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The Development of Comparison in Mathematics Textbook and Problem-Based Learning to Improve Mathematical Problem-Solving Ability of Junior High School Students

Azrina Purba[1], Riskyka[2]
[1,2]*STKIP AL Maksum Langkat, Stabat, Indonesia*
azrinapur@gmail.com

Abstract

In essence, this research is a development research with the aim of producing quality mathematics textbooks. To achieve that, the development model used in this research is the 4-D development model proposed by Thiagarajan, Semmel and Semmel (1974) which consists of the Define stage, Design stage, Develop stage and Disseminate stage. As for the quality of mathematics textbooks, the criteria proposed by Nieveen (2007) consist of Relevance, Consistency, Practically and Effectively. The subjects in this study are 7th grade students of SMP Muhammadiyah 54 Kerasaan and the object of this research Comparison in Mathematics Textbook Textbook and Problem-Based Learning. The instruments used consisted of Textbook validation sheets, student activity observation sheets, teacher ability observation sheets to manage learning, student response questionnaires and students' mathematical problem-solving ability tests. The validation results show that the textbooks are categorized as good. The results of the research trials show that: (1) the level of classical learning completeness is 76.67%; (2) the level of student activity during the learning process is in the ideal time tolerance limit criteria; (3) The level of teacher ability in managing contextual learning is good, because the average has reached the minimum criteria; (4) Student responses to the components of the device and the learning process were positive in the first and second trials; (5) The students' mathematical problem-solving ability has increased with an average score of 1.56 at the pretest and 3.07 at the post-test with an average increase (N-Gain) included in the medium category with an average of 0.512. So it can be concluded that the problem-based learning-based mathematics textbook developed meets the valid, practical and effective criteria.

Keywords
mathematical problem solving; problem-based learning; textbooks; comparison materials

I. Introduction

Mathematics is an important subject to learn, because mathematics has a very important role in determining the success of students. As an educator, teachers should focus on the success and quality of their students. In this regard, teachers must also think hard about how to package mathematics subject matter so that it is interesting and easy to understand by students, so that their passion and motivation to learn mathematics increases. Because passion and strong motivation is one of the factors driving the success of learning.

According to the Regulation of the Minister of Education and Culture No. 58 of 2014 concerning the Junior High School Curriculum that the objectives of learning mathematics in junior high schools are, among others, students are expected to understand concepts, use

patterns in solving problems, use reasoning in problem-solving, communicate ideas, have an attitude of appreciating the usefulness of mathematics, have attitudes and behaviors that are in accordance with values. grades in mathematics, performing motor activities using mathematical knowledge, and using simple teaching aids and technology in mathematical activities. In line with that in the 2013 curriculum, the learning process contained in the 2013 curriculum development draft emphasizes more on the student-centered learning process. In addition, the learning process is also expected to refer to a scientific approach where students are no longer told but, find out for themselves through discovery. Therefore, students must be trained to solve problems.

In learning mathematics, students are faced with problems. Therefore, students must be equipped with the skills to solve these problems. In this regard, Cooney stated as quoted by Hudojo (2005:130) that teaching students to solve problems allows students to be analytical in making decisions. In other words, if a student is trained to solve problems, then the student will be able to make decisions because the student has skills on how to collect relevant information, analyze information and realize how necessary it is to re-examine the results obtained. Problem-solving itself is an exercise for students who deal with something that is not routine and then try to solve it. A problem-solving problem usually contains a situation that encourages someone to solve it but does not directly know how. If a child is faced with a math problem and the child immediately knows how to solve it correctly, the problem given cannot be classified in the category of problem-solving questions. Therefore, students are expected to be able to solve mathematical problems so that learning achievement will also be achieved. Based on this information, we can know that problem-solving is very important in mathematics. The importance of problem-solving skills for students, as well as other abilities, namely reasoning and proof, communication, connections, and mathematical representation, is evident from the determination of standards for these abilities. The standard of problem-solving ability is written in NCTM (2000:334) which formulates the standard of problem-solving. As follows:

"Instructional programs from prekindergarten through grade 12 should enable all students to- : (1)Build new mathematical knowledge through problem-solving; (2) Solve problems that arise in mathematics and in other contexts; (3) Apply and adapt a variety of appropriate strategies to solve problems; (4) Monitor and reflect on process of mathematical problem-solving"

The statement above shows that mathematics learning should be able to train students to build new knowledge through problem-solving, solving problems that arise from mathematics or in other contexts, applying and adapting various approaches and appropriate strategies to solve problems and monitoring and reflecting on the problem-solving process. math.

However, in reality it shows that student achievement in mathematics is still relatively low and has not met expectations. This is indicated by the low student learning outcomes as well as students' mathematical problem-solving abilities. This can be seen from the results of the national exam and research results showing that students' mastery of mathematics is still relatively low. The low ability of students and students' errors in solving mathematical problems can be seen from the results of previous studies. Research conducted by Nuroniah, et al (2013) obtained the results that the tendency of errors made by students was almost evenly distributed for each given question, and the most prominent error tendencies were incorrect data errors, incorrect procedures and skill hierarchies. The causes of errors occur because students do not have the skills to solve mathematical problems, and there is no visible numerical manipulation skill so that it can be concluded that the problems abilities of students are still low.

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Based on the results of the research above, it shows that students still make many mistakes in solving math problems. The mistakes made by students are caused because students have difficulty understanding questions, are not yet skilled in solving problems and students are rarely given questions in the form of story questions that lead to problem-solving abilities which result in students having difficulty solving problems solving ability problems. So we can conclude that students' ability to solve mathematical problems is still low.

Education is an effort that must be carried out in the intellectual life of the nation so that the quality of human resources will increase (Agrista, 2021). With regard to the above, a preliminary study was also conducted on three junior high schools in Pematang Bandar sub-district, Simalungun Regency. From the results of the observations of the three junior high schools conducted, the results showed that students were more likely to be passive in learning activities, learning was still dominated by the teacher, students only accepted what was conveyed by the teacher. So that students are not given the opportunity to build on the ideas and knowledge they have. This is very different from the objectives of the 2013 curriculum, namely, students are required to build their own knowledge through investigations, and students are also required to be able to find their own solutions to problems. To strengthen the reason that students' mathematical problem-solving abilities are still low, students are given tests to measure their problem-solving abilities in comparison material. This test aims to see the extent of students' understanding and problem-solving abilities in completing the comparison material test questions. The test questions are: “A trader buys 24 kg of mango for Rp. 42,000.00. The next day he bought 60 kg of mangoes of the same quality. Make a mathematical model of the problem above and determine the amount of money that must be paid by the merchant?” The results obtained indicate that there are still many students who have not been able to solve the problem correctly. When viewed from the steps in solving the questions, students still do not understand the basic concepts and enter the formula incorrectly so that the results obtained are still wrong.

Training and improving students' mathematical problem-solving skills can be done through learning activities at school. But in reality it is not easy to carry out a learning process that is oriented to improve the quality of students as well as students' mathematical problem-solving abilities. There are many obstacles faced by teachers, one of which is the teaching materials provided in schools have not been able to develop students' problem-solving abilities.

In this regard Amri (2013: 59) reveals why teaching materials need to be developed because learning materials occupy a very important position of the entire curriculum, which must be prepared in order to achieve the target. The teaching materials and textbooks that are developed should still pay attention to the achievement of core competencies and basic competencies in accordance with the applicable curriculum, suitability with the subject matter being taught, support the learning experience and in accordance with the indicators of problem-solving abilities in developing learning assessments.

Many students still have difficulty understanding teaching materials compiled and published by certain agencies in the form of textbooks, worksheets and so on. For this reason, it is necessary for the teacher to make efforts in compiling a textbook that is easily understood by students and is able to support the improvement of students' problem-solving abilities. Conditions in the field, students only use textbooks and worksheets published/circulated by certain institutions. This shows that teachers rarely make their own teaching materials such as textbooks. Existing textbooks have not been able to develop students' mathematical problem-solving abilities. As stated by Amri (2013: 97) if the quality

of the book does not meet the quality standards, especially in relation to concepts and application of concepts (misconceptions, even wrong concepts), the book becomes a source of fooling, not a source of students' intelligence. Such books are very dangerous for the world of education.

The above conditions are also in accordance with previous research conducted by Nu'man (2015) which found that the teaching materials that had been used so far were only in the form of designs as textbooks, which contained definitions, theorems, proofs, sample questions, and practice questions.

In addition to textbooks, the test instruments provided by the teacher are also not adequate. So far, the test instruments provided by the teacher have not directed students to solve problems. The tests given so far are only in the form of questions that refer to the ability to understand and knowledge. This is not as expected, namely students are able to solve problem-solving ability test questions. So it is necessary to make improvements by developing a test that is able to direct students to solve mathematical problems.

The learning process of problem-solving, of course, students are faced with mathematical problems. The learning process begins with submitting a problem. The problem is presented in the context of the problem. With the context given to students, it will invite students to think about building their own knowledge to solve the problem. With regard to students' mathematical problem-solving abilities in solving problems that are oriented to everyday life or real life, one of the lessons that can help students solve problems, be student centered and help students build their own knowledge is problem based learning problem). Problem based learning is a learning approach that makes problems as a starting point in starting learning and is designed as learning that requires students to acquire problem-solving skills, independence and good participation skills in order to gain new knowledge. According to (Rusman, 2011) problem-based learning (PBL) is a learning model that applies constructivism theory. PBL provides the widest opportunity for students to investigate the problems they face.

In relation to the learning process, in PBL the teacher plays a role in helping students carry out investigations regarding the problems presented, the teacher also encourages students to be able to collect a number of information that is appropriate to the problem, and conduct a number of experiments to get a clarity of the problems faced and find a solution to the problem. The problem-based learning approach can help students realize a problem that is around them, and can improve student learning activities in the classroom by not only listening, taking notes, and memorizing what the teacher explains, but students will also be actively involved in learning, both in terms of communicate their mathematical ideas as well as in presenting the learning outcomes they get.

Regarding this learning development is a pedagogical application that promotes a set of personality / character values (Pradana, 2020). Based on the results of research conducted by Purba (2018), the results show that student learning outcomes taught using problem-based learning have increased. In addition, when viewed from student learning activities in the application of problem-based learning, it is included in the good category. Likewise, research by Faizah, et al (2013:177) found that the teaching materials developed were effective and practical to use and could improve student learning outcomes. From the description and results of the study, it is clear that problem based learning is suitable learning and can be used as an alternative learning in the process of increasing students' mathematical problem-solving abilities.

The above conditions are the reasons why the author develops comparison material textbooks using contextual learning. A textbook that can develop students' mathematical problem-solving skills. Without textbooks, it will be difficult for teachers to improve learning effectiveness. Likewise with students, without textbooks students will have difficulty

adjusting to learning. Difficulties faced by students if the teacher teaches the material quickly and not clearly. Therefore, textbooks are considered as materials that can be used by both teachers and students in an effort to improve the quality of learning.

Based on the above background, in this study the problems raised are: (1) Is the comparison material developed textbook valid; (2) Is the comparison material textbook developed practical; (3) Is learning using the developed textbooks effective; and (4) How to improve students' mathematical problem-solving abilities.

II. Research Methods

This research is a development research (Developmental Research). According to Sugiono (2012:407) research and development is a research method used to produce certain products, and test the effectiveness of these products. The product developed in this research is a problem-based learning mathematics textbook in class VII SMP which is oriented towards students' mathematical problem-solving abilities. The development of this textbook is carried out following the stages of the development model using the 4-D model (Four D model) from Thiagarajan (1974: 5 - 9) which consists of stage I (three stages of thiagaradjan), namely: a) defining, b) design, c) development, and the second stage (stage of dissemination. However, in this study only up to the development stage. Researchers will develop a product in the form of quality textbooks, therefore this study pays attention to the product quality aspects proposed by Nieveen consisting of Relevance, Consistency, Practically and Effectively. This research was conducted at the Muhammadiyah 54 Kerarasaan Private Junior High School. The test subjects in this study were class VII students. The instruments used in this study were textbook validation sheets, teacher and student activity observation sheets, student response questionnaire sheets and students' mathematical problem-solving ability tests.

III. Discussion

A quality textbook might meet the criteria of being valid, practical and effective. To produce it, the researcher follows the development procedure and analyzes the research data. First, the development was carried out using a modified Thiagarajan 4-D model.

For the definition stage, starting from the initial-late analysis activity which had the aim of identifying basic problems on the topic of comparison by conducting an initial investigation of the learning process so far, students' mathematical abilities, materials and applicable curriculum. In learning comparison material, especially its application to problem-solving abilities, students are directed to understanding the problem. Make a mathematical model, given time to choose the right strategy and solve the problem in their own way. Contextual learning was given to make it easier for students to solve problems. Before being given treatment, an analysis of the seventh grade students of SMP Muhammadiyah 54 Kerasaan was conducted. If we related it to the learning theory put forward by Piaget, junior high school students are on average 12-14 years old. This meant that students at this age still need concrete objects in learning mathematics. Therefore, it was very suitable if learning begins with real-life problems experienced by students directly. The preparation started from the concrete to the abstract so that it can help students understand it. Increasing children with special needs is not consistent with services for inclusive education (Handayani, 2020).

At the stage of material analysis carried out before the preparation of textbooks and the implementation of learning. So that the material presented in the student book is structured and systematic. Meanwhile, task analysis was adjusted to material analysis. Task analysis for

comparison material was prepared referring to indicators of achievement and indicators of mathematical problem-solving abilities.

Furthermore, in the second stage, namely the design stage, it began with the preparation of tests. The test was structured based on indicators of achievement and indicators of problem-solving abilities contained in the grid for preparing problem-solving ability tests. Furthermore, the selection of formats, this stage aimed to choose a format that is in accordance with the factors that described in the basic competencies, namely the format for designing learning content that refers to the results of material analysis, task analysis and learning outcomes indicators.

After going through the definition and design stages, a textbook called Draft I was produced. Next, the development stage was carried out starting with validation by experts. Validation was carried out on books and instruments developed so as to produce books and instruments that are suitable for use. Validity was carried out to determine the validity of the mathematics textbook as a whole which consists of format, language, illustrations, and content based on the results of the validator's assessment. The validity results obtained as a whole are presented in table 1 below.

Tabel 1. Recapitulation of Textbook Validation Results

No	Assessment Aspect	TEXTBOOKS	Madrasah Curriculum Development Team
1	I	4,2	Good, usable with a little revision
2	II	4	Good, usable with a little revision
3	III	4,2	Good, usable with a little revision
4	IV	4,2	Good, usable with a little revision
5	V	4	Good, usable with a little revision
Average score		**4,12**	

Based on table 1 above, we saw that the final average score of the validator's assessment of the 1st draft textbook is 4.12, which was included in the good category. While the conclusion given is that it could be used with a little revision. As for the mathematical problem-solving ability test, the five validators stated that they were valid even though there were slight revisions to the language used. Based on the results of expert validation of textbooks and mathematical problem-solving ability test instruments, it could be concluded that the developed textbooks have met the valid criteria. Prior to field trials, limited trials were conducted on students to see if the textbooks could be applied in the field. It was found that the textbooks and test instruments could be used with a few revisions.

Furthermore, to determine the criteria for practicality and effectiveness of the textbook, a field trial was conducted. The practicality criteria were based on the validator's assessment which states that this device was practical to use and the results of field trials where all students used textbooks well through observing student activities. Based on the results of these studies, it could be said that the textbooks produced meet the practical criteria.

Next we would look at the effectiveness of problem-based learning using the developed textbooks. Effective criteria can be seen from 4 things, namely:

1. Students' mathematical problem-solving ability on the results of the field trial pretest, it was found that the number of students who completed was 8 out of 30 students 26,67%). The number of students who did not complete was 22 out of 30 students (73.33%). After doing contextual learning using textbooks, it was found that the number of students who completed was 23 out of 30 students (76.67%). The number of

students who did not complete was 7 out of 30 students (23.33%). So based on the criteria set out in the 2013 curriculum that classically a lesson was said to have been completed if there are 75% of students who took the test have achieved a minimum score. Based on the explanation above, the students' learning mastery in the pretest was 26.67% and the post-test was 76.67%, so that the students' learning mastery in the study increased. A summary of the students' mathematical problem-solving skills was presented in table 2 below.

Table 2. Completeness Level of Students Mathematical Problem-Solving Ability

Category	Pre-test		Post-test	
	The Number of Students	Percentage	The Number of Students	Percentage
Complete	8 students	26,67%	23 students	76,67%
Not Complete	22 students	73.33%	7 students	23,33%
total	30 students	100%	30 students	100%

2. The achievement of the ideal time for student activity, in this study the percentage of student activity levels obtained during the learning process was still within the tolerance limit of the ideal time. namely: (a) the time used for listening/paying attention to the teacher's/friend's explanation is 15.5% of the available time; (b) the time used for reading/understanding contextual problems in textbooks was 19.25% of the available time; (c) the time used for problem-solving/finding solutions and problem answers was 37.25% of the available time; (d) the time used for discussion/questioning activities between students or teachers is 25.2% of the available time; (e) the time used for behavior that was not relevant to the teaching and learning process is 1.5% of the available time and was still within the ideal time tolerance limit. From the results of observations about student activities, it could be seen that the activity of solving problems/finding solutions and answers was the highest activity, so this showed that textbooks with problem-based learning could activate students.
3. The ability of teachers to manage learning, based on observations, it was found that the ability of teachers to manage learning was still not good in the first trial of 2.89. The teacher's weaknesses were corrected in the trial and experienced an increase and improvement of 3.58. Thus the teacher's ability to manage learning had met the criteria for effectiveness
4. Based on the student response questionnaire, it was found that the student's response to the components and learning process. In the first trial, the student's response to the components and the learning process showed a positive response with an average of 77.06% and in the second test the positive response of the students had increased by 84.53%. This shows that textbooks compiled using problem-based learning received a good response. So that students feel happy and interested in participating in learning by using the developed textbooks.

Based on the results obtained that the four indicators of learning effectiveness have been met, the criteria for the effectiveness of problem based learning using the developed textbooks have been met.

Improving Students' Mathematical Problem-Solving Ability

Problem-solving ability is measured based on three processes of finding student answers, namely: (1) Creating mathematical models related to real-world problems; (2) Choosing the right problem-solving strategy to solve the mathematical model; (3) Explain the answer and check its correctness. The answers given by students in solving problems will be

given a score according to the scoring rubric for each indicator made. Based on the data from the pretest and posttest results, it can be said that there was an increase in students' problem-solving ability. The increase in students' problem-solving abilities can be seen from the average test score, starting from the average pretest score of 1.56 while the average post-test score of 3.07. This shows that textbooks using problem based learning developed can improve students' mathematical problem-solving abilities and the magnitude of the increase is 1.51

The data on students' problem-solving ability test results with an average increase (N-Gain) for all aspects are included in the medium category with an average of 0.512. This increase occurred because there was a match between the material developed and the learning carried out by the teacher. So that it makes students motivated and interested in learning the material which is seen based on student responses so that students' problem-solving abilities can increase.

IV. Conclusion

4.1 Conclusion

Based on the results of the analysis and discussion of research on comparison in mathematics textbook and problem-based learning to improve mathematical problem-solving ability of junior high school students, the following conclusions are put forward:

1. The developed textbooks have met the valid criteria based on the results of the assessments of experts and practitioners on all textbooks. The five validators have provided an assessment. The results of the assessments of experts and practitioners were analyzed by looking at the average value and the level of agreement on the assessment of the experts through interater statistical analysis. Based on the results obtained, it can be concluded that the textbooks are valid and feasible to use.
2. The textbooks developed have met the criteria for practicality, namely:
    a. The results of the assessment of experts and practitioners (teachers) which state that the textbooks developed are practical or can be used with minor revisions.
    b. Students can use this textbook in learning well based on the results of observations of student activities.
3. The learning carried out during two trials using textbooks has met the effective criteria, with the following criteria:
    a. Students' learning completeness in the first and second trials obtained the results that the number of students who completed was 23 out of 30 students (76.67%). This means showing that the classical mastery of students has been achieved.
    b. Student activities during the learning process have met the specified ideal time tolerance limit. Problem-solving and discussion activities are activities that are mostly done by students. This shows that problem-based learning is able to activate students.
    c. The teacher's ability to manage learning has met the criteria in the second trial, with a teacher ability score of 3.58 and meets the criteria well.
    d. Student responses to the components and the problem-based learning process are classified as positive responses. This positive response was given in the first and second trials.
4. There is an increase in students' mathematical problem-solving skills using textbooks that have been developed, this can be seen from the average score of students at the pretest of 1.56 to 3.07 at the time of post-test. The overall increase in aspects that occur is classified and included in the medium category with an average N-Gain of 0.512.

4.2 Suggestion

Based on the conclusions of the research above, the authors suggest that teachers can use this comparison material mathematics textbook to develop students' mathematical problem-solving abilities. In addition, teachers must motivate and guide students in the problem-solving process so that students are accustomed to using the right way and teachers should make problem based learning as an alternative learning model to improve students' mathematical problem-solving abilities and be able to improve student activities and student learning outcomes.

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