

DEVELOPMENT OF TEACHING MATERIALS BASED ON REALISTIC ALGEBRA AND MEASUREMENT MATERIALS

Luluk Mauluah, Anita Ekantini, Inggit Dyaning Wijayanti^{1,2,3}

UIN Sunan Kalijaga Yogyakarta, Indonesia^{1,2,3}

E-mail: 197007022003122001@uin-suka.ac.id¹, anitaekantini@uin-suka.ac.id²,
inggit.wijayanti@uin-suka.ac.id³

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ABSTRACT

Students' understanding of mathematical concepts still needs to improve. This problem will spread to other subjects because mathematics is necessary for solving various problems. This research aims to determine the product development process for realistic teaching materials for mathematics, algebra material, and measurement and the feasibility of product development according to expert assessments and responses from potential users. This research is an RND with a 4-D development model which includes Define, Design, Develop, and Disseminate. The resulting product validator comprises three media, material, and discussion experts. Practitioner response testing was conducted on two 5th-grade teachers at Elementary School (SD) Muhammadiyah Sukonandi 2. The subjects for product testing were 5th-grade students at Elementary School (SD) Muhammadiyah Sukonandi 2. The instruments used in this research were questionnaires in the form of validation questionnaires, practitioner response questionnaires, and potential user responses. The assessment results from media experts scored 4.75 in the very good category, material experts scored 4.75 in the very good category, and language experts scored an average of 4.55 in the very good category. Practitioner response tests and user responses received very good responses.

Keywords: algebra; mathematical concepts; measurement; realistic; teaching-materials; understanding

INTRODUCTION

Mathematics is a compulsory subject at all stages of education.^{1,2} Mathematics plays an important role in everyday life, so mathematics is called the "mother of all sciences."³ Mathematics is the foundation of other sciences and helps develop that -

¹ Y. N Siregar, K., Muliatik, S., & Harahap, "Improvement Ability Understanding Draft Mathematics Through Approach Mathematics Realistic Helpful YouTube .," *Journal Pedagogy and Learning* 4, no. (3) (2021), <https://doi.org/Article> 3. <https://doi.org/10.23887/jp2.v4i3.39333>.

² P. T Komarudin, K., & Permana, "LKPD Based on a Scientific Approach to Ability Solution Problem Mathematical Elementary School Students ." *Journal of Elementary Education and Learning* 6, no. (1) (2019), <https://doi.org/Article> 1. <https://doi.org/10.24042/terampil.v6i1.4385>.

³ R Tarigan, "Development Mathematics in Philosophy and Schools Formalism Contained in Philosophy _ Mathematics ," *Sepren*, 2, no. (2) (2021), <https://doi.org/Article> 2. <https://doi.org/10.36655/sepren.v2i2.508>.



science. Apart from that, mathematics is also the basis for solving problems in everyday life.^{4,5}

Mathematics is not a rote lesson but prioritizes understanding concepts. Understanding concepts is the mastery of learning materials, where students discuss the concepts again in a form that is easy to understand and can be applied to problems.⁶ Indicators of concept understanding are students: being able to re-express a concept, being able to classify objects according to their characteristics according to the concept, being able to categorize examples and non-examples, presenting concepts in various mathematical representations, selecting and using certain operations, and being able to apply concepts to problem-solving.⁷ Understanding this concept is a very important element in problem-solving.^{8,9,10} Understanding this concept also has a close relationship with other fields of science.¹¹

Understanding mathematical concepts allows students to optimize critical, logical, and systematic thinking skills.¹² The ability to understand this concept must be developed early in students. Mathematical concepts are arranged in stages from basic to difficult so

⁴ & Komarudin Agustiana , N., Supriadi, N., "Improving Capabilities Reasoning Mathematical With Application Bridging Analogy Approach in View of Self-Efficacy," *Development Innovation - Journal Litbang* 7, no. (1) (2019): 61–74.

⁵ H. Rostika , D., & Junita, "Improvement Ability Solution Problem Elementary School Students in Learning Mathematics With the Discourse Model Multy Representation (DMR)," *EduHumaniora | Journal of Campus Basic Education Cibiru* 9, no. (1) (2017), <https://doi.org/Article 1. https://doi.org/10.17509/eh.v9i1.6176>.

⁶ L Fajar, AP, Kodirun , K., Suhar, S., & Arapu , " Analysis Ability Understanding Draft Mathematical Student Class VIII of SMP Negeri 17 Kendari," *Journal of Mathematics Education* 9, no. (2) (2019), <https://doi.org/Article 2. https://doi.org/10.36709/jpm.v9i2.5872>.

⁷ L Mahfud, MS, Mardiyana , M., & Fitriana, " How Understanding Draft Mathematics Students in Learning Online?," *AKSIOMA: Journal of the Mathematics Education Study Program* 10, no. (2) (2021), <https://doi.org/Article 2. https://doi.org/10.24127/ajpm.v10i2.3681>.

⁸ Siregar, K., Muliatik , S., & Harahap , " Improvement Ability Understanding Draft Mathematics Through Approach Mathematics Realistic Helpful YouTube ."

⁹ P Sari, " Understanding Draft Mathematics Students on Angle Size Material Through PMRI Approach .," *Journal Bushel* , 2, no. (1) (2017), <https://doi.org/Article 1. https://doi.org/10.31629/jg.v2i1.60>.

¹⁰ N Aliyunnisa , " Analysis Problematic Student Online Learning Class VIII on Lines and Series Material Judging from Understanding ConceptNo Title," *Dharmas Education Journal (DE_Journal)* Vol 1, no. No. 2 (2020): 135–42.

¹¹ Radiusman, "Studi Literasi: Pemahaman Konsep Siswa Pada Pembelajaran Matematika," *FIBONACCI: Jurnal Pendidikan Matematika Dan Matematika* Vol 6, no. No 1 (2020).

¹² A Haryanti , S., & Sari, " Influence Application of the Problem Based Instruction Model Ability Solution Problem Mathematical Judging from the Adversity Quotient of Madrasah Tsanawiyah Students .," *JURING (Journal for Research in Mathematics Learning)* 2, no. (1) (2019), <https://doi.org/Article 1. https://doi.org/10.24014/juring.v2i1.6712>.

that the process of understanding the next mathematical concept requires a prerequisite of understanding the previous concept.^{13,14}

Class 5 students are in Phase C in terms of competency attainment.¹⁵ Meanwhile, in Phase C, you must be competent in understanding, dividing, comparing, identifying, presenting, analyzing, etc.¹⁶ Achieving this competency is by the intellectual development stage of students aged 7-12 years with a concrete operational stage. According to Piaget, at the concrete operational stage, educators must be able to encourage children to form appropriate concepts, especially in mathematics learning, because most mathematics learning is strongly influenced by cognitive learning theory.¹⁷ Children at the concrete operational stage still experience great difficulty completing logical tasks without physical objects in front of them. The appropriate learning process for this stage is learning facilitated with natural objects, one of which can be teaching materials.¹⁸

Teaching materials are all forms of materials used in teaching and learning activities.^{19,20} Teaching materials are also something students must study to achieve competency standards and basic competencies.²¹ A set of learning materials that refers to the curriculum intending to achieve predetermined competency standards as well as understand the teaching materials.^{22,23}

¹³ E. Graciella, M., & Suwangsih, " Application Approach Mathematics Realistic To Improve Capabilities Representation Mathematical Students ," *Methodical Didactics : Journal of Elementary Education* 10, no. (2) (2016), <https://doi.org/Article 2>. <https://doi.org/10.17509/md.v10i2.3180>.

¹⁴ B Suandito, "Informal Evidence in Learning Mathematics ," *Al-Jabar: Journal of Mathematics Education* , 8, no. (1) (2017): 13–23.

¹⁵ Dewi Rahmadayanti and Agung Hartoyo, " Portrait "Independent Curriculum , the Form of Independent Learning in Elementary School ," *Journal Basicedu* Vol 6, no. No. 4 (2022).

¹⁶ Albert Efendi Pohan, *Concept Based Online Learning Approach Scientific* (CV Sarnu Untung, 2020).

¹⁷ Ridho Agung Juwantara, " Analysis of Development Theory Piaget's Cognition in the Childhood Stage Operational Concrete 7-12 Years of Learning Mathematics ," *Al- Adzka : Journal Madrasah Ibtidaiyah Teacher Education Science* Vol 9, no. N0 1 (2019).

¹⁸ H Hergenhahn, BR, & Olson, *Theories of Learning* (Jakarta: KENCANA, 2015).

¹⁹ Abdul Majid., *Planning Learning , Developing Standard Teacher Competency .* , 2008.

²⁰ I Ahmad, K., & Lestari, " Development of Teaching Materials for the Development of Elementary Age Children as a Means of Independent Learning Students ," *Perspectives Educational Sciences* , 22, no. XIII (2010), <https://doi.org/Article XIII>. <https://doi.org/10.21009/PIP.222.10>.

²¹ Ministry of National Education, *Guidelines Selecting and Preparing Teaching Materials* (Jakarta: Ministry of National Education, 2006).

²² N Nuryasana, E., & Desiningrum, " Development of Teaching and Learning Strategy Teaching Materials To Increase Student Learning Motivation ," *Journal Innovation Research* 1, no. (5) (2021), <https://doi.org/Article 5>. <https://doi.org/10.47492/jip.v1i5.177>.

²³ Ika Lestari, *Development of KTSP- Based Teaching Materials* (Jakarta: Akademia, 2013).

Teaching materials are a set of materials that are arranged systematically, both written and unwritten, to create an atmosphere/environment for students to learn.²⁴ According to their function, teaching materials can be grouped into two, namely (1) based on the party who uses the teaching materials and (2) based on the learning strategy used, whether classical, individual, or group.²⁵ According to Amri, the benefits of teaching materials are divided into two, namely, for educators and students. The purpose of making teaching materials is to provide materials that follow curriculum demands.²⁶

Teaching materials can be implemented in all subjects, including mathematics. Mathematics is a subject studied by students from elementary to high school. Hizbullah stated that Mathematics is one of the subjects studied by students from elementary school (SD) to high school (SMA/SMK).²⁷ Learning mathematics is closely related to calculating numbers, so in practice, students memorize formulas rather than improving their understanding of the material, in accordance with those²⁸ who said that learning mathematics was too dull. Meanwhile, another reality was that students always needed help answering questions based on forgetting the formula.²⁹ In fact, according to the Ministry of Education and Culture, the aim of studying mathematics is for students to use reasoning knowledge.³⁰ This reality is in line with the ranking of students in the last PISA, namely in 2018, in mathematics and science; Indonesia was in 73rd position out of 79 countries.³¹ This proves that the mathematics learning currently taking place has yet to provide meaning for students.

²⁴ F Eliza, " Development of Interactive Multimedia Based Teaching Materials for Electrical Drawing Courses Using Autocad in the FT UNP Electrical Engineering Education Study Program ," *Journal Technology Information and Education* , 2013, 6.

²⁵ Andi Prastowo , *Creative Guide Making Innovative Teaching Materials* (Yogyakarta: Diva Press, 2012).

²⁶ Amri Sofan , *Straegi Learning School Integrated* . (Jakarta: Achievement Pustakarya , 2011).

²⁷ Hasbullah, *Learning Media Mathematics* (Jakarta: Savitra College., 2014).

²⁸ & Abdul Wahid Asadullah. Anjarsari , E., Donny Dwi Farisdianto , " Development of Powtoon Audiovisual Media in Learning Mathematics For Student Elementary School .," *JMPM: Journal Mathematics and Mathematics Education* , Vol 4, no. No. 2 (2019).

²⁹ & Azkia Firdausi Zumeira Firdaus, EF, Sofri Rizka Amalia, "Analysis Error Student Based on Stages Kastolan In Finishing Mathematical Problems ," *Journal Dialectics of Mathematics Education Study Program* , Vol 8, no. No. 1 (2021).

³⁰ & Tri Candra Wulandari. Linola, DM, Retno Marsitin , "Analysis Ability Reasoning Mathematical Students Solving Story Problems at Sman 6 Malang," *Mathematics Education Journal*, Vol 1, no. NO 1 (2017).

³¹ L. & Muh. Shaleh Dewi, "Reflection on PISA (The Program For International Student Assessment) Results: Improvement Efforts Focusing on Early Childhood Education)," *Golden Age Journal* Vol 4, no. No. 1 (2020), <https://doi.org/10.29408/goldenage.v4i01.2018>.

Algebra and measurement are materials in the mathematics family that are often encountered by students both in learning activities at school and in everyday life. Mathematics is important in helping students face daily life problems and developing students' logical thinking processes. Several materials must be mastered in mathematics, one of which is algebra.³² Because it is important, algebra and measurement materials are included in AKM. The Ministry of Education and Culture is implementing a new program called the National Assessment as a replacement for the National Examination, which will begin to be implemented in 2021.³³ Since 2021, the Ministry of Education and Culture has implemented AKM for grade 5 students. AKM can also be seen based on the results of the world assessment of education in Indonesia, according to the 2015 PISA report, a world-level assessment program where students aged 15 years will be tested. The results of the report show that the quality of the education system in Indonesia is ranked 62nd out of 72 participating countries.³⁴ Based on these data, class 5 students' understanding of Mathematics concepts is still lacking, especially in algebra and measurement material.³⁵

Algebra is one of the materials that students must learn in learning mathematics. Studying algebra means studying mathematical objects in the form of facts, concepts, skills, and principles. Mathematical concepts and principles are arranged in stages from simple to complex and adapted to the level of education pursued.³⁶ Algebra and Measurement material is considered difficult for students to accept. So that learning from this material can be done with a realistic approach.³⁷

³² Dian Permatasari and Idris Harta , “ Ability Think Algebra Student Elementary Education School Class V And Classes VII : Cross-Sectional Study," *Journal of Education and Culture* Vol 3, no. No. 1 (2018).

³³ Ingrid Dyah Ganestry Dhina Cahya Rohim, Septina Rahmawati, “ Concept Assessment Minimum Competencies to Improve Capabilities Literacy Numeracy Student Elementary School ,” *Journal Varidika* Vol 33, no. No. 1 (2021).

³⁴ Nanda Novita et al ., " National Assessment : Knowledge and Perceptions of Teacher Candidates," *Journal Social Sciences and Education* Vol 5 (2021).

³⁵ Novita Barokah et al ., " Implementation Use Computer As Alternative Learning Media To Enhancement Readiness AKM Test for Grade 5 Elementary School Level or Equivalent ,” *SEMAI Proceedings : PGMI National Seminar* Vol 1 (2021).

³⁶ Ummi Rosyidah et al ., "Analysis Understanding Draft Mathematical Mathematics Education Study Program Students in Subjects Elementary Algebra ,” *LINEAR: Journal of Mathematics Education* Vol 1, no. No. 1 (2020).

³⁷ Ahmad Zaini and Marsigit , “ Comparison Effectiveness Learning Mathematics With Approach Mathematics Realistic and Conventional Judging from Capability Reasoning And Communication Mathematics Students ,” *Mathematics Education Research Journal* Vol 1, no. No. 2 (2014).

Facts in the field show that understanding of mathematical concepts is still low.^{38,39} This problem will spread to other subjects because mathematics is necessary for solving various problems. If checked, it will continue to be a weakness for students, even up to the tertiary level. Understanding mathematical concepts is an important thing to do when facing the Industrial Revolution. Understanding mathematical concepts is the ability to formulate problem-solving strategies, apply simple calculations, use symbols in solving operations, and convert one form to another, for example, fractions.⁴⁰ Learning that emphasizes understanding concepts directs students to not only memorize the material being taught but also to understand, interpret, identify, and be able to explain the concepts of the subject matter being studied.⁴¹

Understanding mathematical concepts will enable someone to solve problems better, have rules in conceptualization, and develop ideas⁴² so that students' mathematical concepts develop well. Several factors, including inappropriate learning methods and teaching materials, cause this lack of understanding of mathematical concepts.⁴³ These teaching materials are needed to organize the concepts that students have studied and will learn so that they have systematic knowledge.⁴⁴ Teaching materials can also improve

³⁸ Fajar, AP, Kodirun, K., Suhar, S., & Arapu, "Analysis Ability Understanding Draft Mathematical Student Class VIII of SMP Negeri 17 Kendari."

³⁹ N Yanti, R., Laswadi, L., Ningsih, F., Putra, A., & Ulandari, "Implementation of Approach Scientific Helpful Geogebra in an Effort to Increase Understanding Draft Mathematical Students," *AXIOMA: Journal Mathematics and Mathematics Education* 10, no. (2) (2019), <https://doi.org/10.26877/aks.v10i2.4399>.

⁴⁰ R Mawaddah, S., & Maryanti, "Ability Understanding Draft Mathematical Middle School Students in Learning Using the Discovery Model Guided (Discovery Learning)," *EDU-MAT: Journal of Mathematics Education*, 4, no. (1) (2016), <https://doi.org/Article 1. https://doi.org/10.20527/edumat.v4i1.2292>.

⁴¹ H. Permatasari, DN, & Sutarto, "Analysis of the Ability to Understand Mathematical Concepts in Terms of Students' Confidence in Blended Learning," *Unnes Journal of Mathematics Education* 11, no. (2) (2022), <https://doi.org/Article 2. https://doi.org/10.15294/ujme.v11i2.59873>.

⁴² G Edwards, "Concepts of Community: A Framework for Contextualizing Distributed Leadership," *International Journal of Management Reviews* 13, no. (3) (2011): 301–12, <https://doi.org/10.1111/j.1468-2370.2011.00309.x>.

⁴³ OC K Putu, MAN, Putu, SPL, & Gus, "Improvement Ability Understanding Draft Mathematics Students in Learning Media Trials Oriented Mathematics Realistic and Local Wisdom," *Emasains : Journal Education Mathematics And Science* 11, no. (1) (2022), <https://doi.org/Article 1. https://doi.org/10.5281/zenodo.6399084>.

⁴⁴ S Ulandari, L., Amry, Z., & Saragih, "Development of Learning Materials Based on Realistic Mathematics Education Approach to Improve Students' Mathematical Problem Solving Ability and Self-Efficacy," *International Electronic Journal of Mathematics Education* 14, no. (2) (2019): 375–83.

students' reasoning abilities by presenting several learning activities in the material presented.⁴⁵

Teaching materials that are suitable for developing students' understanding of mathematical concepts are teaching materials with a realistic approach. A realistic approach based on human activity, "Mathematics in Human Activity,"⁴⁶ has the principle that mathematics learning must have meaning for students based on everyday life experiences. This realistic teaching material is very suitable for developing students' understanding of mathematical concepts because they will learn from "real" life and practice understanding concepts.

The Realistic Mathematics Approach, called Realistic Mathematic Education (RME), is an alternative strategy for implementing mathematics learning from the Netherlands. RME was first introduced in 1970 by the Prudential Institute. The concept of the RME approach is a form of activity where mathematics learning is linked to students' lives. One of the main principles of learning with the RME approach is that students must be active in learning as stated, mathematics is a human activity that involves observing, representing, and investigating quantitative patterns and relationships between physical and social phenomena and mathematical objects. There are five principles of realistic mathematics,⁴⁷ namely "Context Use, The use of mathematical models for Progressive mathematization, The Utilization of Student's Construction, Interactivity, and Intertwining." The RME approach can create a conducive learning atmosphere because students can manage their abilities and understanding.

Students' need for more understanding of algebra and measurement material can be overcome by developing teaching materials designed with a realistic approach. This approach can present learning close to students' daily lives so students can easily understand mathematics material. Previous research has shown that realistic teaching materials can support students' problem-solving abilities. Research has been conducted

⁴⁵ M Khusna, AH, Yuwono, I., & Muksar, "Development of Worksheets Student Characteristics of RME are sequence and series materials For Class X," *Journal of Education: Theory, Research and Development* 1, no. (4) (2016), <https://doi.org/Article 4>. <https://doi.org/10.17977/jp.v1i4.6242>.

⁴⁶ Y Marium, A., Astuti, HP, & Umayah, "Realistic Mathematics Education Approach to Self Concept in View of Initial Mathematical Ability," *Journal of Authentic Research on Mathematics Education (JARME)*, 1, no. (2) (2019), <https://doi.org/Article 2>. <https://doi.org/10.37058/jarme.v1i2.796>.

⁴⁷ T Le, "Applying Realistic Mathematics Education in Vietnam: Teaching Middle School Geometry," 2007.

on developing teaching materials to improve understanding of other concepts.⁴⁸ Kusumadewi's research shows that comic teaching materials can improve knowledge of mathematical concepts. The novelty of this research lies in developing teaching materials to overcome the problem of low understanding of mathematical concepts at the MI/SD level.

Based on this background, developing realistic teaching materials to improve MI/SD students' understanding of basic mathematical concepts is urgent. This teaching material is very suitable for application in the Independent Learning Curriculum (MBKM). In MBKM, students are asked to explore their knowledge based on daily experience.⁴⁹ This is very in accordance with the teaching materials developed.

RESEARCH METHODS

This research is Research and Development (R&D). This research is intended to produce realistic teaching materials to improve understanding of basic mathematical concepts. This research used Thiagarajan's 4-D development model design, which included Define, Design, Develop, and Disseminate.⁵⁰

Development Procedures

The first step in this research was to collect the information needed, and the development of this information was obtained through literature study and field observations. The second step is design, where the researcher creates a product design consisting of selecting media forms, preparing media concepts, and creating draft I. The main goal of this step is to prepare realistic teaching material prototypes. The third step is to develop a revised product based on expert advice. The steps taken in this stage are expert assessment, practitioner response testing, and response testing of potential product users. Three experts validated and evaluated the product: material, media, and language experts. These experts are lecturers who are experts in their field. Material experts are

⁴⁸ M Kusumadewi, RF, Neolaka, A., & Yasin, "Improving the Ability of Understanding Mathematical Concepts through Digital-Based Comics for Elementary School Students," *Al Ibtida : MI Teacher Education Journal* 7, no. (2) (2020), <https://doi.org/Article> 2. <https://doi.org/10.24235/al.ibtida.snj.v7i2.7024>.

⁴⁹ A Nurulaeni, F., & Rahma, "Analysis Problematic Implementing Freedom to Learn Mathematics," *Journal of Spur Basic Education*, 2, no. (1) (2022), <https://doi.org/Article> 1. <https://doi.org/10.22021/pacu.v2i1.241>.

⁵⁰ MI Thiagarajan, S. Semmel, D.S. & Semmel, *Instructional Development for Training Teachers of Exceptional Children* (Indiana: Indiana University Bloomington, 1974).

Mathematics lecturers, Media experts are lecturers who teach Learning Media courses, and Linguistic Experts are lecturers who teach Indonesian Language courses. The practitioners in this research are grade 5 teachers at SD Muhammadiyah Sukonandi 2, while potential users are grade 5 students at SD Muhammadiyah Sukonandi 2. Aspects of product assessment by experts and practitioner responses can be seen in Table 1. User response tests were carried out on ten students. The questionnaire response grid for potential users can be seen in Table 2.

Table 1
Product Assessment Aspects

No.	Product Assessment Aspects	Item No
1	Components of a Realistic Approach	1 to 4
2	Content Eligibility Components	5 to 10
3	Language Components	11 to 14
4	Presentation Components	15 to 19
5	Graphic Components	20 to 23

Source: ⁵¹

Media, material, and language experts validated the resulting Draft I product. From experts, you will get assessments and suggestions for product improvements. Revisions were made based on recommendations from experts, and a Draft II product was obtained. This revised product was tested by practitioners' responses to obtain assessments and input from grade 5 teachers.

A limited response test is carried out after the product has been revised and produced as a test-ready product. This test was conducted on prospective product users, namely grade 5 students. The prospective user response questionnaire was in the form of a questionnaire to determine the readability of the product by prospective users. This questionnaire is prepared using yes or no answers, making it easier for students to fill it out. The results of this limited trial can be used to improve the product being developed.

Table 2
Prospective User Response Questionnaire Grid

No.	Aspect	Indicators	Item No
1	Image Display	The image display is clear and attractive	1
2	Worksheet view	Attractive worksheet display	2,3

⁵¹ Depdiknas, *Panduan Pengembangan Bahan Ajar* (Jakarta: Depdiknas, 2008).

No.	Aspect	Indicators	Item No
3	Layout of Figures, Tables, and Questions	The layout of images, tables, and questions is displayed clearly and attractively.	4
4	Display of Titles, Commands, Images, Tables and Questions	Display titles, commands, images, tables, and questions clearly	5,6,7
5	Use of Language	The language used in the worksheets is clear and easy to understand.	8
6	Font Size	The font size is appropriate.	9
7	Clarity of Information	Information is presented clearly.	10

Source: Personal Document

Data analysis

After the data is collected, it is analyzed using a certain method. The following procedures were used to analyze the data from this study:

Qualitative Data

Materials, media, language validators, and practitioner and student responses all contributed to data collection. Researchers collected qualitative data in tables so they could detail the data. Researchers consider input and suggestions to improve the final product.

Quantitative Data

Quantitative data was obtained from material, language, media expert assessments, and response tests from educational practitioners and students. This assessment data is then analyzed to determine the category.

Find the mean rating from validators using the equation below

$$\bar{X} = \frac{\sum x}{N}$$

Information :

\bar{X} = Average score

$\sum x$ = total score

N = Number of assessors

Convert the Actual Score to a Five Scale Score

Using the score conversion guideline 5, add the value data for each assessment statement and get a total score (X). The factual score is quantitative and is converted into qualitative

to determine the feasibility of the developed Realistic Teaching Materials. Table 3 provides the conversion from actual scores to a 5-point scale.

Table 3
Conversion of Actual Scores into Five Scale Values

No.	Score Range	Value	Categories
1	$X > x_i + 1.80 S_{bi}$	A	Very Good
2	$x_i + 0.60 S_{bi} < X \leq x_i + 1.80 S_{bi}$	B	Good
3	$x_i - 0.60 S_{bi} < X \leq x_i + 0.60 S_{bi}$	C	Enough
4	$x_i - 1.80 S_{bi} < X \leq x_i - 0.60 S_{bi}$	D	Not Enough
5	$X < x_i - 1.80 S_{bi}$	E	Very Less

Source:⁵²

Information:

X = Actual score (Achieved score)

X_i = average ideal score ($1/2$ (ideal highest score + ideal lowest score))

S_{bi} = Standard deviation of ideal score = $(1/2) (1/3)$ (ideal highest score – ideal lowest score)

Ideal highest score = \sum criterion items x highest score

Ideal lowest score = \sum criterion items x lowest score

The minimum requirements are used to calculate the feasibility value of the product; it can be said to be feasible if the assessment results are C or the "Pretty Good" category so that if the Realistic Teaching Materials give an average final result of at least C in the "Pretty Good" category, this means that the Realistic Teaching Materials are considered appropriate for use.

RESULTS AND DISCUSSION

This research aims to determine the product development process for realistic teaching materials for mathematics, algebra material, and measurement and the feasibility of product development according to expert assessments and responses from potential users. This development research uses a 4D model through the define, design, develop, and disseminate stages.

Define

⁵² Eko Widoyoko , *Assessment of Learning Outcomes in Schools* (Yogyakarta: Student Library , 2016).

The first step in the development process is to conduct a needs analysis. In designing learning, a needs analysis is needed. Hutchinson divides these needs into two: the first is target needs, and the second is learning needs. Target needs can be defined simply as "In a particular target situation, do students need help?" Meanwhile, learning needs are "something that students want when learning" (what the learner needs to do to learn).⁵³ At this stage, it is very important to know the needs of students in the field. All steps that will be taken depend on the needs analysis process. If the process goes well, developing teaching materials will also run well.

The researcher collected initial data through observation and interviews at SD Sukonandi 2 during this process. There are various types of interviews, including structured, semi-structured, or unstructured interviews, depending on the level of framework that has been determined previously.⁵⁴ Researchers carried out observations to obtain initial data regarding the mathematics learning process.

The delivery of material that is usually applied often still uses the lecture method, so it seems boring. In fact, the mathematical concepts given to students must be conveyed with an appropriate approach because they will become the main foundation for learning mathematics in the next class. The choice of learning approach that will be applied to teaching materials greatly influences the development of student's abilities. The chosen approach will help students interpret situations through mathematical modeling and connect them to mathematical concepts. One approach that can facilitate this problem is the Realistic Mathematical Approach.⁵⁵

The fact that happens is that many students consider mathematics material to be one of the most challenging materials in learning because it is considered material that requires in-depth understanding and memorizing formulas. In learning mathematics, students tend to still focus on books/texts so that the questions students work on are only based on the text and are far from students' daily lives. Therefore, mathematics teaching

⁵³ T Hutchinson and A Waters, *English for Specific Purposes: A Learning Centered Approach* (Cambridge: Cambridge University Press, 1987).

⁵⁴ JW Creswell, *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches (4th Ed.)* (Sage Publications, 2014).

⁵⁵ Yeni Haryonik and Yoga Budi Bhakti, "Development of Worksheet Teaching Materials Student With Approach Mathematics Realistic," *MaPan: Journal Mathematics and Learning* 6, no. 1 (June 5, 2018): 40–55, <https://doi.org/10.24252/mapan.2018v6n1a5>.

materials that contain questions or learning with a realistic approach are needed so that later students can solve their problems.

After conducting a needs analysis, determine the instructional objectives. This learning objective is derived from Competency Achievements based on Phase. The learning competencies researchers will achieve are guided by the primary school CP and ATP Phase C published by the Ministry of Education and Culture. At this stage, researchers also narrow down the material included in the teaching materials.

The next step is for the researcher to prepare an assessment instrument to determine the student's final competency. This assessment instrument is in the form of summative questions included in the teaching materials. The final process in the define stage is designing the teaching materials that will be developed. The teaching materials that will be developed must pay attention to aspects of analyzing student needs so that the teaching materials that will be created stay consistent with the facts and needs in the field.

Design

The product design referred to the competency material in algebra and measurement in phase C of elementary school. At this stage, the researcher creates a design for mathematics teaching materials that describes all the content in the teaching materials. The function of making product designs is to serve as a guideline/benchmark for making teaching materials. The general function of making product designs is as a concept and creative expression, such as expressing thoughts or thoughts. Paying attention to the product layout created using the Canva application is very important at this product design stage. Canva is helpful as an application for creating, processing, and editing various designs.

The material contained in this teaching material includes whole numbers and decimals, measurements per unit quantity, quadrilateral angles, addition and subtraction of fractions, volume, and area of flat shapes. At the stage of preparing practice questions in teaching materials, the questions included in this teaching material are essay test questions on algebra and measurement material. Then, backgrounds, images, and materials are collected by downloading them from various sources and making them in image format using Canva.

Development

At this stage, product validation is carried out by experts, practitioner response testing, and potential user response testing. Product validation is carried out to obtain product assessments and expert suggestions for improvements. Experts here include material experts, media experts, and language experts. Material experts are lecturers who teach Mathematics courses. The results of the assessment from material experts can be seen in Table 4, and suggestions from material experts can be seen in Table 5

Table 4
Data on Product Assessment Results by Material Experts

Aspect	Assessment Score
Components of a Realistic Approach	4
Material Components Relevant to Competencies	14
Clarity of Materials	14
Total Score	31
Average Score	4.57
Categories	Very Good

Source: Personal Document

Based on data from material expert assessments, Realistic Mathematics Teaching Materials obtained a total score of 31 with an average value of 4.57 in the Very Good product category. All input from material experts has been followed up.

Table 5
Input and Suggestions by Material Experts

No.	Material Expert input and suggestions	Follow-up
1	The material is sorted from addition to subtraction and so on	Have been done
2	Page 10 Image $\frac{1}{3}$ is not adjusted	Have been done
3	Page 12 add $\frac{6}{8} \dots \frac{5}{8}$	Have been done
4	Page 13 is replaced by the solution $\frac{7}{5} - \frac{5}{6}$	Have been done
5	Page 14 Instruction number 2 equals number 1	Have been done
6	Page 24, question no 5 Table 1, row 2 changed the number of students who have	Have been done
7	Page 25 statement is not clear	Have been done
	Page 58	Have been done
8	No. 1 Box changed to green and blue Just delete the nets	

No.	Material Expert input and suggestions	Follow-up
9	Page 65, Chapter 7 is placed before the fraction operation	Have been done
10	Pages 69-76 Volume Formulas and then used as a volume section for geometric shapes in chapter 6	Have been done
11	Chapter 8 Area of Plane Figures is placed before Volume	Have been done

Source: Personal Document

Media experts are lecturers who teach learning media development courses. The assessment results from media experts can be seen in Table 6, and suggestions from media experts can be found in Table 6.

Table 6
Data on product assessment results by Media Experts

Aspect	Assessment Score
Graphics	43
Presentation or use	14
Total Score	57
Average Score	4.75
Categories	Very Good

Source: Personal Document

Table 6 shows that the assessment results from media experts are in the very good category. All suggestions from media experts in Table 7 have been followed up and revised according to input.

Table 7
Input and suggestions by Media Experts

No.	Media Expert input and suggestions	Follow-up
1	Page 12. The white layout was too large, so it was cut off during binding	Have been done
2	Page 11, the image is cropped	Have been done
3	Page 13, image cropped	Have been done
4	Page 25, the Image resolution is broken in the table image	Have been done
5	Add bibliography	Have been done
6	Page 2 image resolution broken	Have been done

Source: Personal Document

Linguists are lecturers who teach Indonesian language courses. The assessment results from language experts can be seen in Table 8, and suggestions from language experts can be seen in Table 9.

Table 8
Data from product assessment results by language experts

Aspect	Assessment Score
Legibility	5
The language used is in accordance with EYD	28
The language used is appropriate for the child's development	4
The language used is easy to understand	4
Total Score	41
Average Score	4.55
Categories	Very Good

Source: Personal Document

Table 8 shows that the language expert's assessment is very good. The suggestions from language experts in Table 9 have all been revised according to input.

Table 9
Input and suggestions by language experts

No.	Linguist input and suggestions	Follow-up
1	Page 22, question 1 has less effective sentences	Have been done
2	Page 27 on children's opinions 2 and 3 typos	Have been done
3	Page 31 title changed to "Number of angles in triangles and quadrilaterals." There is a typo in the box; take a look.	Have been done
4	Page 55 typo "flower garden"	Have been done
5	Page 56 typo bottom right corner	Have been done

Source: Personal Document

A summary of the results of the assessment of the feasibility of Realistic Mathematics Teaching Materials by the three experts can be seen in Table 10.

Table 10
Summary of Results of Feasibility Assessment of Realistic Teaching Materials by Experts

Assessment Score		
Media Expert	Material Expert	Linguist
A	A	A

Source: Personal Document

The researcher carried out a score conversion based on the five-scale score conversion. The data researchers converted was obtained from product feasibility validation data analysis results.

After experts and a revised product have been validated and produced, the next step is to test practitioner and potential user responses. The practitioner response test was conducted to determine the teacher's response by providing assessments and suggestions for the developed product. The data from the assessment results by the class teacher can be seen in Table 12

Table 12
Table of Realistic Teaching Material Assessment by Class Teachers

Aspect	Assessment Score Teacher 1	Teacher Score Assessment II
Product displays	20	19
The size of the product made	4	5
Color composition	15	14
Durability of the resulting product	4	5
Usage techniques	9	9
Product practicality	5	5
The material is relevant to the competencies that students must master	14	15
The theories presented are close to students' daily lives	5	5
Clarity of Materials	14	14
Legibility	4	4
The language used is in accordance with EYD	31	25
The language used is appropriate to the child's age characteristics	5	4
The language used is easy to understand	5	4
Total Score	135	119
Average Score	4.82	4.25

Source: Personal Document

The overall classroom teacher ratings were very positive, with the first teacher scoring 135 and the second teacher scoring 119 out of 140. The average scores were 4.82

and 4.45. Table 13 displays comments and recommendations from class V homeroom teachers for Realistic Mathematics Teaching Material.

Table 13
Table of input and suggestions from class teachers

No.	Input and suggestions by the class teacher	Follow-up
1	Some writings need to be clarified. An example is on page 28. It would be better if the writing were made clearer.	Have been done
2	Several commands need to be corrected; for example, on page 5, pay attention to the image next to it, which should be above. There is writing that is not clear, for example, on pages 6, 8, 20, 28, and 39	Have been done

Source: Personal Document

Realistic Mathematics Teaching Materials were revised two times. Revision I was carried out according to input and suggestions from experts, namely material, media, and language experts. Revision II is guided by input and suggestions from practitioners, namely from class V teachers and from responses from prospective users. This is done to produce Realistic Mathematics Teaching Material products that are suitable for use as teaching materials for Algebra and Measurement. The revisions obtained have been followed up by improving the Algebra Material. This revision is focused on providing contextual mathematical problems for students because the RME approach starts from contextual problems; the teacher is a facilitator, students are active, students are free to communicate their ideas one way or another. with each other, the teacher compares the ideas and guides them to make a decision about which idea is better for them.⁵⁶

Revision I was carried out based on suggestions and input from media, material, and language experts. An example of revisions made based on input from material experts can be seen in Figure 1. Revisions from material experts include several things, namely the order of material/topics, improvements to several questions, and the closeness of the material to students' daily lives. Figure 1a shows that the image of a vessel with a volume of $\frac{1}{3}$ liter is depicted with $\frac{2}{3}$ of the shaded part, so it requires revisions, as shown in Figure 1b.

⁵⁶ Y Marpaung, "RME Prospects For Learning Mathematics In Indonesia" (RME Prospects For Learning Mathematics in Indonesia, 2001).

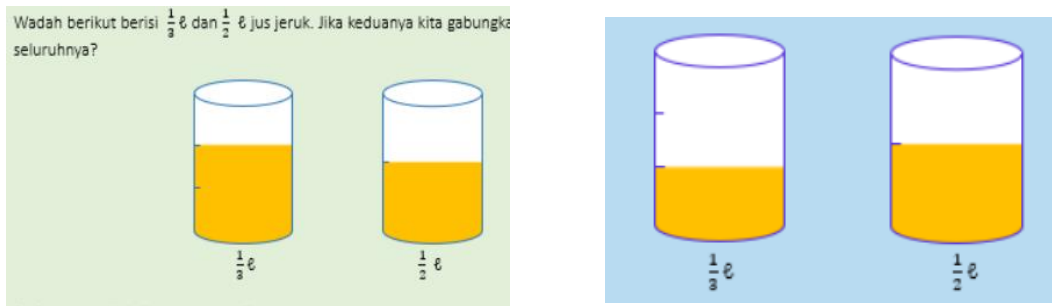


Figure 1a. Vessel before revision and Figure 1b. vessels after revision

Source: Personal Documents

Revisions from media experts include layout, revised images with better resolution, and the addition of a bibliography. One of the revisions made can be seen in Figure 2.



Figure 2a. Multiplication table before revision with a blurry image, and Figure 2b . after revision with a clearer image

Source: Personal Documents

Figure 2a shows a low-resolution image of the multiplication table, so the writing and image are unclear. Figure 2b is an image of the multiplication table after revision. Images have a higher resolution, are clearer, and the writing is legible.

Revisions based on input from language experts include typos and less effective sentences. This revision aims to produce realistic Mathematics teaching materials that are easy to understand for elementary school-age students. The language used should be adjusted to the level of student development.⁵⁷

Realistic mathematics teaching materials revised based on expert advice and input are then tested for read-ability responses by providing a questionnaire containing

⁵⁷ Mohamad Miftah and Nur Rokhman , “ Criteria Elections And Principles Utilization of Learning Media ICT Based Compliant Need Learners ,” *Educenter : Journal Scientific Education* 1, no. 4 (April 25, 2022): 412–20, <https://doi.org/10.55904/educenter.v1i4.92>.

statements regarding the aspects that will be assessed. Data was taken from respondents who were Sokonandi Elementary School students. Based on the results of student responses, the response was very good.

The realistic mathematics approach or RME Realistic Mathematic Education (RME) originates from the Netherlands and is defined as an innovative learning strategy in learning mathematics. In line with Freudhenthal's research (Wijaya, 2012), the Prudential Institute introduced Realistic Mathematic Education (RME) in the Netherlands around 1970.⁵⁸

Students must be given free space to build their own knowledge and understanding.⁵⁹ RME is an approach to mathematics learning that places reality (the real world) and the student's environment as the starting point for learning so that their way of thinking will be structured.⁶⁰ De Lange defines the real world as a concrete real world, which is conveyed to students through the application of mathematics so that the learning process occurs in real situations.⁶¹

The development of realistic-based mathematics teaching materials developed by researchers can facilitate students' mathematics learning. Having teaching materials can help teachers to provide contextual understanding. This aligns with Nurlatifah's statement that the RME and contextual approaches have similar characteristics or components. The activities and meaning of the RME approach and the components in the contextual approach are quite the same. Thus, the RME and contextual approaches will be appropriate in elementary schools and influence students' mathematical understanding.⁶²

CONCLUSION

Realistic mathematics teaching materials in algebra and measurement for phase C elementary schools have been successfully developed with 4D stages (define, design,

⁵⁸ Wijaya, *Mathematics Education Realistic Something Alternative Approach Learning Mathematics* (Yogyakarta: Graha Science, 2012).

⁵⁹ Andi Alim Syahri, "Influence Application Approach Realistic Cooperative Setting To Ability Communication Mathematics Student Class VIII," *MaPan: Journal Mathematics and Learning* 5, no. 2 (December 18, 2017): 216–35, <https://doi.org/10.24252/mapan.v5n2a5>.

⁶⁰ Syahri .

⁶¹ S Hadi, *Pendidikan Matematika Realistik: Teori, Pengembangan, Dan Implementasinya* (Depok: PT Raja Grafindo Persada, 2017).

⁶² Desi Nurlatifah, Ali Sudin, and M. Maulana, "Differences Influence Between Approaches Realistic And Approach Contextual To Understanding Mathematical Students on Consonance Material," *Scientific Pen Journal* 2, no. 1 (December 30, 2017): 961–70, <https://doi.org/10.17509/jpi.v2i1.11233>.

develop, disseminate). Based on the results of the analysis, realistic mathematics teaching materials received assessments from material, media, and language experts. Apart from that, the teaching materials developed also received assessments from practitioners. Researchers also conducted readability tests on fifth-grade elementary school students. Realistic mathematics teaching materials received an assessment from material experts with an average score of 4.57 in the very good category. I received an assessment from media experts with an average score of 4.75 in the very good category and an evaluation from language experts with an average score of 4.55 and classified in the very good category. The readability test carried out by researchers on ten respondents showed that realistic mathematics teaching materials obtained an average score of 4.67 in the very good category. Thus, according to experts and practitioners, realistic mathematics teaching materials such as algebra and measurement are appropriate.

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ORCID ID

Luluk Mauluah		https://orcid.org/0000-0002-5310-7106
Anita Ekantini		https://orcid.org/0009-0006-9632-0659
Inggit Dyaning Wijayanti		-

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