Developing Students' Book Characterized Realistic Mathematics Education (RME) to Improve Numeration Literacy Skill

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ABSTRACT

Based on PISA and TIMSS, it shows that the literacy skills of students in Indonesia in the field of mathematics are still relatively low. The researcher's observations also found that the numeracy literacy skills at the target school were still low, and the teaching materials used did not contain problems in daily life that were relevant to the environmental conditions around students. This research aimed to develop a student book with realistic mathematics education (RME) to improve students' numeracy literacy skills regarding the results of validity, practicality, and effectiveness tests. The development of this student book uses the Plomp model, which was carried out in three phases: (1) Preliminary research, (2) Prototyping phase, and (3) Assessment phase. In the preliminary research, initial observations were carried out. In the Prototyping phase, student book development was carried out using steps that follow the principles and characteristics of RME. In the assessment phase, based on the results of expert validation, an average score of 3,86 was obtained for all aspects which can be valid. From the observations of the implementation, a score of 3,87 was obtained, which means that the practical test by the observer meets the Practical criteria. From working on the numeracy literacy questions, it was found that 90% of students scored above 65, and the results of the N-Gain calculation obtained an average score of 0,71. The observations of student activity obtained an average of 3,8 with the active category, and the results of students' responses obtained 90%, which gave a positive response, which means that the student book with RME characteristics meets the criteria of effectiveness.

Keywords: Developing, Numeration Literacy, RME, Students' Book

INTRODUCTION

The world of education is inseparable from a curriculum because the curriculum is a plan that houses education that has meaning as an experience for students, which in this case concerns the relationship or interaction between students and schools and students and their environment (Sukatin et al., 2020). Pratiwi (2019) the Ministry of Education in Indonesia reviewed the curriculum and made various changes. World Economic Forum has conducted a meta-analysis of research on capabilities in the 21st century in primary and secondary education. The results of these studies filter The 16 abilities, which are divided into three broad categories: basic literacy, competency, and character qualities. Literacy is Basic skills that show how students can apply basic skills to everyday problems. This basic literacy is divided into six types: reading literacy, numeracy literacy, science literacy, digital literacy, financial literacy,

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cultural literacy, and citizenship.

Students' literacy skills in Indonesia, particularly in mathematics, are still classified as low. This is shown by the results of the PISA test 2015 and TIMSS in 2016. Indonesia got a math score of 387 out of an average score of 490, while in TIMSS, Indonesia got a math score of 395 out of an average score of 500. The PISA results In 2018, the value of Indonesian students' mathematical abilities was ranked 7th from the bottom with a score of 379 below the OECD average of 489. These results indicate that literacy competence has not been achieved, especially in the mathematical literacy or numeracy of students in Indonesia. Several studies have found that the cause of Indonesian students' low PISA scores is instructional and student factors. Instructional factors come from the lack of teacher capacity to teach and foster numeracy literacy (Hidayati et al., 2020) and the lack of availability of teaching materials that teachers can use to foster students' numeracy literacy (Kusumawardani, 2018).

Based on the observations of researchers at Public Elementary School 2 Paddenganploso, it was found that students' numeracy literacy skills were still low. This can be seen from the results of the school's AKM (Minimum et al.) and the anxiety of students who cannot apply mathematical concepts to solve problems around them. Students often have difficulty connecting questions or problems in everyday life with mathematical concepts and then looking for a solution. On the other hand, many teachers are unfamiliar with questions based on numeracy literacy. In addition, researchers found that the teaching materials used in schools were worksheets without other supporting references. At Public Elementary School 2 Paddenganploso, the student worksheets used do not contain the problems in everyday life that are relevant to the environmental conditions around students.

Even though student worksheets are one of the teaching materials needed in learning, according to the opinion (Sanjaya, 2011) argues that learning requires a variety of learning resources in the form of teaching materials that can encourage students to learn. Therefore, the existence of teaching materials is necessary because through teaching materials, the teacher will find it easier to carry out learning, and students will be more assisted in learning. One type of teaching material used is student books. Student booklets are designed to be feasible and can guide and stimulate students to construct the knowledge they have learned based on their experiences. Nieven (Siswono, 2019) says that a product is of good quality if it is valid, practical, and effective. Valid if the product is declared valid by the media and material validators. It is practical if students use the product easily. Effective if student learning outcomes are complete and student responses are positive. Therefore, adaptive teaching materials are needed according to students' abilities and curriculum demands and contain questions that can facilitate students to practice independent learning abilities, especially in numeracy literacy. Teaching materials should use an approach that encourages the active participation of students in constructing their concepts. The learning approach that involves students in the learning process is the Realistic Mathematics Education (RME) approach.

Realistic Mathematics Education (RME) in Indonesia is known as Indonesian Realistic Mathematics Education (PMRI). RME was developed in the Netherlands by Hans Freudenthal in 1970. According to him, mathematics is a human activity (*mathematics is a human activity*) (Putri & Zulkardi, 2019). Mathematics is human; students must be allowed to learn to do mathematical activities, and mathematics must be related to situations that students have experienced in mathematics and everyday life (Widjaja & Heck, 2003). Van den Hauvel argues that RME teaching is built on students' informal knowledge. It is crucial to allow students to explore several situations of everyday life (Putri & Zulkardi, 2019).

Several researchers have carried out several learning studies using the RME approach. Uzel & Uyangor (2006) researched students' attitudes toward using learning in RME. The results of this study indicate that students have a positive attitude toward mathematics after implementing RME. In addition, research conducted by (Baarisina et al., 2011) shows that RME-based learning is more effective than traditional methods. Likewise, research results by (Özkaya & Yetim Karaca, 2017) state that academic achievement and student attitudes improve when using RME. (Sagala & Widyastuti, 2022), who developed an ebook using a realistic approach, showed a positive response from students and classical completeness with an N-Gain score of 0.71 in the high category.

The results of these studies have become empirical evidence about the prospects for the development and implementation of RME—the results of the research reported by Widowati (2013) on Engineering Vocational High School students. The results of his research stated that the implementation of learning using teaching materials in the form of workbooks characterized by RME was in practical criteria; the average student gave a positive response, and the test results showed that there was classical completeness. In addition, the results of (Taskiyah & Malasari, 2022) show that RME-based mathematics books are feasible and practical for learning mathematics. Based on the results of the observations and those descriptions, the researcher will develop a student book based on the principles and characteristics of R*ealistic Mathematics Educatio* (RME), which is intended to find out how the developed RME-characterized student book is valid, practical, and effective in increasing students' numeracy literacy. This research is also expected to be an alternative reference for developing learning products to support the development of numeracy literacy.

METHOD

Research Design

This research was categorized as development research, namely developing student books with RME characteristics. The development of this student book used the Plomp development model, which was carried out in the following three phases.

1. *Preliminary research*

The activities in this phase collected various information that explained the importance of developing student books. These activities included interviews with teachers and students of SDN 2 Padenganploso, identifying students' learning problems, analyzing core competencies and basic competencies in the curriculum, and studying realistic mathematical theory.

2. *Prototyping phase*

This phase contains product development activities in the form of student books that guide students in classroom learning activities and independent learning using steps based on the principles and characteristics of RME. Three steps for learning RME are as follows: (1) understanding contextual problems, (2) solving contextual problems, (3) comparing and discussing, and (4) making conclusions. The activities carried out in realizing the student book are compiling ways of presenting information, compiling problem-solving activities, and compiling activity strengthening/practicing questions.

At this stage, a data collection instrument will be developed in addition to student books to assess quality product development. Product quality criteria are valid, practical, and effective products.

3. *Assessment phase*

This phase includes expert validation activities and trials of products produced. Validate this expert by asking for an expert/practitioner's assessment of the validity of the student's book and the instruments made. Meanwhile, product trials are necessary to assess the practicality and effectiveness of the product.

Based on expert validation and field trials, the final product of the development results will be obtained, namely valid, practical, and effective student books. The development process activities described above are more clearly presented in Figure 1 below.
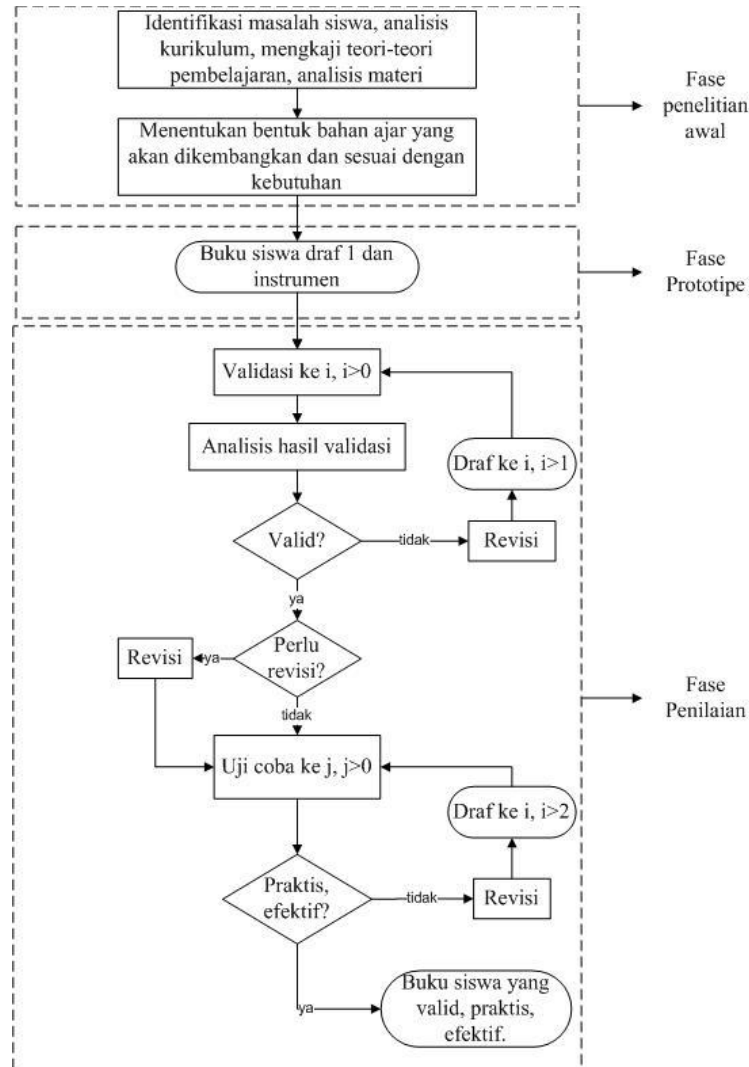

Figure 1. Development Model Chart

Participants

The subjects chosen for this development research were grade 5 students at SDN 2 Padenganploso. The research was selected based on observations and the school's AKM (Minimum Competency Assessment) test results, which showed that students' numeracy literacy skills were still low.

Instruments

The instruments developed in this research include student books that are used as guides for students in classroom learning activities and independent learning using steps based on the principles and characteristics of RME; in addition, there are student book validation sheets, numeracy literacy test validation sheets, student book implementation observation sheets, student activity observation sheets, student response questionnaire sheets, and numeracy literacy test sheets.

Data Analysis

The data obtained are quantitative and qualitative. Quantitative data is in scores, while qualitative data is in notes, criticisms, and suggestions. These data were obtained through validation sheets, observation sheets, student response questionnaires, and tests of numeracy literacy skills.

The data analysis used is descriptive qualitative and quantitative descriptive analysis techniques. Qualitative descriptive analysis was used to analyze data through notes, suggestions, or comments on the assessment results in the validation sheets, observation sheets, and student ' questionnaires. Meanwhile, quantitative descriptive analysis was used to analyze data in the form of scores from validation, observation, student response questionnaires, and processing results of students' numeracy literacy tests. The results of the analysis used to determine the quality of the product being developed, namely valid, effective, and practical student books, which are explained as follows:

(a) Validity Data Analysis

The validation results that the validator has carried out are analyzed using descriptive analysis with the steps: (1) Record the scores for each statement, (2) Calculating the average score of the validation results of all validators on each indicator ($\underline{I}_i$), (3) Calculates the average score of the result value in every aspect ($\underline{A}_j$), (4) Calculating the average score of all aspects ($\bar{V}_k$), (5) Making conclusions on the results of the validity of student books and numeracy literacy tests (($\bar{V}_k$) with criteria:

Table 1. Validity Criteria

Interval	Criteria
$3 \leq \bar{V}_k \leq 4$	Valid
$2 \leq \bar{V}_k < 3$	Quite valid
$1 \leq \bar{V}_k < 2$	Invalid

Information:
($\bar{V}_k$) is the average of all aspects of validity
Adapted from (Parta, 2009).

Qualitative data, such as notes, suggestions, or comments from the validator, is followed up as a product development revision before testing.

(b) Data Analysis of Student Book Practicality

Student books that have been declared invalid by the validator are then tested to determine the level of practicality. Student books are declared practical if they are based on the results of observations of the implementation of these student books in class and the average score of all aspects ($\underline{P}_k$).

Table 2. Practicality Criteria

Interval	Performance Category	Criteria
$3 \leq \overline{P}_k \leq 4$	High	Practical
$2 \leq \overline{P}_k < 3$	Sufficient	Less Practical
$1 \leq \overline{P}_k < 2$	Low	Not Practical

Information:

P_k is the practicality of student books.

Qualitative data in notes, suggestions, or observer comments were followed up. According to the objectives, notes, suggestions, or comments are used to improve the learning situation.

(c) Data Analysis of the Effectiveness of Student Books

The effectiveness of student books is determined by the results of the mastery test of teaching materials, student ' activities using RME and student responses.

1) Analysis of test results data

The minimum learning completeness criterion used at SDN 2 Padenganploso is if a minimum of 85% of students score 65. The numeracy literacy ability test is analyzed by adopting theory (Hake, 2007) to determine whether the student book that has been developed can improve students' numeracy literacy skills. Data from pre and post-test results that students have completed are calculated using the normalized gain (n-gain).

$$N - gain = \frac{final\ test\ score - preliminary\ test\ score}{maximum\ test\ score - preliminary\ test\ score}$$

The categories of interpretation are in the following table.

Table 3. Category n-gain interpretation

N-gain Score	Category
$g \geq 0,7$	High
$0,3 \leq g < 0,7$	Medium
$g < 0,3$	Low

2) Analysis of Student Activity

Student activity data was analyzed by following the same steps as analysis of validity data. Then, match the average score of all aspects (A_k) with the following criteria:

Table 4. Student Activity Criteria

Interval	Criteria
$3 \leq \overline{A}_k \leq 4$	Active
$2 \leq \overline{A}_k < 3$	Quite Active
$1 \leq \overline{A}_k < 2$	Not Active

3) Analysis of student response data

Student responses were shown through a questionnaire at the learning process's end. According to Hobri, if the number of students who give positive responses is at least 80% of the total number of students who take part in learning with student books resulting from this development, then it can be said that the indicators used to assess the effectiveness of student books have shown that student books meet the criteria of being effective.

Table 5. Student Response Criteria

Interval	Criteria of Student-i Response
$1 \leq \overline{Si} < 3$	Negative

$3 \leq \overline{Si} \leq 4$	Positive

While the class response is determined by

Interval	Criteria of Whole Students' Response
$1 \leq \overline{S} < 3$	Negative
$3 \leq \overline{S} \leq 4$	Positive

RESULTS AND DISCUSSION

Results

The development of this student uses the development model, which is carried out in the following stages.

1. *Preliminary research*

At this stage, the researcher interviewed the principal and teachers of SDN 2 Padenganploso and obtained information that the curriculum used at SDN 2 Padenganploso for grades 1 and 4 used the independent curriculum. In contrast, grades 2, 3, 5, and 6 used the 2013 curriculum; thus, the teaching materials and other learning devices refer to K13.

One of the problems faced by students of SDN 2 Padenganploso in learning is the anxiety of students who have been unable to apply mathematical concepts to solve problems around them. Students often have difficulty connecting questions or problems in everyday life with mathematical concepts and then looking for a solution. On the other hand, students' numeracy literacy skills are still low; many teachers are not familiar with questions based on numeracy literacy. In addition, researchers found that the teaching materials used in schools were worksheets without other supporting references. The student worksheets (LKS) used do not contain everyday problems relevant to the environmental conditions around students.

2. *Prototyping phase*

This phase contains product development activities in the form of student books that are used as a guide for students in classroom learning activities and independent learning using steps that follow the principles and characteristics of RME. The selection of student book formats was prepared according to (Shoimin, 2014), which contains the steps of learning RME. RME learning steps include (1) understanding contextual problems, (2) solving contextual problems, (3) comparing and discussing, and (4) making conclusions.

In addition, in this phase, the researcher also carried out several designs, namely the cover, introduction, table of contents, and instructions for use, and compiled a student book assessment instrument to measure the high and low quality of the student book.

3. *Assessment phase*

The results of this phase are obtained from 2 activities: expert validation and product trials. Expert validation is done by learning media expert validators and experts in learning materials. The results of student book validation can be displayed in the following table.

Table 6. Expert validation results

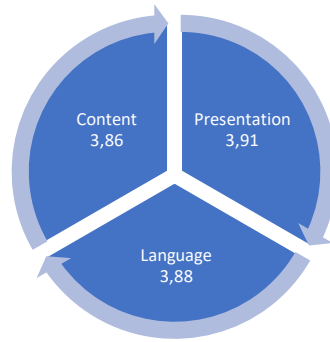| Score Aspect	Average ($\overline{A_j}$)	Overall Average (V_k)	Criteria
Content	3,86		
Presentation	3,91	3,89	Valid
Language	3,88		

Figure 2. Validation Results

Table 6 shows that the average rating of all aspects is 3.89 in the valid category; thus, student books can be used to implement learning with several suggestions for improvement. The suggestions include changing the cover design, size, and appearance of the font or letters in the student book. Thus, it is more interesting for students.

Furthermore, the results of product trials include practicality and effectiveness tests of student books. Practicality is seen based on observations of the implementation of student books in class and the average score of all aspects (Pk). The results of the practicality test of student books can be presented in the following table.

Table 7. Practical test results

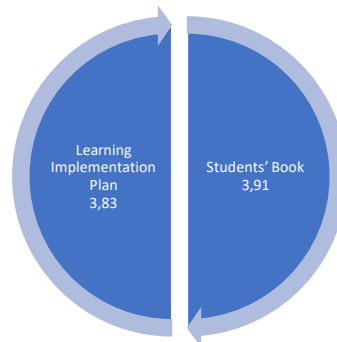| No	Assessment Aspect	Average	Overall Average ($\bar{P}_k$)	Criteria
1	Learning Implementation Plan	3,83	3,87	Practical
2	Student's Book	3,91		

Figure 3. Practical Test Results

Based on Table 7 above, the average for the evaluation aspect of the Learning Implementation Plan is 3.83 with Practical criteria, and the student's book aspect with an average of 3.91 with Practical criteria. Indeed, the overall average is 3.87, which means that the practicality test by the observer meets the practical criteria.

The effectiveness of student books is determined by the results of student book mastery tests, student activities using RME, and student responses.

Based on the results of the students' numeracy literacy test, it was found that more than 85% of students obtained a minimum score of 65. In addition, the overall average pre-test score was 34, and the average post-test score was 79,5. The results of the N-Gain

calculation as a whole obtained an average score of 0.,1 with a high interpretation. After the learning process with RME-based student books and the post-test was carried out, observers and students were given questionnaires, which were filled out to determine student activities and responses.

Observers observe student activities to obtain detailed records of student activities during the learning process using RME-based student books. The results of these observations are presented in the following table.

Table 8. ObservationnResults of Student Activitie

RME Characteristics	Average	overall average $(\bar{A}_k)$	Criteria
The use of context	3,80		
Use models, bridging by vertical instruments	3,90	3,83	Active
Students' contribution, Interactivity	3,80		

As for student responses, it was found that 90% of all students gave a positive response to learning using RME-based student books.
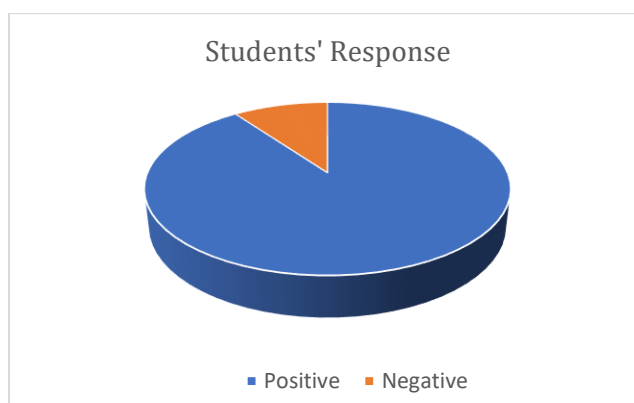

Figure 2. Student Response Percentage

Based on the students' numeracy literacy test results, which experienced an increase, student activity averaged 3,83 in the active category, and 90% of students' responses gave positive responses; Thu,s, the RME-based student book met the criteria of effectiveness.

Discussion

The initial stage of this research was to conduct a need analysis through interviews and literature studies. From these stages, it was found that students needed a supporting medium for learning mathematics based on numeracy literacy. Therefore, developing realistic mathematics education student books for learning mathematics based on numeracy literacy is necessary. The developed student book is expected to help fifth-grade students understand mathematical concepts from real contexts and be able to solve numeracy literacy problems properly and correctly. The selection of media in the form of student books is supported by the opinion of (Anita et al., 2021), who stated that books are learning media that facilitate and interest students in learning. This is because, in the preparation, you can add text, images, and attractive color combinations, and the contents can be designed according to your needs.

Several analyses have been carried out to determine the quality of this student book, including an analysis of the validity, practicality, and effectiveness of student books. The validity analysis includes aspects of material content, presentation, and language. The validity

analysis for the average score on the content aspect obtained a value of 3.86, which was included in the valid category. The presentation aspect obtained a validation value 3.91, which was included in the valid category. The following criterion to be validated is the linguistic aspect. This criterion has an average score of 3.88, which is included in the valid category. Overall, student books get a score of 3.89 in a valid category. Research results (Riyanto & Gunarhadi, 2017) on media in learning mathematics show an average score of 4.5 for material aspects and 4.4 for media, which can be categorized as Valid criteria.

After the developed student book is valid, product implementation is carried out to see the practicality of the student book. This practicality aspect is seen from the observations of implementing student books in the classroom, including Learning Implementation Plans, with an average of 3.83 and 3.91 student books that meet the practical category. This is the result of (Taskiyah & Malasari, 2022) research which shows that RME-based math books are valid and practical for learning mathematics.

The effectiveness of the RME student book was seen from test results, student activities using RME, and student responses. The results of the numeracy literacy test show that more than 85% of students score above 65, and the calculation of the N-Gain from the score pre-test and post-test overall, an average score of 0,71 is obtained with a high interpretation. This shows that the RME student book effectively improves numeracy literacy skills. This increase can be seen from the students' pre-test and post-test scores after using the RME student book, which uses contextual problems in everyday life to help students understand mathematics. This is in line with the opinion of (Herpratiwi, 2016), which states that learning activities that involve students' direct experience or daily life will be more effective than just verbal explanations. Meanwhile, the research results of (Istihapsari et al., 2023) resulted in the development of teaching materials using an environmental context capable of fostering students' mathematical literacy. At the same time, the results of observing student activity in the RME characteristic activities show that the overall average is 3.83 with the active criteria. As is the opinion of (Saraseila et al., 2020), the RME approach is an approach that emphasizes the importance of students' active involvement in the process of learning mathematics.

The recapitulation of student response questionnaire data shows that 90% of all students responded positively; therefore, this RME student book meets the criteria for effectiveness. This is reinforced by (Özkaya & Yetim Karaca, 2017), who state that academic achievement and student response attitudes will be better if using RME.

CONCLUSION

Based on the results of research and development of student books with RME characteristics to improve students' numeracy literacy skills, it can be concluded that the validity analysis of all student books, which includes aspects of content, presentation, and language with an overall average score of 3,89 is included in the Valid category. The results of the product trials show that the RME student book is included in the Practical category in terms of its implementation in class, with an average score of 3,87 for all aspects. The results of this student book trial also showed an increase in students' numeracy literacy skills with an N-Gain score of 0.71, including high interpretation, student activity with an average of 3.83 including the active category, and 90% of all students gave a positive response to learning using student books based on RME. Thus, the student book with RME characteristics meets the criteria of being effective for use in learning.

ACKNOWLEDGEMENTS

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