IJEDs
http://ijeds.ppj.unp.ac.id/index.php/IJEDS

International Journal of Educational Dynamics
Vol. 3 No. 2 (pp. 41-47) June 2021
p_ISSN 2655-4852
e_ISSN 2655-5093

DEVELOPMENT OF PROBLEM-BASED MATHEMATICS TEACHING MATERIALS FOR ELEMENTARY SCHOOL STUDENTS

*Nori Marsena, Ahmad Fauzan, Nurhizrah Gistituati

Master Program (S2) Basic Education, Universitas Negeri Padang, Indonesia
*E-mail: norimarsena@gmail.com

Received: 01 Feb. 2021, Revised: 10 Jun. 2021, Accepted: 30 Jun. 2021

ABSTRACT

This study aims to develop a product in the form of problem-based mathematics teaching materials for fourth-grade students at SDN 183 Pekanbaru by the 2013 curriculum and to produce teaching materials that are valid, practical, and effective for use in learning. This research is development research with the development model used is the Plomp model which consists of three stages, namely preliminary research, prototyping phase, and assessment phase. Based on the results of the assessment analysis by the three experts, namely: material experts, linguists, and graphic experts, it shows that problem-based GCF and LCM teaching materials meet the valid criteria with an average of 86%. While the results of the analysis of the practicality assessment sheet for educators with an average of 82% and students consisting of 16 people, it was found that problem-based GCF and LCM teaching materials met the practical criteria with an average score of 86%. The learning outcomes of 84% of students reached the KKM, so it can be concluded that the GCF and LCM mathematics teaching materials based on Problem Based Learning meet the valid, practical, and effective criteria that can be used in learning.

Keywords: Development, Teaching Materials, Mathematics, Problem Based

INTRODUCTION

Mathematics is the science of logic regarding shapes, arrangements, quantities, and concepts that relate to one another in large numbers, which are divided into three fields, namely algebra, analysis, and geometry (Suherman, 2003). Mathematics lessons need to be given to students starting from elementary school (SD) to college. The purpose of giving mathematics subjects is to equip students with the ability to think logically, analytically, systematically, critically, and creatively, as well as the ability to work together (Depdiknas, 2006).

The purpose of learning mathematics according to Permendiknas No. 22/2006 is so that students have the following abilities: 1) Understanding mathematical concepts, explaining the relationship between concepts, and applying concepts or algorithms, flexibly, accurately, efficiently, and precisely, in problem-solving, 2) Using reasoning on patterns and characteristics, 3) solve problems which include the ability to understand problems, design mathematical models, complete models and interpret the solutions obtained, 4) communicate ideas with symbols, tables, diagrams, or other media to clarify the situation or problem, and 5) have an attitude of appreciating usability mathematics in life, namely having curiosity, attention, and interest in learning mathematics, as well as a tenacious and confident attitude in problem-solving (Depdiknas, 2006). As the goal of learning mathematics, one of the materials in learning mathematics that can improve this ability is

geometry. Learning about geometry can help students represent their abilities and reach a certain view of the world. Mastery of geometric models and their properties can provide a perspective for students so that students can analyze and communicate things related to geometric shapes (Nur'aeni, 2000).

One of the materials in learning mathematics is the Greatest Common Factor (GCF) and Least Common Multiple (LCM). The GCF and LCM materials are quite easy to learn because they are the implementation of factoring. The essence of the LCM is to choose the smallest multiple of the two numbers in question, while to find the GCF is to choose the largest factor of the 2 numbers in question. Although the material is quite easy, there are still some students who have difficulty understanding the material. Students still have difficulty solving story questions about GCF and LCM, due to the lack of understanding of students towards the teacher's explanation. (Majid, 2006). This is also supported by the findings of Lutfi (2007), stating that many students experience difficulties and errors in solving GCF and LCM problems, thus causing low student learning outcomes in mathematics. Therefore, this learning problem needs to be immediately found a way out. The problem of students' difficulties in understanding the concepts of GCF and LCM in the mathematics learning process, one of the factors that influence it is teaching materials. Teaching materials are all forms of material or subject matter that are arranged systematically, which are used by educators and students in the learning process (Prastowo, 2014).

Learning outcomes are a measure used to determine the level of success of students in knowing and understanding a subject. Learning outcomes are manifested in changes in behavior from not knowing to know and from not understanding to understanding. Learning outcomes in the form of changes in behavior, learning is a mental activity that takes place in active interaction between a person and the environment and produces changes in knowledge, understanding, skills, and attitude values that are relatively constant and imprinted. The conclusion from the learning outcomes is that there is a change in learning achievement and behavior towards a better direction for students so that the results of the learning experience can be utilized in overcoming problems in everyday life. Learning outcomes include mastery of cognitive, affective, and psychomotor aspects. Measuring student learning outcomes, especially learning outcomes in the cognitive domain about mastery of learning materials by educational objectives, learning that is seen and the ability of students to answer tests, as well as mastery of the material provided (Sudjana, 2009). Learning outcomes can be seen by conducting evaluation activities. Evaluation is useful to find out to what extent the achievement of students towards a predetermined learning goal.

The instrument that can be used in the evaluation is a test. The results of this test will then be processed, analyzed, and assessed by educators. Learning outcomes achieved by students should have a positive effect on increasing student interest in learning. By knowing the results achieved in learning, students will be motivated to increase their activeness and involvement in learning.

METHODS

Development research is a systematic study to design, develop a product such as programs, models, teaching materials, teaching and learning strategies, materials, and so on as solutions in answering complex problems. In addition, development research is a series of processes or steps to develop a new product or improve an existing product so that it can be accounted for (Trianto, 2011).

The product that will be produced in this research is problem-based mathematics teaching materials. The main purpose of development research in education is not to formulate or test a theory, but to develop effective products that can be used in the learning process. The effectiveness of the product developed will be known by observing the learning activities of students during the application of the spatial module and learning outcomes after learning mathematics.

This development model follows the process in educational development research which is carried out systematically by conducting needs analysis, prototype development, evaluation, and prototype revision through cycles to produce the desired product. According to Plomp (2013) "authors may vary in the detail of how they picture design research, but they all agree that design research consists of several phases". Plomp states that authors may vary in how they describe development research, but all agree that development research has several phases. The research development phase includes a preliminary research phase, a prototyping phase, and an assessment phase.

RESULTS AND DISCUSSION

Researchers researched intending to produce problem-based mathematics teaching materials for fourth-grade elementary school students on GCF and LCM materials that were valid, practical, and effective. This study uses the Plomp research design model which consists of three stages, namely (1) Preliminary research (preliminary analysis), 2) Prototyping phase (design stage), and 3) Assessment stage (assessment stage).

The development of problem-based mathematics teaching materials was developed according to the 2013 Curriculum during the COVID pandemic. Curriculum analysis aims to determine whether the material being taught is by the expected competencies. Curriculum analysis is done by analyzing Basic Competencies (KD) and indicators that must be achieved by students. Researchers also conducted interviews to see the basic problems that became obstacles to learning mathematics.

The results of this curriculum analysis are used as considerations for making mathematics teaching materials so that through these teaching materials students can gain knowledge about GCF and LCM materials from solving problems that are close to life. The next analysis is the analysis of teaching materials. The teaching materials analyzed are textbooks because educators use teaching materials in the form of textbooks in the field. Textbooks are analyzed by looking at the contents and writing methods of the textbooks used. This evaluation aims to determine whether the textbooks used are in accordance with the applicable curriculum and the way of presentation. This analysis was carried out using the textbook evaluation sheet used in the field. The next analysis is Concept analysis. Concept analysis is developed to plan teaching sequences for the achievement of a concept. Concepts are arranged systematically by linking one concept to another relevant concept so as to form a concept. Concept analysis aims to arrange the order of the material to be discussed.

Then analyze the students. Student analysis is carried out to examine the character of students to be used as a basis for consideration in designing teaching materials. Fourth-grade elementary school students are generally 10-11 years old. At this age, students are able to understand logical operations using concrete objects and can solve logical problems. The results of the analysis of interviews conducted with fourth-grade elementary school students obtained information that students did not understand learning mathematics with existing textbooks. They prefer color and picture books. There are students who are

pensive and silent when they are confused about studying the material in the textbook when they are given an assignment. The following is a snippet of interviews with students.

Table 1. Results of Validation of Teaching Materials Aspects of Feasibility of Content

No	Content Feasibility Aspect	Average (%)	Category
1	Materials designed in accordance with Basic Competencies (KD) and indicators	100	Very Valid
2	Materials designed according to the concept	100	Very Valid
3	The material presented in teaching materials is in accordance with the development of students	95	Very Valid
4	The material in the teaching materials contains real problems that are in accordance with the concept	90	Very Valid
5	Teaching materials are arranged systematically designed	85	Very Valid
6	Teaching materials contain material explanations to support understanding concepts	90	Very Valid
7	Learning activities designed to make students learn actively	85	Very Valid
8	Teaching materials contain examples of questions that are in accordance with the material	100	Very Valid
9	The content of teaching materials can increase students' knowledge	90	Very Valid
10	The stages of problem-based learning that are designed to add insight and knowledge of students related to GCF and LCM materials	100	Very Valid
11	Teaching materials can be used by students to learn independently	75	Valid
12	Teaching materials begin with giving problems in the form of pictures or questions	100	Very Valid
13	Teaching materials organize students to learn	90	Very Valid
14	Teaching materials guide students to carry out the problem-solving process individually or in groups	75	Valid
Overall average		91	Very Valid

Based on table 4.3, it can be seen that the average validation results from the content aspect reached 91. This shows that problem-based mathematics teaching materials have been very valid in terms of content.

Table 2. Results of Language Aspect Validation

No	Content Feasibility Aspect	Average (%)	Category
1	Teaching materials use good and correct Indonesian rules	80	Valid
2	The language used is good and polite	100	Very Valid
3	Teaching materials use familiar greetings in the form of pronouns to create two-way communication between teaching materials and students	100	Very Valid
4	Sentences are written using standard spelling	80	Valid
5	Sentence text is clear and easy to read	90	Very Valid
6	Correct use of capital letters	85	Very Valid
7	Correct use of punctuation	80	Valid
8	Correct use of affixes	90	Very Valid
9	The use of unambiguous language (double meaning) so it is not confusing	80	Valid
10	Consistency in the use of good and correct terms	90	Very Valid
11	The use of language can support the achievement of knowledge that must be achieved by students	80	Valid
12	Sentences of information instructions for carrying out tasks are easy to understand	100	Very Valid
13	Learning teaching materials can be used by students for independent learning	80	Valid
Overall average		87	Very Valid

Based on Table 2. it can be seen that the level of achievement of each indicator in the language aspect ranges from 80 to 100 with a very valid category. Problem-based mathematics teaching materials already use language that is by the rules of Indonesian

which is good, clear, easy to understand, interactive, and communicative. In general, the validity of mathematics teaching materials from the language aspect is 87, with a very valid category. So, it can be concluded that from the language aspect, the problem-based mathematics teaching materials that have been designed are very valid. The last aspect to be validated is the graphic aspect.

The average validation result from the graphic aspect is 80. This shows that problem-based mathematics teaching materials are valid from the graphic aspect. The types of fonts, images and illustrations used are appropriate, and the appearance of the teaching materials is also attractive. While the average validation of the problem-based mathematics teaching material module as a whole is 86 with a very valid category. So, it can be concluded that problem-based mathematics teaching materials are very valid and can be used. Problem-based mathematics teaching materials that have been revised according to expert advice and are named prototype 2. The researcher asked the expert's willingness to estimate whether the problem-based mathematics teaching materials developed could be used for learning mathematics in elementary school. The researcher used an expert prediction questionnaire instrument about the practicality of teaching materials. The results of expert predictions about practicality can be seen in Table 3 below.

Table 3. Expert Predictions about the Practicality of Problem-Based Mathematics Teaching Materials

No.	Practical Aspect	Average (%)	Category
1	This teaching material has a form that is suitable for elementary school (SD) students.	83	Very
2	The material in the teaching materials is presented on a problem-based basis	97	Practical
3	The use of images contained in teaching materials will motivate students in learning	89	Very
4	These teaching materials can help students learn independently.	81	Practical
5	The language used in the teaching materials is easy for students to understand	86	Very
6	Students will be interested in learning because teaching materials are presented as attractive as possible	81	Practical
7	Presentation of material with teaching materials using these teaching materials is more practical	78	Very Practical
Overall average		85	Very Practical

Table 3 shows that based on expert considerations, problem-based teaching materials can be estimated to be practically used in learning mathematics in fourth-grade elementary school. One To One Evaluation practicality test or individual evaluation. Evaluation is done by asking students to provide their responses to the teaching materials that have been designed. Teaching materials are given to 3 students with different abilities. Students are asked to fill out a student response questionnaire. Student response questionnaires were given to find out students' opinions about the level of practicality of teaching materials.

The last stage in this research is the assessment stage. This assessment stage is carried out to evaluate the effectiveness of the problem-based mathematics teaching materials that have been designed. This effectiveness evaluation is focused on evaluating whether problem-based mathematics teaching materials can be used to achieve effective goals in increasing student activity and learning outcomes. This stage is the final result of a series of problem-based mathematics teaching materials development. This stage was carried out four times at SDN 183 Pekanbaru with a total of 16 students. The effectiveness of problem-based mathematics teaching materials that have been designed can be seen from expert effectiveness questionnaires, student activities, and assessment of student learning outcomes in aspects of knowledge. The effectiveness prediction questionnaire according to

experts was given to several experts to estimate and consider how far the usefulness and benefits of this problem-based mathematics teaching material in improving learning activities and student learning outcomes in learning mathematics in grade IV elementary school.The activities of students during learning using problem-based mathematics teaching materials were observed by observers. The types of student activities observed consisted of 1) EA (Emotional Activities), namely students looked happy and interested in learning with teaching materials, 2) VA (Visual Activities), namely students saw and read teaching materials, and 3) WA (Writing Activities), where students write answers on teaching materials.

The results of the analysis of student activities as a whole during the learning process showed that the activities of students were in the very high category with an average score of 91 to 100. Of the 16 students who had participated in the learning, it was seen that students carried out activities that were quite varied. Based on the activities of 16 students who have participated in learning using mathematics teaching materials, it can be seen that the most prominent student activities at each meeting are viewing and reading teaching materials, writing answers on teaching materials, and feeling happy learning with teaching materials. The learning outcomes of students assessed are from the aspect of knowledge related to students' understanding of the material being studied. Student learning outcomes to determine the effectiveness of problem-based mathematics teaching materials using formative tests in the form of essays. Essay questions are given to students at the end of the learning process. The question was given to 16 fourth-grade students at SDN 183 Pekanbaru. Student learning outcomes were analyzed using the learning completeness criteria (KKM) which was 70. If there were 70% of the students' scores did not reach the KKM, it was said to be ineffective. If more than 70% of students' scores exceed the KKM score, it can be said that they have achieved effectiveness in the knowledge aspect. Of the 16 students who took part in the evaluation, 14 students scored 70 and were declared complete, while only 2 students were declared incomplete with a score of 70. The evaluation results obtained a class average score of 88 with the complete category. While the analysis of student final test results in more detail can be seen in Table 4 below.

Table 4. Learning Test Results

No	Student Names	Values	Category
1	ALK	50	Not finished
2	HBB	80	Complete
3	ARF	75	Complete
4	MLK	80	Complete
5	MLF	80	Complete
6	RNO	30	Not finished
7	ARL	85	Complete
8	IRG	100	Complete
9	GRI	85	Complete
10	MTR	90	Complete
11	IMM	100	Complete
12	CHS	100	Complete
13	AIR	100	Complete
14	NRG	100	Complete
15	TRA	90	Complete
16	WLS	95	Complete

Based on this final test, it is known that more than 70% of the students' scores are above the KKM. Therefore, it can be concluded that student learning outcomes after using problem-based mathematics teaching materials have been effective in improving student learning outcomes.

CONCLUSION

This research is development research that produces problem-based mathematics teaching materials. Based on the results of the development and testing of problem-based mathematics teaching materials, the conclusions are: 1) The validity of problem-based mathematics teaching materials is obtained from the results of self-evaluation and validation results by experts. The results obtained illustrate that the problem-based mathematics teaching materials developed are valid and can be used in learning mathematics; 2) The practicality of problem-based mathematics teaching materials is known from the results of the questionnaire responses of educators and student responses so that an illustration is obtained that problem-based mathematics teaching materials are practically used and can help improve student activities and student learning outcomes; and 3) The effectiveness of the use of problem-based mathematics teaching materials is known through observation of learning activities and student learning outcomes. The learning activities of students while studying using problem-based mathematics teaching materials are high and student learning outcomes also show good results. The results of these observations illustrate that problem-based mathematics teaching materials have been effectively implemented.

REFERENCES

Depdiknas. 2006. Standar Kurikulum Tingkat Satuan Pendidikan Mata Pelajaran Matematika. Jakarta: Depdiknas.

Lufri. 2007. Kiat Memahami Metodologi dan Melakukan Penelitian. Padang: UNP Press.

Majid. 2006. Perencanaan Pembelajaran. Bandung: PT Remaja Rosdakarya.

Nur'aeni (2000). "Model Pembelajaran untuk Memahami Konsep Unsur-unsur Bangun Ruang Kubus dan Balok Berdasarkan Kesalahan Siswa Kelas V Sekolah Dasar". Tesis tidak diterbitkan. Malang: Program pascasajana IKIP Malang.

Plomp, T dan Nieveen, N. 2013. Educational Design Research: An Introduction, (Online), (www.international.slo.nl, diakses 15 Januari 2015).

Prastowo, Andi. 2013. Pengembangan Bahan Ajar Tematik Panduan Lengkap Aplikatif. Jakarta: Kencana Prenadamedia Group

Sudjana, Nana. 1992. Penilaian Hasil Proses Belajar Mengajar. Bandung: PT Remaja Rosdakarya.

Suherman, dkk. 2001. Strategi Pembelajaran Matematika Kontemporer. Bandung: UPI Press.

Trianto. 2010. Mendesain Model Pembelajaran Inovatif. Progresif Konsep, Landasan, dan Implementasi pada Kurikulum Tingkat Satuan Pendidikan (KTSP). Jakarta: Kencana Prenada Media Group.