style="list-style-type: none"> 1. Given contextual and realistic problems for each sub-chapter of fractional arithmetic operations material 2. Contextual problems have been adapted to the editor of each sub-chapter. 3. Entering

such as the image of a ribbon with a length of $2\frac{1}{3}$ meters is the same as an image of a ribbon with a length of $\frac{2}{5}$ meters and an image of an onion $3\frac{1}{4}$ kg is the same as an image of an onion $2\frac{2}{5}$.

appropriate contextual issues natural and cultural characteristics of Indonesia, especially in the area of Malang, East Java or the research area.

3. still does not involve the natural and cultural characteristics of Indonesia and it is advisable to use problems involving arts and culture in East Java or the area where the research is conducted.
4. use the same sample questions to find the concept of fractions (page 17) so that the material is structured.

4. Arrange for structured materials.

2.	Dr. Intan Dwi Hastuti, M.Pd	<ol style="list-style-type: none"> 1. Corrected the use of punctuation, and conjunctions 2. There are several sentences that must be replaced to clarify the meaning of the question 3. The use of words and sentences adapted to the characteristics of elementary school students. 4. The words and sentences used need to be adapted to the KBBI and in accordance with standard language standards. 	<ol style="list-style-type: none"> 1. Improve the use of punctuation, and conjunctions 2. Change the sentence to clarify the meaning of the question. 3. Using words according to the characteristics of elementary school students 4. Using words according to KBBI
3.	Dr. Dedi Kuswandi, M.Pd	<ol style="list-style-type: none"> 1. redesign using a design application such as corel draw or the like. 2. change the color of the fractional count operation writing realistically on the 	<ol style="list-style-type: none"> 1. Cover design using the Corel Draw application 2. Clarify the color of the cover and the writing.

	<p>cover page so that it looks clear and not the same as the background color.</p> <ol style="list-style-type: none"> 3. zoomed out photo realistic sequence on the cover page or placed on the back cover. 4. The author's name is stored in the lower left corner. 5. remove the frame on each sub or make it more interesting, reduce the frame on the header and footer, and the page number is not italicized so that it can be read clearly 	<ol style="list-style-type: none"> 3. Reducing the image according to the context of problems in everyday life. 4. Put the author's name in save in the bottom left corner. 5. Makes the appearance of the sub chapters more attractive.
4. Student 1	<ol style="list-style-type: none"> 1. Interesting student books, so you know the use of fractions in everyday life. 2. Too many colors, so, a little dizzy in learning. 3. The picture is too small 4. The material accompanied by pictures made us understand the material for counting fraction operations in everyday life. 	<ol style="list-style-type: none"> 1. Reducing too much color. 2. Enlarge image size
5. Student 3	<ol style="list-style-type: none"> 1. The student books are colorful, making them easier to study. 2. Practice questions are also related to everyday life, so I realized that math lessons can be used in everyday life. 	Revise according to input
6. Student 2	<ol style="list-style-type: none"> 1. An exciting book full of pictures and colors, so excited to learn the material. 2. The material is related to everyday life. 	Revise according to input

3. Development Stage

After the student's book was revised through the stages of expert review and one-to-one evaluation, it can be concluded that the first prototype developed was classified as valid. The results of this first prototype improvement obtained a second prototype. The description of the development results in the form of a second prototype is as follows:

This student book discusses 4 subject matters, namely: (1) fractional addition operations in everyday life, (2) fraction subtraction operations in everyday life counting, (3) fractional multiplication operations in daily life arithmetic, and (4) fraction division operations in daily life.

The developed student book consists of: (1) the beginning; (2) the content section; (3) the final part. The following will explain in more detail the parts of the student book that have been developed.

a. Description of the Beginning of the Student Book.

The initial part of the student book consists of: (1) cover page (cover), (2) introduction, (3) table of contents, (4) exposure to learning activities, (5) presentation of basic competencies & indicators, (6) learning objectives, (7) concept maps, (8) a glimpse of math figures, and (9) crossword puzzles.

b. Description of the Student Book Contents

The contents of the student book consist of 4 (four) sections consisting of lesson 1, lesson 2, lesson 3, and lesson 4. The material in lesson 1 is the operation of adding fractions in everyday life. The material in lesson 2 is fraction subtraction operations in everyday life. The material in lesson 3 is fraction multiplication operations in everyday life. The material in lesson 4 is fraction division operations in everyday life. Each lesson contains learning steps, namely (1) introductory activities; (2) let's observe; (3) let's ask; (4) let's try; (5) let's reason; (6) let's communicate; (7) let's conclude; (8) practice questions; (9) study with parents at home; (10) summary of the material; and (11) parental records containing messages and suggestions from parents.

c. Description of the End of the Student Book

The final part of the student book consists of: (1) Daily Test Questions, (2) Glossary, (3) notes, (4) bibliography, and (5) author's biodata.

4. Implementation Stage

At this stage, the revised student books were based on suggestions and comments from experts, so the student books were then tested at SDN Sukoharjo 2 Malang City. The stages of implementation are as follows:

a. Small Group

At this stage, the second prototype produced from the previous two stages was tested on six fifth grade students at SDN Sukoharjo 1 Malang City who were not research subjects in a group with heterogeneous abilities. Students are asked to work on student books that have been made from the results of their work they can use the student books. The use of student books at the small group stage shows that this student book can be said to be practical. After studying using this student book, students were asked to provide their comments on the student book using the PMRI approach.

The results of student comments can be seen in table 6 below:

Table 6. Small Group Student Comments on Prototype II and Revision Decisions

Comment	Revision Decision
I'm still confused with the mixed fraction arithmetic operations using the context of everyday problems.	Student books are made in the context of daily life problems related to collecting data
The material for division operations and practice questions is too much so it doesn't focus on working on the problem	Reduced contextual issues as per comments
The second problem in the question instructions is not clear	Revise according to input

After the small group stage is implemented, then the second prototype is evaluated and improved according to comments and suggestions during the small group. The results of this second prototype improvement obtained a third prototype.

b. Field Test

After conducting a small group trial, the next step is the field test stage in the real class. The field test was carried out in class V. Totalling 20 students, who were divided into 5 groups with different abilities. The data collection process in this study was carried out in 4 meetings starting on April 25, 2019. In each lesson, each group was given a student book which students would complete through group discussion and the results were presented alternately by group representatives.

5. Evaluation Stage

At this stage, an evaluation of the results of expert assessments, student book users, and student learning outcomes from the developed book is carried out. The following are the results of the validation, practicality, and effectiveness assessment results.

Table 7. Validity, Practicality, and Effectiveness of Student Books

No	Rated aspect	Average Percentage	Validity Criteria
1	Validity	79.4%	Valid
2	Practicality	75.7%	Practical
3	Effectiveness	77, 5%	Effectiveness

Source: Processed by the Author

Based on the description of the three aspects above, it can be obtained that the average percentage of student book validity according to experts is 79.4% with the assessment criteria being valid or can be used with revisions. Meanwhile, the average percentage of practicality of student books according to students is 75.7% with the assessment criteria being practical or can be used with revisions. Meanwhile, the average percentage of the effectiveness of student books according to students is 77.5% with the assessment criteria being effective in supporting students' mathematical problem-solving abilities.

Based on the process of developing teaching materials that has gone through several stages starting from the preliminary stage to the prototyping stage with a formative evaluation flow which includes self evaluation, expert review, one-to-one, small group, and field test, a student book set has been produced. which is characterized by a realistic Indonesian mathematics education approach that has been declared valid, practical, and effective to support the mathematical problem-solving abilities of fifth grade elementary school students.

The developed student book adopts the ADDIE development procedure which consists of the analysis stage, the design stage, the development stage, the implementation stage, and the evaluation stage. To determine the effectiveness of students' books using the Indonesian Realistic Mathematics Approach (PMRI), then the student's book is implemented in learning mathematics in elementary schools. Before being implemented (tested), the student's book is first validated by experts. After being validated by the experts, the student book was revised according to the advice of the experts, then the revised teaching materials were tested at the one-to-one stage and produced prototype 2. The results from prototype 2 were then tested again at the small group stage and produce prototype 3. The revised results of prototype 3 are tested in the real class or what is called the field test stage.

Based on the description of the three aspects above, it can be obtained that the average percentage of student book validity according to experts is 79.4% with the assessment criteria being valid or can be used with revisions. The results of this study are in accordance with the results of several previous studies. Research by (Harahap, 2017) shows: 1) The validity of RME-based geometry teaching materials is very valid. This can be seen from the results of the mathematical problem-solving ability test using This teaching material is complete because 80% of the test subjects meet learning mastery on average-average score more than KKM 75. The development of teaching materials in the form of the development of teaching materials in the form of thematic comics based on Android with the RME approach is declared valid by meeting a score of 3.67 (Latif et al., 2019). Then research on the development of teaching materials shows that the development of teaching materials based on Realistic Mathematics Education (RME) for prism and pyramid material is declared valid with a score of 3.36. Indonesian realistic mathematics education-based student book (Fuadiyah, 2015).

Meanwhile, the average percentage of practicality of student books according to students is 75.7% with the assessment criteria being practical or can be used with revisions. This is in accordance with the results of research that development of realistic mathematics education (rme) based teaching materials by meeting criteria 3.38 with practical criteria (Yunita, 2017). Development of realistic mathematics education (RME)-based teaching materials to support students' mathematical literacy skills, shows that these teaching materials meet the practical criteria with a score of 91.3% (Mardiana, 2019). Teaching materials for Android-based mathematics teaching materials with a realistic mathematics education (rme) approach to Cartesian coordinates were carried out through a small group trial of 5 students at SMP Negeri 1 Kotagajah, the average percentage was 83.50% in the very practical category (Sari et al., 2021).

Then, the average percentage of the effectiveness of students' books according to students is 77.5% with the assessment criteria being effective in supporting students' mathematical problem-solving abilities. The results of this study are that a small group trial (10 students per school) was conducted in three schools. The results of the evaluation the teaching materials produced are declared valid, practical, and effective by the validators and research respondents (Yerizon, 2014). The results of the trial by all validators who got an average score of 3.44 and the results of the user responses (users) conducted to 10 students of class VIII got an average score of 3.8. So that interactive teaching materials based on Realistic Mathematics Education which contain Strengthening Character Education (PPK₁₆) and 21st Century Competencies in class VIII statistics material can be declared valid and suitable for use (Murniati, 2020).

In developing these teaching materials, it is necessary to pay attention to conceptual aspects, to be understood by students according to their level of development, and to motivate students. Developed that teaching in the form of books students need to pay attention to the following things: 1) material with RME can be implemented with conceptual questions to generate metacognitive activities, critical thinking, creative, and higher order thinking with

teacher guidance; 2) RME materials can be implemented in teaching texts as media that are easy to understand, provide useful problems related to the real world, so that they can help students solve learning problems, and provide useful information to solve real-world problems; 3) the teacher's role in the learning process with RME material as a facilitator and motivator for students (Sunismi, 2015).

D. CONCLUSION AND SUGGESTIONS

The development of teaching materials characterized by an Indonesian realistic mathematics education approach to support students' mathematical problem-solving abilities can be declared valid, practical, and effective. The average percentage of student book validity according to experts is 79.4% with the assessment criteria being valid or can be used with revisions. Meanwhile, the average percentage of practicality of student books according to students is 75.7% with the assessment criteria being practical or can be used with revisions. Meanwhile, the average percentage of the effectiveness of student books according to students is 77.5% with the assessment criteria being effective in supporting students' mathematical problem-solving abilities.^[17]

Suggestions from researchers for future researchers must pay attention to several things: 1) the results of developing teaching materials are expected to be able to serve as alternative teaching materials on fractional arithmetic operations material for grade V elementary school so that it is hoped that there will be the development of similar teaching materials for other materials. Teaching materials are expected to be considered in developing similar teaching materials; 2) for further researchers and developers to be able to consider large-scale trials to determine the level of effectiveness of the teaching materials developed using either experimental research or CAR; and 3) pay attention to the presentation of material and questions that need to be adjusted to the characteristics of students.

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