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The Development of Teacher and Student's Book Based on Realistic Mathematics Education in Statistics for A package Program

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Abstract: Development research demands a improvement in the implementation of learning by developing products based on learning needs. The products of this development are teacher book and student book based on the realistic mathematic education (RME) approach for package A in statistics material. Validity testing in this study includes instrument validation, self-evaluation, expert validation, one-to-one evaluation. Aiken's V and Intraclass Correlation Coefficient (ICC) are used to determine the validity and reliability of the product. The result of research shows that the instruments and prototype are valid and feasible. Then, the ICC obtained moderate stability, it also categorize reliable. In terms of context and hypothetical learning trajectory (HLT) developed, the products should be revised to achieve meaningful learning.

Keywords: *Realistic mathematical education, student books, teacher's books, validity.*

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Introduction

The intervention developed must be appropriate with the problems in the teaching-learning process being faced. It also must be qualified in order to be used. An intervention is valid if it is developed based on need, theory, and all components are connected (Nieveen, 2013; Syafriandi et al., 2020). A quality intervention must have three criteria, are; valid, relevance (content validity), and consistency (construct validity). Content validity relates to the intervention being developed should fulfil a need, and its components should be in line with current knowledge, while construct validity relates to remaining in line with others. The validity of the content related to the developed intervention must meet the needs, and its components must be on the latest knowledge, while the construct validity should be constantly linked to each other.

The intervention developed in this study is a learning design based on the realistic mathematic education (RME) approach for the Package A program, level 2 in mathematics with the resulting products being teacher's books, student books, and hypothethical learning trajectory (HLT) books. Inappropriate learning flow is one of the things that can affect learning barriers (Evayanti, 2018). The quality of these products refers to learning need, theory (state of the art) in mathematics for package A program (content validity), the components contained in a consistent learning design (construct validity), and teaching process used principles and characteristics of realistic mathematic education (Rochmad, 2012). The important topics in mathematics learning that will be used as a role in the development of the curriculum system is statistics. Learning in Package A uses multigrade classes consisting of multiple classes with 2 levels, namely level 1 and level 2 (equivalent to grades IV, V, and VI SD). The basic competencies that must be mastered are related to data concepts (class IV), data presentation (class V) and data processing (class VI). One of the objectives of learning mathematics is to increase students' mathematical problem-solving abilities. Hence they are able to make decisions on various information or phenomena that occur.

Based on preliminary research, it is known that the implementation and completeness of learning have not been fulfilled curriculum 2013 demands. Competent educators in mathematics got difficulty in teaching class parallel (3 classes). It shows that the targeted learning outcomes are not achieved, including the ability to solve mathematical problems. The other problem is the teaching-learning process runs in one way direction. It means, the teacher is the

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main source in front of the class. Then, it is mechanistic in nature so that the activeness of students is not visible. The availability of learning modules nationally has not been able to assist in maximizing learning in multigrade classes because it is less contextual.

For this reason, it is necessary to develop a learning design for multigrade classes. Learning with the RME approach will be supported by teacher and student books, and HLT in contextually and heterogeneous problem-solving skills based on grade levels at level 2 of Package A program. These books are provided to facilitate students activities in learning independently based on SKK. The context that will be presented is based on students real activities and the existing conditions around them (Fauzan et al., 2018).

Literature Review

Product quality is the ability of a product to carry out its functions, including durability, reliability, accuracy, ease of operation, and repair, as well as other valuable attributes. The quality of the development in mathematics is the learning systems. It is the tools to review based on 4 (four) criteria (Plomp, 2013), namely:

1. *Relevance (Relevancy): This criterion is also called content validity, namely the need for the importance of intervention in learning. Its design is based on the latest knowledge or the latest scientific studies.*

2. Consistency: This criterion is also called construct validity. That is, the designed intervention must be logical.

3. Practicality: This criterion is interpreted from two aspects between expectations and the fact that the designed intervention must be appropriate. So, the resulting intervention can be used easily by students and students by the research objectives.

4. Effectiveness: This criterion is also interpreted from two aspects between expectations and the fact that in using the intervention that has been designed, it is expected to produce the desired learning outcomes (outcomes), and using the product also makes the desired learning outcomes. Thus, it can be said that the model's effectiveness is in terms of the Consistency between the design or objectives with the experience and learning outcomes students achieve. The Students' experiences were determined through his appreciation of the learning model, and then student learning outcomes could be resolved through test results.

A learning device is considered valid or suitable for usage if the material and format are adequate and linked to facilitate both instructors and students (Nieveen, 2013). Validity may be determined in two ways: a) if the produced curriculum or learning model is founded on current knowledge, and b) whether the various components of the learning tools are consistently connected (Nieveen, 2013). Additionally, Plomp (2001) asserts that two types of validity must be satisfied for a product originating from development research to be considered valid: content validity and construct validity. According to Plomp, a product is deemed to have content validity if it is based on sound ideas (state-of-the-art knowledge) and construction validity if all components of an intervention are correctly integrated.

It is consistent with the Ministry of National Education's (Depdiknas, 2008) evaluation of the validation of instructional materials, which includes the following: (a) the content feasibility component, which comprises compliance with standard competency and basic competencies, compatibility with children's development, compliance with the demands of teaching materials, and the truthfulness of the learning materials' substance, (b) linguistic components included readability, information clarity, adherence to proper and proper Indonesian language norms, and effective and efficient language usage, (c) Presenting components comprise the following: clarity of objectives (indicators) to be accomplished, presentation sequence, incentive, and appeal, (d) visual elements, such as the use of fronts, the style and size of lettering, the layout or design, illustrative pictures, photographs, and display design. According to some of these perspectives, determining the validity of the learning design applied via HLT in teacher and student books requires consideration of numerous factors, including content, language, didactic or presentational features, and graphic or display characteristics.

The collected product's validity must fulfill the standards for content and structure. Thus, in the opinion of Plomp, the solid theories (state-of-the-art knowledge) for determining the validity of the content of the learning design via HLT that are implemented in teacher books and student books are as follows: (a) utilizing the RME approach, which emphasizes the process of performing mathematics skills and is guided by RME's principles and characteristics; (b) The implemented learning design materials are aligned with the relevant curriculum's content, and (c) The learning goals are aligned with the applicable curriculum's competence standards and fundamental competencies. (d) The issues mentioned in the learning design are the students face regularly. Meanwhile, construct validity refers to the compatibility of the generated product with the identified development parts. Validity will be determined during the development step or prototyping. It was a stage in which solutions identified during the preliminary analysis stage were designed. This stage is characterized by generalization across all aspects of issue resolution, comparison, evaluation of existing options, and selecting the best design to be employed as a solution. This stage used formative assessment techniques, including self-evaluation, expert evaluation, and individual and small group evaluation. Before the expert review, the product is self-evaluated, examined, and updated. Additionally, individual and small group tests were conducted to determine the items' practicability.

Methodology

Research Design

The type of research used for research development is determined by the concerns mentioned. The development model employed in this study is a modification of the model devised by Tjeerd Plomp, dubbed the Plomp research model. Plomp (2013) define the Plomp model. There are three stages: preliminary research, development, and assessment.

1. Preliminary research is a preparatory stage consisting of needs analysis, student analysis, curriculum analysis, and concept analysis.

2. The development stage or prototyping phase is gradually designing and developing learning tools through formative evaluation stages to evaluate and improve the prototype.

3. The assessment phase is a semi-summative evaluation to see if the final prototype or product meets the quality standards, especially those for usefulness and effectiveness.

Teacher and student books were designed to implement the multi-grade learning design using the RME approach. The teacher's book contains guidance on teaching plans tailored to student activities, time allocation, and assessment plans. The student book contains learning activities carried out by students to achieve learning objectives and contextual questions in the form of modules by developing students' mathematical problem-solving abilities.

Following is a summary of the activities performed during the three phases:

1. *Preliminary Research: Several data collection and analysis activities are performed at this stage to identify mathematics learning problems, which serve as a reference for determining alternative solutions. To provide researchers with a brief overview of the product specifications required for creating learning designs. In this phase, needs, students, curriculum, and concept analysis are carried out.*
2. *Development Stage: Later, the results of the multi-grade learning design using the RME are evaluated and refined gradually at the development stage. A series of prototypes were developed at the prototype development stage (prototyping phase). Where this prototype is evaluated concerning formative evaluation, self-evaluation, expert review, one-on-one evaluation, and small group evaluation are all parts of formative assessment.*

   The prototype was designed for multi-grade mathematics learning design using the RME approach by referring to the results of the preliminary analysis stage and the stage of preparing the experiment. The formative evaluation carried out is a self-evaluation. The second prototype was obtained after being revised based on the self-evaluation results. The formative assessment of these two prototypes was an expert review by asking experts to assess the designed prototype. The third prototype was obtained after the second prototype was repaired according to the expert's advice. The formative evaluation carried out on the third prototype was a one-to-one evaluation. Specifically, the formative evaluation of this prototype was through a focus group discussion (FGD).
3. *Assessment Stage: Field Test carried out at the assessment stage aims to determine whether the product met expectations. The assessment at this stage is carried out by going through a practical test and examining the effectiveness of the learning tools developed. The results of this stage will be presented in the following article.*

   We will discuss the development stage evaluation in this article. Later in the development stage, the outputs of the multi-grade learning design employing the RME are assessed and adjusted progressively. Various prototypes were created during the prototype development stage (prototyping phase). This prototype is examined using formative assessment techniques. Formative assessment is a multi-stage process that begins with self-evaluation and continues with instrument validation and expert review. In this section, a One-to-One Evaluation is also conducted to determine the accuracy of the context given in the problems in the given activity. In addition, validation was also carried out on the HLT. It was developed regarding the accuracy of predictions and anticipations designed based on field findings so that they could be set for the better. The results of the One-to-one Evaluation will be presented descriptively.

Instruments and Analysis Data

The validity testing should describe the important aspects to develop in teaching materials appropriately (Azwar, 2013). These aspects are integrated with RME approach and solving mathematical problems. The aspects are:

Table 1. Evaluated Aspects of Teacher and Student Books and HTL

No	Valued Aspect
1	Enable Content
2	Graphics
3	Language
4	Design/Lay out

The validation results of learning design through HLT, teacher book and student book were analyzed by validators scores for each item using the assessment scale. Validity value using Aiken's V formula (Bashooir & Supahar, 2018). Determining validity levels of Irawan and Wilujeng (2020) based on criteria on Table 2.

Table 2. Aiken's V Coefficient Value and Criteria

No	Rated Coefficient of Aiken's V	Validity criteria
1	$0 \leq V \leq 0{,}4$	Not valid
2	$0{,}4 < V \leq 0{,}8$	Valid
3	$0{,}8 < V \leq 1$	Very Valid

To determine the consistency and stability of the validator's evaluation, the correlation coefficient between classes was calculated (Intraclass Correlation Coefficient or ICC). Calculation of ICC values with program assistance SPSS Version 20.0. with the criteria of Rosner in Markey (Murti, 2011).

Results

Based on the results obtained in the preliminary study, the process of development is accompanied by formative evaluations. This activity is to assess the quality of the product designs developed. The formative evaluation developed by Tessmer (2013) used in stages; self-evaluation, expert validation , focus group discussion (FGD), one-to-one evaluation, small group, and field test. However, this article stress on self evaluation, expert validation, and one-to-one evaluation to determine the feasibility of the instrument and product.

Self Evaluation

The self-evaluation is to re-examine the product conformity with the validity indicators (obvious error). The purpose of self-evaluation is to obtain product criteria that are relevant and based on science, consistency, and have practicality as expected. It is done by checking for errors that are clearly visible on the product. This activity were helped by some colleagues.

The types of errors examined included book structure errors, word typing, spelling and punctuation errors, cover and layout errors, errors in the use of type, font size and color, as well as an examination of important parts that must be in each product according to with the theory used. Some changes that occurred in the design of model books and textbooks, especially in terms of the appearance of the book. Consideration of researchers revising the presentation of the book to make it look attractive and fulfil student need.

Instrument Validity

The instrument is said to be valid if the instrument used can measure what is being measured. The Preliminary stage, the prototype stage and the summative evaluation stage are validated by using some indicators; clarity of purpose or accuracy of the instrument, the ability of the questionnaire to dig up information, the correctness of the use of the Indonesian language, as well as the clarity of the assessment instructions. The results of the assessment of research instruments from experts were analyzed using the Aiken formula with the results as shown in the Table 3.

Table 3. The Results of the Instrument Assessment Using the V-Aitken

No	Research Instruments	Average V-Aitkens	Criteria	Validator Conclusion
I	**Research Preliminary Instruments**			
1	Checklist tar list	0.65	Valid	Proper to use
2	Teacher interview guide	0.69	Valid	Proper to use
3	Learning implementation observation sheet	0.70	Valid	Proper to use
4	Student characteristic analysis questionnaire	0.65	Valid	Proper to use
II	**Prototype Stage Instruments (Validation and Practicality)**			
1	Self-Evaluation Validation Sheet	0.69	Valid	Proper to use
2	Interview Guidelines for Mathematical Curriculum System in Context	0.69	Valid	Proper to use
3	Interview Guidelines with Students for One To One, Small Group and Field Tests (After Using the Student Book)	0.67	Valid	Proper to use

Table 3. Continued

No	Research Instruments	Average V-Aitkens	Criteria	Validator Conclusion
4	Teacher Interview Guide for One to One, Small Group and Field Test (After Using Teacher Book)	0.65	Valid	Proper to use
5	Learning Implementation Observation Sheet Using Teacher Books and RME-Based Student Books	0.69	Valid	Proper to use
6	RME-Based Student Book Validity Instrument	0.68	Valid	Proper to use
7	RME Based Teacher Book Instrument	0.69	Valid	Proper to use
8	HLT Sheet	0.72	Valid	Proper to use
9	Student Book Practicality Questionnaire by Students	0.60	Valid	Proper to use
10	Student Book Practice Questionnaire and Teacher Books by Teachers	0.71	Valid	Proper to use
III	**Assessment Stage Instrument (Effectiveness)**			
1	Independence Questionnaire	0.65	Valid	Proper to use
2	Problem Solving Ability Test	0.64	Valid	Proper to use

Based on Table 3, it can be seen that instruments were the valid and reliable based on criteria, and they are suitable for data collection. To determine the consistency and stability of the assessments of the validators, the intraclass correlation coefficient (ICC) using SPSS 20 was used for each instrument and the results are shown in table 4.

Table 4. Results of Instrument Assessment with ICC

No	Research Instruments	ICC Value	Criteria	Validator Conclusion
I	**Research Preliminary Instruments**			
1	Checklist tar list	0.512	Medium stability	Reliable
2	Teacher interview guide	0.529	Medium stability	Reliable
3	Learning implementation observation sheet	0.462	Medium stability	Reliable
4	Student characteristic analysis questionnaire	0.780	Medium stability	Reliable
II	**Prototype Stage Instruments (Validation and Practicality)**			
1	Self-Evaluation Validation Sheet	0.727	Medium stability	Reliable
2	Interview Guidelines for Mathematical Curriculum System In Context	0.696	Medium stability	Reliable
3	Interview Guidelines With Students For One To One, Small Group and Field Tests (After Using the Student Book)	0.519	Medium stability	Reliable
4	Teacher Interview Guide For One To One, Small Group and Field Test (After Using Teacher's Book)	0.555	Medium stability	Reliable
5	Learning Implementation Observation Sheet Using Teacher Books and RME-Based Student Books	0.750	Medium stability	Reliable
6	RME-Based Student Book Validity Instrument	0.444	Medium stability	Reliable
7	RME Based Teacher Book Instrument	0.667	Medium stability	Reliable
8	HLT Sheet	0.483	Medium stability	Reliable
9	Student Book Practicality Questionnaire by Students	0.500	Medium stability	Reliable
10	Student Book Practice Questionnaire and Teacher Books by Teachers	0.640	Medium stability	Reliable
III	**Assessment Stage Instrument (Effectiveness)**			
1	Independence Questionnaire	0.593	Medium stability	Reliable
2	Problem Solving Ability Test	0.761	Medium stability	Reliable

Expert Review

Before doing summative evaluation, the product was validated by experts. The experts are lecturers who are experts in this study.

The Teacher's Book

Validation results in teacher's book can be seen in the table below. There are some explanations about aspects, means, and categories of validation results in students' book.

Table 5. Validation Results of the Teacher's Book

No	Aspect	Mean	Category
1	Graphic	0,61	Valid
2	Content Eligibility	0,57	Valid
3	Language	0,60	Valid
4	Presentation	0,56	Valid
	Mean	0,59	Valid

Based on the table, it can be explained that prototype 2 of teacherbooks that have been revised based on to the expert suggestions. Generally, It has got very valid criteria with an average of 0.59. It Means the prototype 2 of the teacher books has the feasibility to be used in this study.

Student Books Validation

According to the Table 6, it can be explained that the revised student book prototype isn based on expert suggestions, and it categorized very valid criteria with an average value of 0.61. It Means the prototype of the student's book has a high feasibility to be used in research. Although it is in valid categorization, it needs improvement.

Table 6. Validation Results of Student Books

No	Aspect	Mean	Category
1	Content Eligibility	0,55	Valid
2	Language	0,62	Valid
3	Presentation	0,59	Valid
4	Graphic	0,66	Valid
	Mean	0,61	Valid

HLT Validation Results

Based on the table above, it can be explained that the HLT prototype that has been revised based on expert suggestions, in very valid criterion, average value of 0.52. Hence, the prototype of the student's book has the feasibility to be used in research. It is also need to improve. In general, HLT is very feasible to be used in research.

Table 7. HLT Validation Results

No	Aspect	Mean
1	Content Eligibility	0,50
2	Language	0,54
	Mean	0,52

One-to-One Evaluation (Context and HLT)

In one-to-one evaluation, the prototype II evaluated was HLT, teacher books and student books. The design of the teacher's book and student's book would be used on 3 students who have different abilities (heterogeneous). The determination of the three students was based on by their daily test scores of previous materials. The teacher's book and HLT in context, obtained input from teachers in the field of mathematics who teach in Package A program level 2 equivalent to grades 4,5, and 6 of elementary school.

This is a finding of difficulties in using student books, teacher's books, and HLT an Activity: " In 2021 was the beginning of the implementation of the Minimum Competency Assessment (AKM). This activity asses the basic competencies possessed by students related to reading literacy and mathematical literacy. At the elementary school level, AKM is attended by students in grade 5 including package A students. first, the teacher conducts simulations based on AKM question books sold in bookstores. After giving math literacy AKM questions to students in package A program level 2, the teacher records the scores obtained by students, namely 70, 65, 85, 70, 85, 90, 70, 95, 75, 90, 85, 70, 80, 75, 85, 75, 85, 80, 85, 75, 85, 75, 80, 65, 80, 75, 80, and 90. But, the teacher has not had time to present these scores well. Help your teacher in presenting the data in tabular form!"

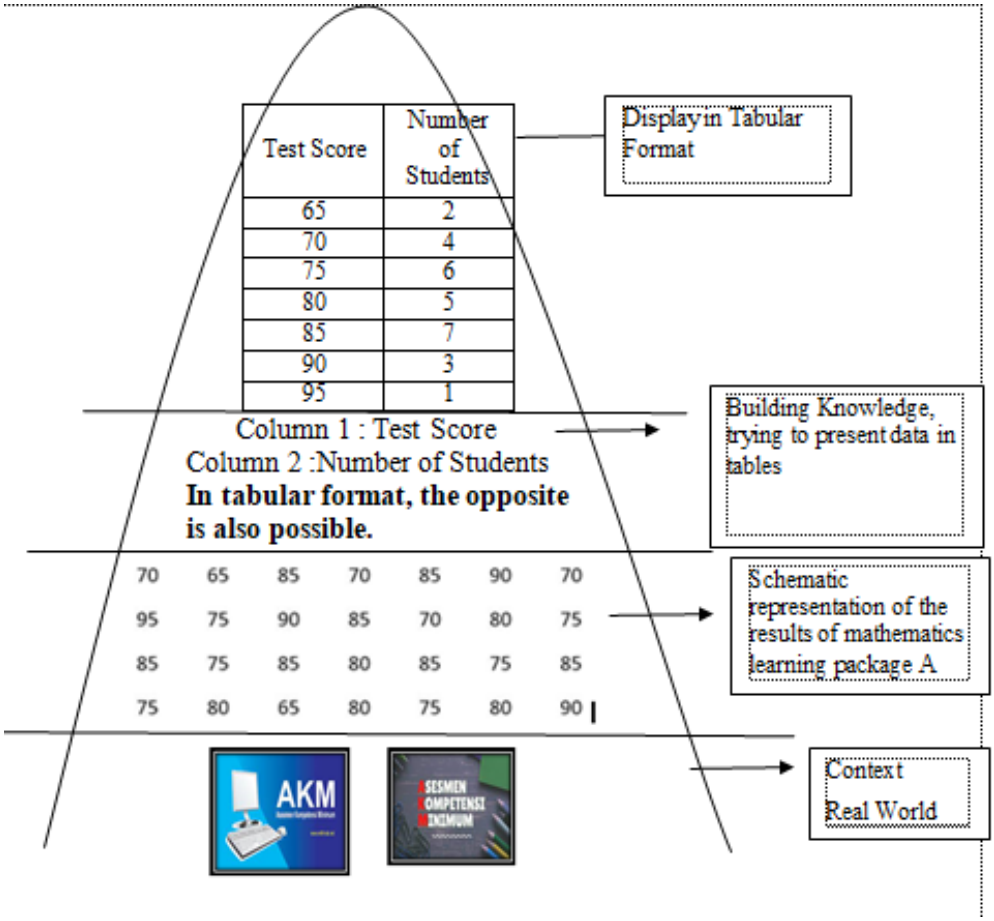


Figure 1. Example of Iceberg Data Presentation

Teachers argued that Iceberg which is designed for one the activities of has built knowledge. The context of the problem-solving questions given is relatively good. However, the types of questions given are only story questions that directly lead to the need for the required solution. It is necessary to develop more analytical questions to stimulate students to think more critically and creatively in solving mathematical problems. In addition, it is better if the images used are not just AKM labels but display AKM books. Likewise, the predictions and anticipations given need to be developed based on the findings in the student book.

Based on trials on three students with high, medium, and low abilities, it was found that there were difficulties faced by students. The difficulties encountered include understanding the stages of problem solving given because of the lack of direction given as a description of the activities that need to be done. At each stage of RME that has been developed by integrating mathematical problem solving skills for low ability students still have difficulty. Students do not understand the meaning of the questions given, as examples of the following answers are related to what is known and asked from the problems given in activity 4.

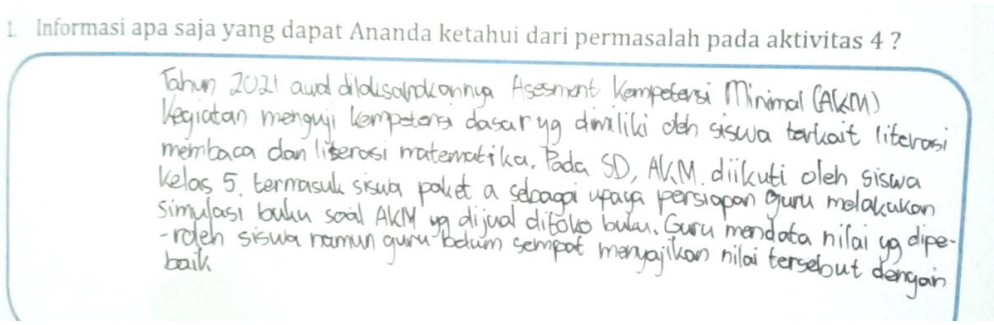


Figure 2. Examples of Answers to the Stages of Understanding the Problem

The question in activity 4 is "What information can you get from the problem in activity 4?" in tabular form. High-ability, medium-ability, and low-ability students answered: "In early 2021, the AKM was carried out. These activities are to test the essential competencies possessed by students related to reading literacy and mathematical literacy. In elementary school,

AKM is attended by 5th-grade students, including students of Package A, as an effort to prepare teachers for simulating AKM question books sold in bookstores. The teacher recorded the scores obtained by the students, but the teacher has not had time to present these values correctly. "

Misunderstanding with the problem at the stage of understanding the problem has an impact on the stage of planning problem-solving, causing wrong answers. Students did not give the slightest information on the data obtained from the AKM simulation. So that students give the answer to the solution of the problem is "students have to read a lot", as shown in the following figure.

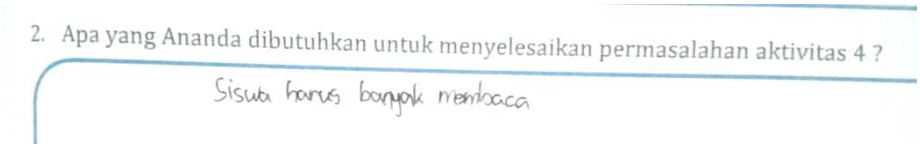


Figure 3. Examples of Answers to the Stages of Planning a Solution

The second question was, "What do you need to solve the problem of activity 4?" Medium and low-ability students answered, "Students should read a lot." At the problem solving stage, students present the data in a bar chart, while what was requested is in the form of a table. It causes the solution not to match. In this question, students were asked to present the data using the phrase, "Please write in detail how you helped the teacher in presenting the data!"

At the stage of problem solving, students present the data in the form of a bar chart, while what is requested is in the form of a table. This causes the solution does not match what is needed.

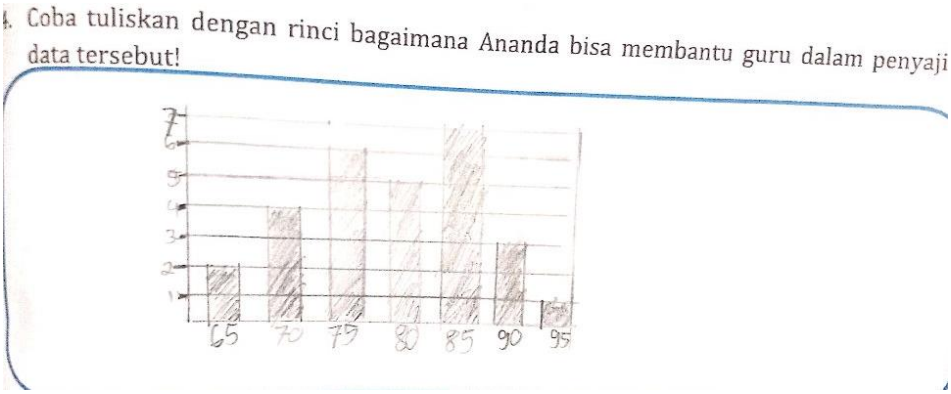


Figure 4. Problem-Solving by Students

Based on the diagram in Figure 4, it is noticed that students are already capable of presenting the data using Cartesian - bar charts. The x-axis represents students' Minimum Competency Assessment scores, and the y-axis represents the number of students. A score of 65 was achieved by two students, 72 by four students, 79 by five students, 85 as the most common score achieved by seven students, 90 by three students, and only one student achieved 95.

The final problem-solving stage requires students to be able to re-check the results of the answers that have been written. The directions given are through other solutions with the same presentation technique. However, all of the students were unable to give the answer. This indicates the need for improvement in the design of the prototype. Improvements need to be made to HLT, teacher's books, and student books because all three work together in creating meaningful learning for students.

In the learning carried out to find concepts, various anticipations are given according to the predictions that have been designed previously. For students who have not been able to answer correctly, they are directed back through questions that are easier to understand. Regarding the question about the information that is known based on the problem given, the teacher directs by guiding students through the question "what are the values obtained by students through the AKM simulation that is known in the problem in activity 4?". With the stimulus in the form of questions, students are able to understand the problem well. The researcher also asked students to find out what form of data presentation was needed in solving problems.

In the second and third stages students are expected to be able to plan problem solving and actualize them. Students' give answers as follows.

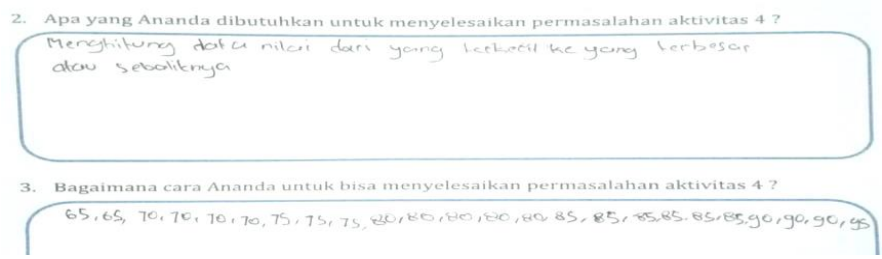


Figure 5. Student Completion Through Researcher Anticipation

Question 2 "What do you need to solve the problem of activity 4?". Students overall gave the answer "counting the value data from the smallest to the largest or vice versa." So that students presented a sequence of data 65,65,70,70,70,70,75,75,75,80,80,80,80,80,85,85,85,85,85,85,90,90,90,95. "Students tried to solve the problems given by first sorting the data obtained from the problem. The data was arranged from the smallest to the largest. After the data was sorted, students presented it in tabular form with the following presentation.

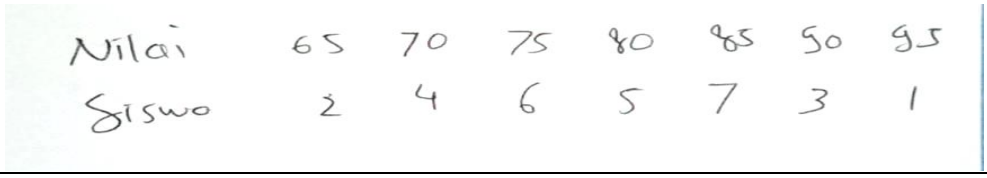
Students try to solve the problems given by first sorting the data obtained from the problem. The data is arranged from the smallest to the largest. After the data is sorted, then students present it in tabular form with the following presentation.

Score	Students
65	2
70	4
75	3
80	5
85	7
90	3
95	1

Figure 6. Presentation of Data by Students in Tabular Form

Based on the results obtained in Figure 6, there are still errors, namely the amount of data from the AKM simulation results which were followed by 28 people, only 24 students were recorded. This proves that students are less careful in sorting data, and researchers need to direct students to use tallies in presenting data in tabular form so that the results are more precise. As for the final stage of the problem-solving ability of students to provide answers based on sorting the data from the largest to the smallest. When asked why this is so, students think that sorting the data can be done with two possibilities, namely from small to large or from large to small. So that these alternatives are also used in helping to present data in tabular form.

Researchers also explore again that in the presentation of the table form there are rows and columns of presentation. Should each information be presented in the form of columns or can it be in the form of rows? This question arouses the curiosity of students so that they try to write a presentation table described by the researcher. The presentation given according to the correction of the previous erroneous data is as follows.



Score	65	70	75	80	85	90	95
Students	2	4	6	5	7	3	1

Figure 7. Presentation of Tabular Data

The steps taken in problem solving, indirectly lead to the stages of student thinking according to Iceberg which starts from the real world context based on the problems presented by trying to understand them. The understanding obtained through these concrete conditions is directed at the formation of a scheme known as the model of. At this stage, students try to link the basic knowledge they have previously to model existing problems. Students do this by sorting the existing data so that it will be easier to present it in tabular form. Sorted data grouping becomes the next stage in achieving the for model. The grouping of data is in the form of student scores and the number of students who get it, making it easier to present in the rows and columns of the available tables. This condition is a process of building student knowledge in presenting data to match the information presented in the problem. In the final stage, the data presentation is obtained in the form of a table. This achievement indicates that students have reached the stage of formal mathematics.

Discussion

Mathematics learning in elementary schools including package A has several objectives to achieve the expected results. The purpose of learning mathematics is not only so that students are able to solve routine math problems (daily test questions, semester exams, and entrance exams to a higher level). The objectives of learning mathematics must be directed to more comprehensive goals, in accordance with the demands of the curriculum (Kamarullah, 2017), namely: (a) Understanding mathematical concepts, explaining the interrelationships between concepts and applying concepts or algorithms, in a flexible, accurate, efficient, and precise manner, in solution to problem; (b) Using reasoning on patterns and traits, performing mathematical manipulations in making generalizations, compiling evidence, or explaining mathematical ideas and statements; (c) Solving problems which include the ability to understand problems, design mathematical models, complete models and interpret the solutions obtained; (d) Communicating ideas with symbols, tables, diagrams, or other media to clarify the situation or problem; (e) Having an attitude of appreciating the usefulness of mathematics in life, namely having curiosity, attention, and interest in learning mathematics, as well as a tenacious and confident attitude in problem-solving. Thus, one of the main goals of learning mathematics in elementary schools is to make students able to solve problems. Mathematics subjects are given to students so that they are able to think critically, have problem-solving skills, can work together, and have creativity (Muchlis, 2012).

Regarding problem-solving, *The National Team of Mathematics* (NCTM, 2000) states that learning to solve problems is the main reason for studying mathematics. With problem-solving students will learn to develop appropriate strategies to solve the problems they face. Problem-solving is considered as the heart of mathematics learning (Yazgan, 2015) problem-solving always plays an important role, because all mathematical creative activities require problem solving actions. Although mathematics is a very important subject in formal education and is closely related to human life, mathematics is not a topic of interest to students and many students face difficulties in solving mathematical problems due to the inability to acquire many mathematical abilities and lack of cognitive learning abilities (Siagian et al., 2019; Tambychik & Meerah, 2010). One of the biggest problems with modern mathematics is presenting mathematics as a finished product, ready to use, abstract, and taught mechanistically: educators dictate formulas and procedures to students (Fauzan, 2002). With such a procedure, many of the students do not understand the process of where to get it but only know the result. To fix this, one solution is to give students the habit of being able to solve their own problems so that the material provided in mathematics learning is meaningful.

Problems related to mathematical problem-solving skills: students do not understand the problem, do not understand the problem, problems in choosing a procedure/completion strategy to solve problems (Nicolas & Emata, 2018; Psycharis & Kallia, 2017; Salado et al., 2019), lack of calculation process skills (Dewi et al., 2019), less thoroughness of students in writing the answers requested by the questions (Hasibuan et al., 2020; Wardana & Rifaldiyah, 2019). Our students are weak in working on questions that require problem solving, argumentation, and communication skills, based on this, it means that the mathematical problems that are often encountered, one of which lies in the low problem-solving ability (Tohir, 2019).

The results showed that the application of the RME approach gave better results compared to traditional learning (Fauzan, 2002; Fauzan & Yerizon, 2013). Students not only have to understand concepts that are relevant to the problem that is the center of attention but also gain learning experiences related to skills in mathematical problem-solving (Haryono, 2014; Hasibuan et al., 2020; Ulandari et al., 2019). Learning that uses the RME approach, one of which is by using a context that is easily imagined by students in real life. The use of contexts that are in the student's environment makes learning more meaningful, besides that learning will also provide experiences for students in everyday life.

Wilson, et al (Bayu et al., 2021) mention that mathematics *learning trajectory* can support teachers in creating models of student thinking and rearranging teachers' understanding of mathematics and reasoning. Furthermore, HLT can build teacher in thinking about the learning process and can provide an overview of the implementation of learning in the classroom before the learning process begins (Daro et al., 2011); HLT is very necessary implementing innovation in learning (Cárcamo Bahamonde et al., 2017); HLT is very helpful in connecting the work of researchers and education practitioners in building a learning environment that helps students understand a particular topic or material (Andrews-Larson et al., 2017). Based on the results of these relevant studies, the researcher believes that applying learning design through the RME approach-based learning flow will improve students' mathematical problem-solving abilities.

However, the results obtained from the validation that have been carried out in the current prototype development, need to be improved. Improvements will be made related to the context of the problem given, refinement of students' thinking stages which are illustrated through Iceberg, design improvements in predictions and anticipations based on findings during One-to-One Evaluation. The contribution of students in learning must be increased by providing a stimulus through questions that guide students to find mathematical concepts independently so that learning becomes meaningful.

In the One-to-One evaluation stage, researchers tried to find improvements to the prototype design related to HLT by referring to the Iceberg that had been made. One of them is Iceberg regarding the presentation of data in tabular form.

Researchers try to direct students to reach stages that start from real conditions to the stage of formal mathematics. Anticipation that has been made previously, based on field conditions, the questions need to be corrected so that it is easy to direct students to find the stages of building good knowledge. As stated by Gravemeijer et al. (2009) that in the Iceberg model there are four stages that must be passed by students, namely the concrete stage, the modeling/schema/model of, the stage of building knowledge, and the stage of formal mathematics.

Various problems may arise in the stages of formal mathematics achievement. therefore, it is necessary to anticipate the predictions of student answers that arise. Based on field findings, it is known that students still have difficulty understanding the problems presented, so they need guidance through anticipatory questions given. Based on the communication made with students related to understanding the real problems given.

Researcher : What can Ananda know from the problem of activity 4?

Student : AKM Simulation.

Researcher : Based on the AKM simulation, what was obtained?

Student : There are student grades.

Researcher : How many students were assessed from the AKM simulation?

Student : There are 28 students.

Researcher : Has the existing data made it easier for Ananda to know how many students got a certain score, for example, how many students got a score of 70?

Student : I don't know because it hasn't been calculated. The data is still scattered.

Researcher : What should Ananda do?

Students : Presenting the requested data in the form of a table.

Based on the conversation, students can understand what must be done in solving the existing problems. To be able to present correctly, the researcher guides back the correct way of presenting.

Researcher : What did Ananda do to be able to present the data in a table?

Student : Make the table.

Researcher : What will Ananda fill in the column and each row?

Student : Will be given a column of grades and students.

Researcher : How many values are there?

Students : There are 65, 70, 75, 80, 85, 90, and 95.

Researcher : Ananda, do you know the number of students who got each of these scores?

Student : Not yet.

Researcher : What will Ananda do so that he doesn't put it wrong grades and number of students?

Students : Sort the data from small to large.

The guidance and interaction activities carried out run throughout the learning process to make it easier for students to find the concept of presenting in tabular form. Learning that has been carried out through this stage requires improvements in the development of predictions and anticipation. For prediction, it is necessary to add stages in the presentation in the form of tally so that all existing data can be read properly. Meanwhile, to anticipate the need for development in questions that are raised as a stimulus for students in finding formal mathematics.

Conclusion

Based on the results obtained at the design stage and prototype development related to self-evaluation and expert validation, the results showed that the research instrument was valid and reliable. This provides a statement that the instrument is feasible to use. Likewise, the results of product validity, the results obtained are already valid so that only the parts suggested by the validator need to be corrected. The results of instrument validation indicate that the instrument is valid so that it is suitable for use with moderate stability ICC which shows reliability. As for the prototype, it shows that the product in the form of a teacher's book, student book, and HLT is valid and suitable for use with improvements according to suggestions. For the teacher's book, the average value is 0.59, for the student's book it is 0.61, and for the HLT it is 0.52. The results obtained based on one-to-one evaluation need to be improved according to the findings of the difficulty of solving problems obtained in the field. Input from mathematics teachers also contributed to the development of this prototype.

Recommendations

First, this research was conducted at a A package Program level 2 equivalency school which was carried out in a city. In the future, research can be developed at different levels of education or different educational paths. The research can be extended to try out more than one city in one province.

The instrument used leads to the RME approach in accordance with the treatment to be used so that the principles and characteristics are integrated in the statements and prototypes developed. Other researchers can implement approaches or other learning methods that are in accordance with the characteristics of the problems encountered.

Limitations

This study is applied to package A program in Bukittinggi City only, it does not represent student achievement in Indonesia generally. Since the teaching materials developed are intended for package A Program, level 2, it cannot be generalized to others schools in Indonesia. In addition, validation was carried out based on the development of HLT, teacher's books, and students' books according to needs based on preliminary research.

Authorship Contribution Statement

Fauzan: Conceptualization, critical revision of the manuscript, reviewing, final approval. Armiati: Reviewing, technical or material support, supervision. Bayu: Design, data analysis, statistical analysis, drafting manuscript

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