

# Development of Problem-Based Learning Devices to Improve Elementary School Students Ability on problem solving in Fraction Topics

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**Abstract-** The low level of problem solving abilities of students and the lack of learning activities that hone problem solving skills are one of education problems that must be overcome. This study aims to develop and examine the feasibility, practicality, and effectiveness of problem-based learning devices to improve problem solving skills of fifth grade students of elementary school. This study used the Thiagarajan research and development (R & D) model known as 4D (define, design, develop, & disseminate). The feasibility of learning devices based on the results of expert validation. The practicality of learning devices based on the results of observations of the implementation of learning and student activities. While the effectiveness of learning device based on the results of the student questionnaire response and the problem solving ability test used One Group Pretest-Posttest Design. The results of the study showed that problem-based learning devices are feasible, practical, and effective to improve students' problem solving abilities. So that the problem-based learning device is recommended to be used as a learning tool for improving problem solving skills of fifth grade students of elementary school.

**Index Terms-** Problem based-learning, problem solving ability, Fraction, Elementary school

## I. INTRODUCTION

On 2013 Curriculum, the general meaning of mathematics learning has an aim to the students competencies on mathematics skills, especially in fraction material, one of them is the ability to solve problems in daily life problems. In addition, one of the objectives of mathematics learning is students are able to solve the problem, that is the ability for understanding some problems, designing mathematics learning models, completing the models and drawing solutions [1]. This aim of this study is to replace problem solving material as a part of the crucial mathematic curriculum. In the process of learning and problem solving, students get an experience from his/her knowledge and skills which are they already have. Mathematics was developed as one of its objectives to the needs of humankind in problems solving for their lives [2].

Based on the description above, it can be said that one of the abilities that students must develop and possess is problem solving ability. By solving a problem, students will get new experiences in implementing the basic knowledge and skills they already have [3]. In the 2013 curriculum, problem solving learning skills at school became an important thing for students because problem solving were often used by students in daily life. Therefore, students must be equipped with problem solving by solving their own problems in their daily lives.

Based on the observations on several teachers when teaching mathematics showed that explanation is the most method that is used by the teachers when they are teaching in the class, teachers speak more than students, almost all teachers give unchallenging task and almost teachers only used textbooks. In addition, for knowing the facts about this case, researchers also conducted interviews with teacher at Sukomanunggal Elementary School I / 105 Surabaya, whose results showed that teachers preferred to use conventional learning models in teaching mathematics. They gave some assignment based on the textbook and is similar to the assignment quite similar with the tasks given by the teacher when explaining the material.

Based on the facts above, it can also be said that in the school, teachers have not taught optimally about the way of solving problem so the students are still having difficulty in giving some tasks on solving problems. Students are still not able to solve non-routine questions which is given by the teacher. This is also indicated by the score of the most students on the topic of fraction is still very low. Students' ability to solve mathematics problems is in low level. The cause of the low ability of the students because the students are not familiar with problem solving material, teachers have not often drilled their students by using problem solving questions (*LKPD*) and dominant evaluation exercise in the form of daily question. In addition, the teacher still used a conventional learning model. The teacher preferred

using explanation model and has not used a learning model that can improve problem solving skills. Teachers also focused on achieving students' numeric skills by using mathematics formulas.

Based on these problems, the teacher must be able to choose the appropriate learning model. The choice of learning model must be accordance with the material and students' conditions, so that it is expected that learning can improve student activity in solving mathematical problems skills and also create a competitive atmosphere. In this learning process, it is expected that there will be interaction between students and other students in the form of group discussions, so that students can be active.

One learning model that can be offered to improve problem solving skills is a problem-based learning model. Problem-based learning model is an innovative learning model that requires students to learn and work actively, either in pairs or in groups to develop high thinking order by finding the problems, building an understanding, and finding alternative solutions to gain a knowledge and skills. Based on the analysis of several journals, one of them states that the learning model of problem-based learning can improve students' problem solving abilities [4]. The type of research is conducted as classroom action research in two cycles. The implementation of the PBL model can improve students' problem solving skills where in cycle 1, which is 69%, in the second cycle, is 73%.

The problem-based learning model has three main characteristics [5]. First, problem-based learning is a series of learning activities, it means that there are a number of activities must be done by students. Problem-based learning does not only listen something, but memorizing subject matter, and students actively think, communicate, search and process the data, and finally conclude. Second, learning activities are directed at solving the problems, knowing the problems as the keywords of the learning process. Third, problem solving is done by using a natural thinking approach.

This model also has the characteristic of using real life problems, students must learn to train and improve problem solving skills and gain knowledge of important concepts. The application of problem-based learning model is one of the efforts and students can solve every problem related to mathematics. Every student has different abilities in solving each problem. The steps of problem-based learning are orientation to students about a problem, organizing students to study, providing personal guidance and guidance to small groups when conducting investigations, developing and presenting works that have been made, and making analysis and evaluation of how to solve problem [6].

Learning strategies based models have several advantages, such as problem solving is a good technique to better understanding of the lesson. It can improve student learning activities, problem solving is more fun and students will like this method [5]. Problem solving can give some opportunities for students to apply the knowledge which they have in the real life. Other advantages are: (1) students can find their own concepts through a series of learning activities, so that students are able to understand the concept; (2) students are active in learning that is conducting an investigation, while the teacher is as a guide; (3) learning is more meaningful because problems solved are related to students' real life so students are motivated to learn; and (4) students are controlled in group learning process which interact with each other so they can complete the learning achievement.

This study aims to (1) describe the process of developing problem-based learning devices on fraction topics; (2) describe the quality (validity, practicality, and effectiveness) of problem-based learning devices on fraction topics; and (3) describe the students' problem solving abilities with problem-based learning on fractional topics.

## II. IDENTIFY, RESEARCH AND COLLECT IDEA

This research is developmental research. The study produced learning devices with problem-based learning models to improve the problem solving abilities of elementary students in the form of lesson plan (RPP), Student Worksheets (LKPD) and Problem Solving Ability Tests. The development model used 4D model which is developed by Thiagarajan [7]. It consists of define, design, develop, and disseminate stages. The subject of this study was the fifth grade students of SDN Sukomanunggal I / 105 Surabaya in academic year 2018/2019 with 20 students. The experimental research was conducted on several students using *One Group Pretest-Posttest* Design [8]

Data collection techniques used in this study were questionnaires, observations, and tests of problem solving abilities. While the feasibility analysis technique for problem-based learning is done by converting the average observation results into validation criteria. Analysis of the practicality of learning devices is obtained from the results of the average implementation of learning, activities, and student responses, henceforth converted into predetermined criteria. While the effectiveness of problem-based learning devices can be measured based on the results of student problem solving ability tests

## III. RESULTS AND DISCUSSION

The results of validity test of problem-based learning devices were obtained from the validation sheet from two validators. Based on the results of the validation sheet, it showed that the problem-based learning device which is developed is valid (feasible to be applied with

little improvement). Some suggestions given by the validator are on the learning objectives in lesson plans, it should be more detailed, writing on teaching materials should use contrasting colors, and tests of problem solving skills should be tested first to find out whether the problem is a problem solving problem. The results of the validation sheet can be seen in the following table.

Table 1. The Result of Validator

Devices	Score		Average	Category
	V1	V2		
Syllabus	3,82	3,00	3,41	Valid (usable, minor revision)
Lesson plan	3,79	3,14	3,46	Valid (usable, minor revision)
Material	3,47	3,00	3,23	Valid (usable, minor revision)
Students worksheet	3,67	3	3,33	Valid (usable, minor revision)
Test	3,75	3	3,37	Valid (usable, minor revision)

The practicality of problem-based learning devices can be seen from the results of the observation sheet of the students' implementation learning and activities. The results of the learning implementation obtained from the observation sheet which is conducted by two teachers and showed good implementation. While the students' activities during the implementation of learning by using a problem-based learning model based on observations obtained in good interpretation results. In more detail the results of the observation sheet of the implementation learning and student activities can be explained in the following table.

Table 2. Practicality of Learning Devices

Validity	Observation result		Average	Category
	Observer 1	Observer 2		
Teaching learning	3,60	3,66	3,63	Very good
Students' activities	3,35	3,40	3,37	Good

The effectiveness of problem-based learning devices to improve students' problem-solving abilities was obtained from the results of questionnaires and the results of problem-solving ability tests. Student responses are presented in the form of questionnaires and given after learning is completed. The results of the student questionnaire showed that 76% -100% of children were happy and interested in participating in learning with the development of problem-based learning devices. The problem solving ability test is in the form of a description problem as many as six questions. This test is given to 20 students before being given treatment (pre-test) and after being given treatment (post-test). The test results of students' problem solving skills will be described in the following table 3.

Table 3. The result of Problem Solving Ability/ skills

No.	Name	Score		Achievement		N-Gain	Criteria
		Pre-test	Post-test	Pre-test	Post-test		
1	ABD	67	97	TT	T	0.91	High
2	ADN	73	100	T	T	1	High
3	ANN	43	77	TT	T	0.60	Medium
4	APR	40	77	TT	T	0.62	Medium
5	CHT	67	93	TT	T	0.79	High
6	DEN	23	57	TT	TT	0.44	Medium
7	FRH	67	93	TT	T	0.79	High
8	FRS	53	83	TT	T	0.64	Medium
9	FAR	43	70	TT	T	0.47	Medium
10	FIK	50	73	TT	T	0.46	Medium
11	FIY	53	80	TT	T	0.57	Medium
12	HAW	73	90	T	T	0.63	Medium
13	MAG	40	70	TT	T	0.50	Medium
14	MWA	47	67	TT	TT	0.38	Medium
15	NOO	63	83	TT	T	0.54	Medium
16	NOV	60	93	TT	T	0.82	High
17	QUR	43	77	TT	T	0.60	Medium
18	SAI	47	70	TT	T	0.43	Medium
19	SIN	57	70	TT	T	0.30	Medium
20	YAS	40	80	TT	T	0.67	Medium
	Average	52	80	TT	T	0.58	Medium

Based on table 3, it is known that at the pretest, the problem solving abilities were 5% of students completed. Whereas in the posttest the problem solving skills is from 100% of students completed. The table also showed the N-Gain score which showed an increasing of students' problem solving abilities that ranged from 0.30 to 1 with a moderate to minimum category.

The implementation of problem-based learning devices in learning proved an effectiveness of improving problem solving skills of elementary school students on fractions topic. This is in accordance with research by Rokhmawati, et al. [4] which states that the learning model of problem-based learning can improve students' problem solving abilities. Based on the validation results, the development of problem-based learning devices is included in the valid category. The validity of the learning device developed based on the results of validation expert in the syllabus, lesson plan, student worksheet, teaching materials and problem-solving ability tests. The Valid devices can be seen from the suitability of the device with the learning model and material, and all components of the learning device are related consistently between one another [9]. After the validation stage, the problem-based learning device can be continued at the small group on experiment stage. Based on the results of the feasibility analysis, a feasible problem-based learning device is used to improve the problem solving skills of students in grade V of elementary school with fraction material.

The practicality of problem-based learning devices is known from the results of observations implementation learning and student activities. Based on the results of observations, it was found that a problem-based learning device was developed practically and it was used to improve problem-solving skills of students in grade V of elementary school with fractions. While the effectiveness of the problem-based learning device based on the results of the student response questionnaire and the results of the student's problem solving ability test. Questionnaire for student responses is given at the end of the lesson, that was in the second meeting The results of student responses are positive because the average student answers was "yes" statement around 76% -100%. They were interested in problem-based learning because the students solve problems in groups and then discussed to be agreed. This can motivate students to increase attention and make them visible in fun and meaningful learning [10]. While the results of the problem solving ability test showed an increasing in the pretest and posttest score. Increasing students' problem solving skills can be known by using N-Gain. The results of the student's problem-solving ability test presented in table 3 showed students have problem-solving abilities with an average n-gain of 0.58 which is included in the medium category. At the pretest of 20 students there were only 2 students or about 5% of students completed. While at the posttest there was an increase in test results, that is 90% of students completed the test. The test uses problem solving questions consisting of six questions. Increasing the results of this problem solving ability test shows that the learning tools developed by researchers can improve students' problem solving skills on the topic of fractions.

#### IV. CONCLUSION AND SUGGESTION

Based on the results of research and discussion, the results of the study can be concluded such as: (1) Problem-based learning devices to improve the ability of problem solving is valid based on the score of the validator and can be used in the learning process. (2) The practicality of the problem-based learning device is seen from the implementation of the lesson plan that takes place well and the activities of the students are in a good category which means that students carry out all activities needed in learning process. (3) The effectiveness of learning devices can be seen from the increasing problem-solving abilities which is indicated by n-gain scores in the medium category and the most students response expressed interest in problem-based learning.

Based on these conclusions, it can be suggested that problem-based learning devices can be used and disseminated in the learning of fraction subject in the fifth grade of elementary school, especially in examining and improving students' problem solving abilities.

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