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Development of Learning Devices Based on RME Approach to Increase Problem Solving and Mathematical Disposition Ability Students at SMP N 1 Batang Kuis

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Abstract This study aims to analyze: 1) the validity, practicality, and effectiveness of the learning devices based on RME approach developed, 2) improvement of problem solving abilities using the developed learning devices, 3) students using the developed learning devices. This research is a research development (research and development), the product produced is the implementation of learning plans, student activity sheets, and student books. The development of learning devices based on RME approach was developed using Thiagarajan's 4-D development model with 4 steps: defining, designing, developing, and disseminating. From the results of trial I and trial II obtained: 1) the learning devices obtained meet the valid, practical and effective criteria. Practical criteria are reviewed from: a) Validator assessment and b) implementation of learning devices, while effective criteria, in terms of: a) classical learning outcomes, b) achievement of learning outcomes, c) learning, and d) positive student responses. 2) There is an increase in students 'problem solving abilities using developed learning devices, 3) there is an increase in students' ability to use developed learning devices.

Keywords: *development, learning devices, realistic mathematics education, problem solving ability, mathematical disposition*

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1. Introduction

Mathematics has a very important role in life because basically mathematics is needed by all scientific disciplines to increase the prediction and control of the science. Mathematics also plays an important role in the development of modern technology, various scientific disciplines and advancing human thought power. Cornelius suggests five reasons for studying math because math is (1) a means to think clearly and logically, (2) the means to solve the problems of everyday life, (3) the means to know the relationship patterns and generalizations experience, (4) the means to develop creativity, and (5) a means to increase awareness of cultural development. [1]

In study of mathematics, the ability to think and to solve the problem is one of the very important ability that must be owned by the students. The ability to solve problems will be a barometer for the student's success in learning mathematics. The main purpose of the students in learning mathematics are solving the problems. [2] Students can also develop positive attitudes through learning to solve the problem. These attitudes are unyielding, determined and confident in unusual situations. These attitudes positively affects the ability of students in solving the problems. [3]

Problem solving abilities very important to be owned by the students. Based on NCTM, solving the problem is an important component for the students to possibly gain experience using the knowledge and abilitys already owned to applied at solve the problem. [4] Solving the problem is something that is essential in the study of mathematics at the school, because students become abilityed at selecting relevant information, analyze it and then examine the results.

Given the importance of problem solving abilities for students, it is fitting for students to have good problem solving abilities. But based on the results of observations in the field the student's problem solving ability is still low. Of the 30 students who took the diagnostic test in terms of problem solving, only 5 students (16.67%) received a score in the medium category, while 22 students (73.33%) scored in the low category and 3 students (10.00 %) with a very low category. Overall students have not been able to

answer by meeting all the indicators of mathematical problem solving abilities. Based on observations, the main obstacle of most students in the process of solving that occurs is at the stage of planning problem solving. Students have not been able to analyze the problem properly, it is difficult to separate information into smaller and detailed sections, and it is difficult to combine parts of information into new forms or arrangements so that problem solving is not appropriate.

The low ability of students to think is caused by the teacher not being able to develop learning devices that are suitable for training students' high-level thinking skills [5]. In order for the learning objectives to achieve the expected goals, it is necessary to develop learning devices by choosing the right learning approach.

Besides the factors that influence students in learning mathematics are students' mathematical disposition abilities. Mathematical disposition is the connection and appreciation of mathematics, which is a tendency to think and act in a positive manner [4]. The importance of developing mathematical disposition in accordance with the statement [6] that in learning mathematics fostering affective domain components requires independence which will then form a strong tendency which is also called mathematical disposition (mathematical disposition) namely desire, awareness, dedication and strong inclination in students to think and do mathematically in a positive way and based on faith, piety, and noble character.

The interviews found that when given a problem most students complained, gave up quickly, and did not feel challenged to solve it. Some students have resolved but are not confident, not thorough, and not diligent in solving the problems given by the teacher. In addition, teachers also still use the conventional way of teaching, knowledge is only sourced from the teacher and there is only one-way communication that causes students to be passive in the learning process.

One approach that is considered appropriate is Realistic Mathematics Education. This approach is a learning approach that directs students to real problems, and makes students active, especially in building their thinking abilities. Gravemeijer in [7] states that there are three RME principles that can be used as a reference in developing learning devices, namely: 1) Guided reinvention / progressive mathematizing, 2) Didactical phenomenology, and 3) Self-developed models. Based on the description, learning devices with the application of realistic mathematics education are expected to be an alternative to creating good learning in improving students' mathematical problem solving abilities and mathematical dispositions.

2. Literature Review

2.1. Problem Solving Ability

Problem solving ability is a process for accepting the challenge of answering the finishing non routine math problem in the contextual form or story questions. Based on the purpose of learning mathematics, the ability to solve problems is one of the abilities that must be possessed by students in learning mathematics [8]. Solving problems is not only as a goal of learning mathematics but is also a major tool in learning mathematics. In solving problems students must have the opportunity to formulate frequently, students wrestle, and solve complex problems that require a large amount of effort and then must be encouraged to reflect on their thinking.

The task of solving problems is expected to reveal the mathematical competencies needed to solve them rather than remembering the problems that were previously solved. [9] The problem solving process starts after the problem solver produces enough information about the problem space to get an understanding of the problem [10].

By learning to solve mathematical problems, students will learn how to think, get used to being diligent and have curiosity, and have confidence in unfamiliar situations that they will live well outside of mathematics classes. According to [11] on solving the problem there are 4 steps that must be done, there are: “first, we have to understand the problem; we have to see clearly what is required. Second, we have to see how the various items are connected, how the unknown is linked to the data, in order to obtain the idea of the solution, to make a plan. Third, we carry out our plan. Fourth, we look back at the completed solution, we review and discuss it”.

In simple way [11] state that problem solving indicator are 4 steps, There are: i) understanding the problem, ii) devising a plan, iii) carrying out the plan, and iv) Looking back the problem solving. In this study, the four problem solving abilities indicators stated by Polya, will be used as a guide in measuring the students' mathematical problem solving abilities.

2.2. Mathematical Disposition

Mathematical disposition is the correlation and appreciation of mathematics is a tendency to think and act in a positive way [12]. The meaning of the sentence is a mathematical disposition is a correlation and appreciation of mathematics that leads to a tendency to think and act in more positive ways.

While Kesumawati stated that mathematical disposition is a desire, awareness, and a strong dedication to the students to learn and implement a variety of math activities [13]. The meaning of mathematical disposition is a strong desire, awareness, and dedication to students to learn and apply various mathematical activities.

Kilpatrick states that disposition is defined as a tendency to see mathematics as something that can be understood, something that is useful in understanding mathematics, believes that diligent and persistent efforts in learning mathematics will produce results, and act as effective students [14].

Based on some expert opinions above, it can be concluded that the students' mathematical disposition ability is a strong desire, awareness, and dedication to students to learn mathematics and carry out various mathematical activities. Indicators that show the mathematical disposition in this study are: 1) trust; 2) curiosity; 3) perseverance; 4) flexibility; 5) reflective, 6) application; and 7) appreciation.

2.3. Realistic Mathematics Education

The Realistic Mathematical Approach is an approach to learning mathematics that expresses experiences and

events that are close to students as a means of understanding mathematical problems. In RME, context problems are the basis for progressive mathematization, and through mathematizing, the students develop informal context-specific solution strategies from experientially realistic situations [15]. Thus, it is necessary for the researchers who adapt the instructional design perspective of RME to implement contextual problems that allow for a wide variety of solution procedures, preferably those which are considered together have indicated a possible learning route through a process of progressive mathematization. The realistic mathematics education approach is based on a different point of view of mathematics education.

The main difference with the mechanistic and structural approaches is that RME does not start from abstract principles or rules with the aim to learn to apply these in concrete situations. There are four stages of developing models in a realistic mathematical approach, namely: real situations, references, general, and formal [15]. And there are five characteristics in RME, namely: 1) phenomenological exploration, 2) bridging by vertical instruments, 3) students' contribution, 4) interactivity, and 5) intertwining. [15]

On the other hand, there are five basic characteristics in conducting RME-based learning, yaotu: 1) The use of real-life contexts, 2) The use of use models, 3) Student's free production; 4) Interaction, 5) Intertwining [16]. In this study the RME approach is a learning process that starts from real things for students and the environment and emphasizes the skills of 'process of doing mathematics'. The steps of the RME approach in this study are: 1) conveying contextual problems, 2) explaining contextual problems, 3) solving contextual problems 4) comparing and discussing answers, and 5) concluding.

2.3. Quality of Learning Devices

To obtain quality development results, an assessment of the devices developed is needed. To determine the quality of the results of the development of models and learning devices, it refers to the quality criteria of the results of development research proposed by Nieveen that a development of the learning component is said to be good if the model (1) is valid; (2) practical; and (3) effective [17]. However, in this study the quality of learning devices only focused on valid and effective criteria, because there were no appropriate instruments found in measuring the practicality of learning devices.

Validity refers to the extent that the design of the intervention is based on state-of-the art knowledge (content validity) and that the various components of the intervention are consistently linked to each other (construct validity) [18]. The indicator components of the validation aspects regarding validation criteria in general are: format, language, illustrations, content of the material and learning objectives [18].

Besides validity, a good quality assessment tool is the practicality of its use (usability). A second characteristic of high quality materials is that teachers (and other experts) consider the materials to be usable and that it is easy for teachers and students to use the materials in away that are widely compatible with the developers' intentions [17]. Practicality in this study was reviewed based on: 1) Experts and practitioners stated that the developed learning devices can be used easily, and 2) The implementation of learning devices is in the minimal good category.

The effectiveness criteria include the achievement of classical learning completeness, the achievement of learning objectives, the time spent in learning, and students' responses to learning [7]. On the other hand, the effective criteria for learning if it meets 4 indicators, namely the completeness of classical learning outcomes, activities, and student responses [19]. Based on the expert opinion, the effective criteria in this study focused on: 1) completeness of student learning classically, 2) achievement of learning objectives, 3) learning time; and 4) positive student responses.

3. Research Method

This type of research is Development Research. The development model used is a 4-D development model consisting of 4 stages of development, namely: define, design, develop, and disseminate [20].

3.1. Research Subject and Object

The subjects in this study were students of SMP Negeri 1 Batang Kuis, class VIII-2 and VIII-3 each with 30 students. As an object in this study is a mathematics learning tool SMP Negeri 1 Batang Kuis on social arithmetic material.

3.2. Development of Learning Devices

The learning devices developed in this study are in the form of Learning Implementation Plans (LIP), Student Books (BS), Student Activity Sheets (SAS) and research instruments in the form of Problem Solving Ability Tests (PSAT). The development of learning devices is carried out by applying a 4-D development model with four stages of development namely: define, design, develop, and disseminate. [20]

3.3. Instruments and Data Analysis Technique

The instruments used in this study include instruments for assessing the quality of instructional devices covering aspects of prevalence, practicality and effectiveness. Instruments used in the form of observation sheets, questionnaires, and tests. For more details can be seen in Table 1 below.

Learning devices are said to be valid if they meet the criteria of content validity and construct validity. Learning devices meet the expected content validity if the average validator's assessment of all learning devices is at the minimum valid criteria with an average value of ≥ 4 [5]. If it is not met, then validation activities need to be done again. And so on until we get a learning device that meets the content validity. Then the construct validity of the problem solving test is performed. Before being used for

field trials, items of problem solving tests were tested outside the research subject to measure validity and reliability. To measure the validity of items it can use the product moment correlation formula and to calculate the reliability coefficient of the test items used the *Alpha-Cronbach* formula [5].

Table 1. Research Instrument

Aspect	Instruments	The Observed Data	Respondent
Validity	Validation Sheet	Validity of LIP, SAS, SB, Problem Solving Test, Disposition of Mathematics Questionnaire.	Expert / Practitioners
Practicality	Validation Sheet	Practically of LIP, SAS, SB, Problem solving ability Test	Expert / Practitioners
	Observation Sheet	Learning Devices Implementation	Observer
Effectiveness	Test	Completeness of Learning Outcome & Achievement Learning Objectives	Research Subject
	Questionnaire	Students Response	Observer

The effectiveness of learning devices is reviewed based on: 1) Completion of student learning outcomes is classically fulfilled if ≥ 85% gets a test score ≥ 65, 2) Achievement of learning objectives are met if the score of each item reaches 75% of the maximum score, 3) Learning time is fulfilled if not exceeding normal learning time, and 4) student responses are met if classically ≥ 80% of subjects give a positive response [21].

After the learning device meets the valid, practical and effective criteria, then an increase in students' mathematical problem solving abilities is reviewed based on the N-gain test. Improved problem solving abilities are reviewed based on the results of pre-test and post-test students' mathematical problem solving abilities in each trial. Whereas the increase in mathematical disposition is reviewed by the N-Gain test based on the average between trials.

The process of testing the learning device is stopped when the learning device meets the criteria for good device quality. As well as learning devices are also able to improve the ability of problem solving and minimal mathematical disposition in the medium category.

4. Result

The following are the results of the study obtained based on the learning device trials in SMP Negeri 1 Batang Kuis with two trials. The test results described include: 1) validation of learning devices, 2) practicality of learning devices, 3) effectiveness of learning devices, and 4) improvement of students' mathematical problem solving abilities.

4.1. Description of the Validity of Learning Devices

Based on the validator's assessment consisting of 3 experts and 2 practitioners, the results obtained that the learning devices developed meet the criteria as listed in the following Table 2.

Table 2. Results of Validation of Content of Learning devices

No	Learning Devices	Average Value of Total Validity	Validation Level
1	Lesson plan	4,52	Valid
2	Student Activity Sheet	4,56	
3	Student Book	4,37	
4	Problem solving ability test	-	All Items Valid
5	Mathematical Disposition Questionnaire	-	All Items Valid

Based on Table 2 it is found that all learning devices meet valid criteria because they obtain an overall average value of ≥ 4. Then the results of the instrument trial indicate that all items of the problem solving ability test and the mathematical disposition questionnaire meet the valid criteria. The results of the reliability of the problem-solving ability test were 0.899 (very high category) and the mathematical disposition questionnaire was 0.949 (very high category). Therefore, learning devices based on Realistic Mathematics Education that are developed meet the content validity and construct validity criteria.

4.2. Description of Practicality and Effectiveness of Learning Devices

4.2.1. Description of Practicality and Effectiveness of Learning Devices on Trial I

The practicality criteria of learning devices based on validator assessment are fulfilled, because all validators consisting of experts and practitioners assess the learning devices developed can be used easily. The implementation of the learning devices has not been fulfilled, in terms of the average of all learning meetings, it receives a percentage of 79.00% (sufficient category). Fulfillment of performance score in the minimum percentage range of 80% <k <90% in (good category). Based on the description, the learning devices developed have not met the practical criteria.

Based on the results of the trial I obtained the classical student learning outcomes completeness as listed in the following Table 3.

Table 3. Results of students' problem solving abilities on Trial I

No	Score Interval	Sum of Students	Persentage	Category
1	0 ≤ SPAS < 50	0	0,00%	Very low
2	50 ≤ SPAS < 65	7	23,33%	low
3	65 ≤ SPAS < 80	4	13,33%	Medium
4	80 ≤ SPAS < 90	17	56,67%	High
5	90 ≤ SPAS ≤ 100	2	6,67%	Very High

Explanation:
SPAS: student's problem solving ability score.

From Table 3, it can be seen that the number of subjects who completed a score of ≥ 65 reached 23 students (76.67%) out of 30 students, so they did not meet the completed classical learning outcomes criteria of 85%.

Furthermore, the achievement of learning objectives in trial I can be seen in the following Table 4.

Table 4. Achievement of Learning Objectives in Trial I

Nu	Learning objectives	Problem solving ability	
		% Achievement	Explanation
1	Students are able to solve contextual problems related to sales, purchases, profits, and losses.	80,28%	Reached
2	Students are able to solve contextual problems related to discounts, single interest and taxes.	78,61%	Reached
3	Students are able to solve contextual problems related to Gross, Net, and Tara.	76,67%	Reached

From Table 4 it can be seen that all Basic Competencies have been able to achieve a percentage of achievement ≥ 75%. Thus the achievement of learning objectives in the first trial based on the results of the posttest students' mathematical problem solving abilities have not been achieved.

The results of achieving learning time in trial I were 6 x 45 minutes (3 x meetings). When compared with ordinary learning done so far, there is no difference between the achievement of RME-based learning time and the achievement of normal learning time. This is in accordance with the specified learning time criteria, thus the achievement of learning time for trial I has been fulfilled.

Based on the results of the trial also obtained an average percentage of the total positive response of students to the device and learning activities in the first trial of 82.89%. Therefore, student responses were also fulfilled because students who gave positive responses to the components and implementation of learning reached ≥ 80%.

While the results of students' mathematical disposition can be seen in the following Table 5.

Table 5. Description of Student Mathematical Disposition Score Achievement in Trial I

Nu	Student Score	Category	Sum of Student	Persentage
1	$X > 104{,}644$	Very High	5	16,67%
2	$96{,}367 > X \geq 104{,}644$	High	9	30,00%
3	$88{,}089 > X \geq 96{,}367$	Low	10	33,33%
4	$X < 88{,}089$	Very Low	6	20,00%
Jumlah		-	30	100%

Based on Table 5, it can be seen that the score of the most dominant mathematical disposition of students in trial I is very low and low categories with a total of 16 students (53.33%) out of 30 students. Thus it can be concluded that the Mathematical Disposition of students in the first trial has not yet reached the expected criteria.

Based on the above results, it is found that the learning device has fulfilled the aspects of the achievement of learning objectives, learning time and positive student responses that have been set, but has not met the criteria of completeness of learning outcomes in a classical and mathematical disposition set. Thus the learning devices developed have not met the effective criteria. Therefore, it must be revised to the learning device and retried to produce an effective learning device.

4.2.2. Description of Practicality and Effectiveness of Learning Devices in Trials II

The practicality criteria of learning devices based on validator assessment are fulfilled, because all validators consisting of experts and practitioners assess the learning devices developed can be used easily. The implementation of the learning devices is fulfilled, in terms of the average of all learning meetings obtaining a percentage of 85.44% (high category). Fulfillment of performance score in the minimum percentage range of 80% < k < 90% in (good category). Based on the description, the learning devices developed meet practical criteria.

Based on the results of the second trial, the classical student learning outcomes are complete as stated in the following Table 6.

Table 6. Results Problem Solving ability of Students on Trial II

No	Score Interval	Sum of Students	Persentage	Category
1	$0 \leq SPAS < 50$	0	0,00%	Very low
2	$50 \leq SPAS < 65$	2	6,67%	low
3	$65 \leq SPAS < 80$	3	10,00%	Medium
4	$80 \leq SPAS < 90$	22	73,33%	High
5	$90 \leq SPAS \leq 100$	3	10,00%	Very High

Explanation:
SPAS: student problem solving ability score

From Table 6 it can be seen that the total number of subjects who have completed nilai 65 has reached 28 students (93.33%) out of 30 students, so that they have met the criteria for completing classical learning outcomes set at least 85%.

Furthermore, the achievement of learning objectives in trial II can be seen in the following Table 7.

Table 7. Achievement of Learning Objectives on Trial II

Nu	Learning objectives	Problem solving ability	
		% Achievement	Explanation
1	Students are able to solve contextual problems related to sales, purchases, profits, and losses.	84,44%	Reached
2	Students are able to solve contextual problems related to discounts, single interest and taxes.	82,22%	Reached
3	Students are able to solve contextual problems related to Gross, Net, and Tara.	80,28%	Reached

From Table 7 it can be seen that all Basic Competencies have been able to achieve a percentage of achievement ≥ 75%. Thus the achievement of learning objectives in the second trial based on the results of the posttest students' mathematical problem solving abilities have not been achieved.

The results of achieving learning time in trial II were 6 x 45 minutes (3 x meetings). When compared with ordinary learning done so far, there is no difference between the achievement of RME-based learning time and the achievement of normal learning time. This is in accordance with the specified learning time criteria, thus the achievement of learning time for trial II has been fulfilled.

Based on the results of the trial also obtained an average percentage of the total positive response of students to the device and learning activities in trial II amounted to 86.67%. Therefore, student responses were also fulfilled because students who gave positive responses to the components and implementation of learning reached ≥ 80%.

While the results of students' mathematical disposition can be seen in the following Table 8.

Table 8. Description of Student Mathematical Disposition Score Achievement in Trial II

Nu	Student Score	Category	Sum of Student	Persentage
1	$X > 104{,}644$	Very High	6	20,00%
2	$96{,}367 > X \geq 104{,}644$	High	12	40,00%
3	$88{,}089 > X \geq 96{,}367$	Low	7	23,33%
4	$X < 88{,}089$	Very Low	5	16,67%
Jumlah		-	30	100%

Based on the Table 8, it can be seen that the most dominant score of students' mathematical disposition in trial IIout is the very high and high category with a total of 18 students (60.00%) out of 30 students. Thus it can be concluded that the Mathematical Disposition of students in the second trial has reached the expected criteria.

Based on the above results, it is found that the learning device has fulfilled the classical learning outcomes and the mathematical disposition specified. As well as the achievement of learning objectives, learning time and positive student responses set. Thus the learning devices developed have met the effective criteria.

4.3. Improvement of Students Mathematical Problem Solving Ability

Data obtained from the results of the students 'pretest and posttest problem solving abilities in trial Iout, were analyzed to find out the improvement of students' problem solving abilities. Based on the acquisition of data on the problem solving ability test, the summary of the N-Gain results for the first trial based on the predetermined improvement categories is listed in the following Table 9.

Table 9. Summary of N-Gain Results in PSAT Trial I

Range	Boost Category	Sum of Students	Persentage
N > 0,7	High	1	3,33%
0,3 ≥ N ≥ 0,7	Medium	18	60,00%
N < 0,3	Low	11	36,67%
Total		**30**	**100 %**

Based on the results of the N-gain calculation, it was found that the increase in students' classical problem solving abilities in trial I was worth 0.43 or in the category of "Medium". Thus the use of learning devices oriented models developed realistic mathematical approaches can improve students' problem solving abilities in trial I.

Based on the acquisition of data on the problem solving ability test, the summary of N-Gain results for trial II based on the improvement categories that have been set out are listed in the following Table 10.

Table 10. Rangkuman Hasil *N-Gain* Pada PSAT Uji Coba II

Rentang	Kategori Peningkatan	Jumlah siswa	Persentase
N > 0,7	High	2	6,67%
0,3 ≥ N ≥ 0,7	Medium	24	80,00%
N < 0,3	Low	4	13,33%
Total		30	100 %

Based on the results of the N-gain calculation, it was found that the increase in students' classic problem solving abilities in trial II was worth 0.52 or in the category of "Medium". So that the use of learning devices oriented towards realistic mathematical approaches that are developed can improve students' problem solving abilities in the second trial.

The results of increasing students' mathematical problem solving abilities in trial II were slightly better than trial I, although both improvements were in the moderate category. Because the improvement criteria have met the target to be achieved, thus the learning devices based on realistic mathematical approaches developed can improve students' problem solving abilities.

4.4. Improved Student Mathematical Disposition

Descriptions of increasing students' mathematical disposition using mathematics learning devices based on a realistic approach on trial I and trial II are shown in Table 11 below.

Table 11. Description of Student Mathematical Disposition Results

Explanation	Mathematical Disposition in Trial I	Mathematical Disposition in Trial II
Nilai Tertinggi	111	129
Nilai Terendah	81	88
Rata-rata	96,367	108,467

Based on Table 11, the results of an analysis of increasing students' mathematical disposition in trials I and II showed that the average mathematical disposition of students on the results of the posttest in trial I was 96,367, increasing to 108,467 in trials II. The results of the Gain calculation are based on the average results of the posttest of trials I and II, it was found that an increase in the N-Gain value of students' mathematical dispositions was 0.30 (moderate).

This shows the mathematical disposition of students using mathematical learning devices developed based on a realistic approach has increased from trial I to trial II to moderate categories. Thus, it was concluded that mathematics learning devices based on realistic approaches can improve students' mathematical disposition.

5. Discussion

The learning device developed in this study is a mathematics learning device based on a realistic approach. In general, the purpose of this study is to produce a product in the form of learning devices that can improve the problem solving abilities and mathematical disposition of junior high school students. The resulting learning

devices must also meet practical and effective criteria. In the research development of learning models need quality criteria, namely validity (practicality), practicality (practically), and effectiveness (effectiveness). [21]

Development of learning devices is very important to do, because there is no one set of learning that is able to solve all problems in learning activities [22]. The statement is supported that there is no single model or approach that allows to overcome various problems to get a good learning outcome.

To obtain a good learning outcome, must carry out activities planned through the development of learning devices, so that learning objectives will be more directed and more successful. The approach used in this study is a realistic approach. The results showed that the application of a realistic mathematical approach was effective in increasing students' high-level abilities, especially problem solving abilities. [23]

Correspondingly, in another study stated "one of the learning approaches that depart from contextual problems and are considered effective for improving mathematical ability is a realistic approach" [24]. A realistic approach offers more than just a way to support student understanding from abstract to concrete. The learning sequence using a realistic approach is understood as a "learning line" where context problems are used as a starting point for getting students' informal reasoning. The realistic approach emphasizes that learning aids and learning must be linked to students' lives and experiences. Learning mathematics is more effective if students work to process and transform information actively [25]. Therefore, a realistic approach is very appropriate to be used in the development of learning devices.

The results showed that the learning devices based on a realistic approach developed using the 4-D model met the practical and effective criteria in improving students' higher-order thinking skills, where the problem-solving ability was one of the higher-level thinking abilities for students. As the results of his research show that learning devices based on a realistic approach developed to improve students' critical mathematical thinking abilities meet valid, practical and effective criteria for use in mathematics learning [18]. Then the students' critical thinking skills increase using learning devices based on a realistic approach developed.

Furthermore, the results of other studies indicate that RME-based geometry teaching materials for students in Class 4 in Indonesian primary schools meet valid, practical, and effective criteria. ... A realistic approach can overcome several problems, especially in changing the classroom climate and providing guidance on how to develop and apply quality course material for teaching mathematics [26]. These results indicate that a realistic approach can be used as a solution in solving the problem of students' low mathematical abilities in learning, especially in this case is the ability of problem solving.

There is a difference in the improvement of students' critical thinking capability under realistic mathematics approach with normal learning …, the learning of mathematics with realistic mathematical approach can be implemented in an effort to improve critical thinking ability [27]. In line with this, the results of other studies indicate that students' mathematical critical thinking abilities using the realistic approach are in the high category, while the conventional approach is in the middle level category [28]. These results indicate that students' critical thinking skills are better when taught using a realistic approach.

Based on the acquisition of scores on trial I and second try, it can be concluded that the students' mathematical problem solving ability by using learning devices oriented towards a realistic mathematical approach has increased based on the N-Gain scores in the medium category. This result is supported by the results of a study that found that high-level students' ability to apply learning based on realistic mathematical approaches is better than the application of conventional learning [29]. Likewise, the results of the study which stated that: students' mathematical problem solving abilities using learning devices that were developed experienced an increase from trial I of 55.56% to trial II of 88.89%. [30]

One of the important affective aspects students have is a mathematical disposition. Mathematical disposition can encourage someone to perform better. Mathematical disposition in learning mathematics can help students reduce anxiety so that it has an impact on increasing mathematical ability. Through a realistic mathematical approach, students can develop mathematical dispositions in themselves, because when the concept of the material provided is related to daily life and in accordance with the cultural context that is close to students will make students more confident that they can solve problems correctly.

6. Conclusion

Based on the results of data analysis and discussion of research results, the conclusions obtained in this study are:

1) Learning devices based on realistic mathematical approaches that are developed meet valid, practical, and effective criteria in improving students' mathematical problem solving abilities and mathematical dispositions.
2) Learning devices based on realistic mathematical approaches that were developed were able to improve students' mathematical problem solving abilities in trial II worth 0.52 (medium category).
3) Learning devices based on realistic mathematical approaches that are developed are able to improve students' mathematical disposition between trials I and trials III worth 0.30 (medium category).

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