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DEVELOPMENT OF FRACTION BOARD TEACHING AIDS TO IMPROVE MATHEMATICAL PROBLEM SOLVING SKILL OF JUNIOR HIGH SCHOOL STUDENTS IN LHOKSEUMAWE

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ABSTRACT

The purpose of this study is to (1) find out how the feasibility of the digital teaching aids for mathematical derivative boards developed to improve mathematical problem solving abilities of junior high school students in Lhoksmawe; and (2) to find out whether there is an increase in students' problem-solving abilities in the material of fractional arithmetic operations for class VII junior high school Lhokseumawe city. In this study, want to develop a product in the form of board props, then use the type of research and development or better known as the type of R&D research (Research and development). The population in this study were all junior high school students in Lhokseumawe, while the samples were taken randomly, namely SMPN 5 Lhokseumawe and SMPN 10 Lhokseumawe. This research begins with a trial of the fraction board teaching aid with the ADDIE development model (Analysis, design, development, implementation, and evaluation) then test the students' mathematical problem-solving abilities that have been tested for (1) validity (2) reliability (3) distinguishing power and (4) the level of difficulty of the questions. Then, giving questions about students' mathematical problem-solving abilities at the end of the lesson using fraction board props and continued with data collection. The instrument used in this research is a mathematical problem-solving ability test in the form of a description. Data processing using t-test to see an increase in students' mathematical problem solving skill using a fraction board in class VII junior high school Lhokseumawe.

Keywords: Development of training tools, problem solving skills

1. INTRODUCTION

Along with the times, science and technology have also developed. The development of science and technology from day to day is becoming more sophisticated, directly or indirectly, has a considerable influence on aspects of education (Adhikar, 2016). Current technological developments can be used wisely to improve human resources. Excellent human resources will lead a nation to be advanced and able to compete in the global arena. Increasing human resources can be done through education. For humans, education functions as a means and facilities that facilitate, are able to direct, develop and guide towards a better life, not only for themselves but also for other humans. According (Adhikar, 2016) education is one of the main instruments in the development of human resources with multiple cognitive, affective, and psychomotor abilities. Therefore, the implementation of education requires careful planning and implementation so that the expected progress of a nation is achieved optimally.

The progress of a nation is determined by the level of knowledge developed in the lives of citizens. The knowledge possessed by humans is one of them in the form of scientific knowledge or commonly referred to as science. Mathematics is one of the sciences that must be studied because it can be applied and can help people every day (Nurhairunnisah, 2017). Mathematics has a significant role in life. The development of information and communication technology today is inseparable from the existence of mathematics. Mathematics is a foundation and framework for the development of science and science technology for students and is one of the subjects in school that can be used for achieve that goal (Muliana & Nuraina, 2020). Mathematics has become a very important science in human life because of learning mathematics must be able to demand and build students' skills that can answer future problems (Safrina, Muliana, & Aklimawati, 2021).

The low mathematical ability of students is caused by the low quality of the learning process. This can be seen from the results of the 2015 TIMSS (*Trend in Mathematics and Science Study*), which shows that the achievement of Indonesian students in mathematics is ranked 46 out of 51 countries with a score of 397. Various abilities- Mathematical abilities are expected to be achieved in learning mathematics from elementary school to higher education. *The National Council of Teachers of Mathematics* (NCTM) in 2000 in a book entitled ' *Principles and Standards for School Mathematics* ' stated that the five mathematical abilities that students should have are (1) mathematical communication; (2) mathematical reasoning; (3) mathematical problem solving; (4) mathematical connection; (5) mathematical representation.

Problem solving ability is one of the abilities contained in the five NCTM standards that students and prospective teacher students should possess. A problem usually contains a situation that encourages someone to solve it but does not directly know what to do (Suherman, 2003). Problem solving contains four steps of completion: understanding the problem, planning the problem, solving the problem according to the plan, and re-checking all the steps taken. One stage to the next stage in problem solving supports each other to produce problem solving contained in the problem. The Problem Solving Approach to be an alternative for teachers in improving students' math problem solving abilities (Muliana & Nuraina, 2017). Mathematical problem solving abilities are students' abilities in solving a problem or problem by involving the selection of mathematical procedures, either previously known or appropriate new procedures to solve the problem or problem (Rosfarianti, 2021). Problem solving is a process for resolving problems involving several statements with problem identification and resolution.

In learning mathematics, intermediary objects are still needed as teaching aids that function to state facts to be more precise and more understood by students (Nahdiyah, 2020). Teaching aids help students to understand the material more quickly and understand concepts. Thus, teaching aids are needed in learning mathematics. Teaching aids serve to concretize so that the facts are more precise and manageable for students to accept. According to (Yohanes, 2020), mathematics teaching aids are learning media that can help students concretize abstract concepts

to become easy to understand. Based on this, to understand a mathematical concept, students must be given a series of actual activities that their minds can accept.

Based on the results of an interview with one of the mathematics teachers of SMPN 5 Lhokseumawe, it was found that in general, mathematics learning carried out in schools is very limited only using learning media in the form of class VII mathematics textbooks with conventional learning using the lecture method. Even using PowerPoint cannot be applied because the focus is not sufficient in the classroom. So if it is necessary, they must confirm it with the school operator. The limitations of learning media include the lack of teaching aids and the absence of teacher creativity in creating teaching aids according to the material being taught. Therefore, it takes as many teaching aids as possible to support learning.

Figure 1. Props Available at School

Learning mathematics, especially infractions material, has not used teaching aids to help students understand the subject matter. So that students are less active in the learning process. In this regard, the researcher wants to develop a teaching aid that can help students understand mathematical concepts and is expected to attract students' attention and activity in learning. This is in line with the theorists in constructivist learning, Dewey and Piaget. Dewey, Piaget, and Montessori have a similar view in developing knowledge according to the constructivist theory, which views students as actively creating cognitive structures in their interactions with the environment. This emphasis on active and independent student learning needs to be developed (Ültanir, 2012) for that we need an environment that facilitates the needs of children in developing their cognitive processes independently.

The above statement can be strengthened by the research conducted by previous researchers, namely research (Aji, 2016) showing the results of students' understanding of mathematical problem solving abilities after the implementation of the development of mathematics teaching aids are better than mathematical problem solving abilities with conventional learning. The results of the effectiveness of mathematics teaching aids can be seen from the student scores in the small group trial showing the percentage of student understanding reaches 90% with a very effective category, in the large group trial the percentage of student understanding reaches 88% in the very effective category.

Based on the problems above, researchers are interested in researching " Development of fractional board teaching aids to improve mathematical problem solving abilities of SMP students in Lhokseumawe City".

2. METHODS

This research wants to develop a product in the form of board props, then use the type of research and development or better known as the type of research R&D (*Research and Development*). According to (Sugiyono, 2018) research and development is a research method used to produce specific products and test the effectiveness of these products.

The population of this study was all students of SMP Lhokseumawe. Samples were taken randomly, namely SMPN 5 Lhokseuamwe and SMPN 10 Lhokseumawe. The development model used in this study is the ADDIE model (*Analysis, Design, Development, Implementation, and Evaluation*). The procedure for developing the ADDIE model is as follows:

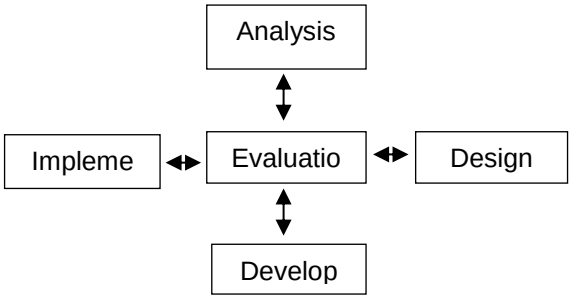

Figure 2. Schematic of the ADDIE Model

Source: (Sugiyono, 2018)

Researchers use research instruments are tools used by researchers in collecting data so that work is easy and the results are better (Arikunto, 2012). The research instruments used to obtain data from this study include tests and interviews. The test of students' mathematical problem solving abilities will be measured through students' abilities in solving questions that contain indicators of these abilities.

Table 1. Indicators of Students' Mathematical Problem Solving Ability

No	Indicators of Students' Mathematical Problem Solving Ability
1.	Identify the elements that are known and asked
2.	Formulate math problems
3.	Explaining the results of problems using mathematics
4.	Checking the results back

3. RESULTS

The data on the fraction board teaching aid feasibility was obtained from the validation questionnaire sheet filled out by media experts, material experts, and small group students at the development stage. The following is an analysis of the feasibility of the fraction board teaching aid by media experts, material experts, and small group students.

The data on the feasibility of the fraction board teaching aid by media experts obtained the results that validator I obtained a percentage result of 82.35% in the "Very Good" category and validator II obtained a percentage result of 74.12% in the "Good" category. The average percentage of the two validators is 78.24%, with the "Good" category. The data on the feasibility of the fraction board teaching aid by material experts obtained that validator I obtained a

percentage result of 78% in the "Very Good" category and validator II obtained a percentage result of 94% in the "Very Good" category. The average percentage of the two validators is 86% in the "Very Good" category.

The data on the feasibility of the fraction board teaching aid by small group students obtained the result that validator I obtained a percentage result of 80% with the "Good" category. Validator II obtained a percentage of 82.5% in the "Very Good" category. Validator III obtained a percentage result of 80% with the "Good" category. Validator IV obtained a percentage yield of 92.5% in the "Very Good" category. Validator V obtained a percentage of 82.5% in the "Very Good" category. The average percentage of the five validators is 83.5% in the "Very Good" category.

From the results of the feasibility of the fraction board teaching aid by media experts, material experts and small group students above, the results are shown in table 2.

Table 2. Product Feasibility Results

Validator	Average (%)	Category
Media Expert	78.24%	Well
Material Expert	86%	Very good
Small Group Students	83.5%	Very good
Average (%)	82.63%	Very good

Based on the data in table 2. above, the results of the feasibility of the fraction board teaching aid will be presented based on the results of the validation assessment in the form of the following bar chart:

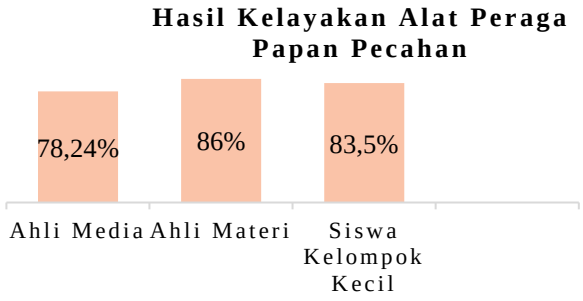

Figure 3. Feasibility Result Bar Chart

Based on table 2 and figure 3, the feasibility results of the fraction board props for each validator, namely media experts, obtained a percentage result of 78.24% in the "Good" category. Material experts obtained a percentage of 86% in the "Very Good" category. Small group students obtained a percentage of 83.5% in the "Very Good" category. The average percentage of the three validators is 82.63% in the "Very Good" category. Thus, the fraction board teaching aid is declared feasible to be used in the learning process.

Data on the results of improving mathematical problem solving with the help of fraction board teaching aids were obtained from the *pretest* and *posttest* scores of large group students at the implementation stage. The pretest and posttest scores *were* used to determine the improvement of mathematical problem solving with the aid of the seventh-grade fraction board teaching aids on fractional material. The *pretest* and *posttest were* given in the seventh grade of SMPN 5 Lhokseumawe Middle School with 30 students and the seventh grade of 10 Lhokseumawe junior high school with 29 students. The following is the *pretest* result data per item for class VII students of SMPN 5 Lhokseumawe.

Table 3. Value of *N-Gain*

Serial number	SMPN 5 Lhokseumawe		
	Score	*N-Gain*	
	Pretest	*Posttest*	
1	12	38	0.81
2	6	40	0.89
3	11	39	0.85
4	9	40	0.89
5	6	44	1.00
6	7	39	0.86
7	8	41	0.92
8	9	40	0.89
9	6	39	0.87
10	13	38	0.81
11	12	38	0.81
12	6	39	0.87
13	2	40	0.90
14	3	39	0.88
15	5	37	0.82
16	8	39	0.86
17	9	40	0.89
18	4	40	0.90
19	3	41	0.93
20	9	34	0.71
21	6	34	0.74
22	5	36	0.79
23	4	30	0.65
24	8	33	0.69
25	7	35	0.76
26	9	34	0.71
28	3	34	0.76
29	11	34	0.70
30	7	32	0.68
Average	6.93	36.23	0.79

Based on the data in table 3. above, the results of the comparison of the *pretest* and *posttest* will be presented in the form of the following bar chart:

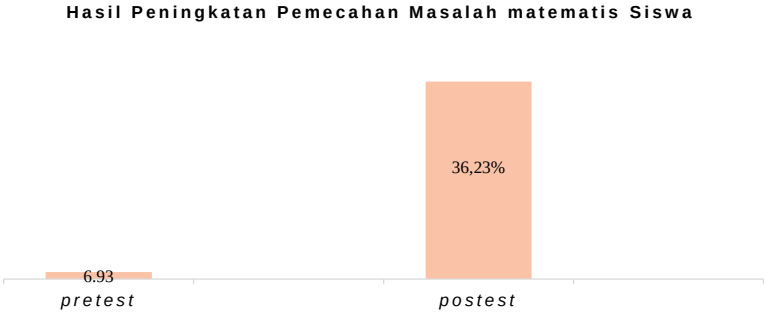

Figure 4. Improvement Results

Based on Figure 4th, the average value of the *pretest* data results is 6.93 and the average post*test* data results are 36.23, showing an increase in mathematical problem solving. From the average *pretest* and *posttest*, the *N-Gain* value will be sought in order to interpret the improvement of mathematical problem solving. Here is the calculation of *N-Gain* :

$$G = \frac{\text{Posttest average} - \text{Pretest average}}{44 - \text{Pretest average}}$$

$$= \frac{36.23 - 6.93}{44 - 6.93}$$

$$= \frac{29.3}{37.07}$$

$$= 0.79$$

Based on the results of the *N-Gain* calculation above, the comparison of *pretest* and *posttest* scores in the fraction board-assisted learning process is 0.79 with the interpretation of "High" so it can be said that there is an increase in mathematical problem solving. Based on the calculation of the comparison of the average *pretest* and *posttest scores* and the calculation of *N-Gain* above, it can be concluded that the fraction board teaching aid can improve mathematical problem solving for class VII students of SMPN 5 Lhokseumae.

The following is the *pretest* result data per item for class VII students of SMPN 10 Lhokseumawe.

Serial number	SMPN 10 Lhokseumawe		
	Score		*N-Gain*
	Pretest	*Posttest*	
1	9	34	0.71
2	6	34	0.74
3	5	36	0.79
4	4	30	0.65
5	8	33	0.69
6	7	35	0.76
7	9	34	0.71
8	3	34	0.76
9	11	34	0.70
10	7	32	0.68
11	6	33	0.71
12	6	33	0.71
13	7	30	0.62
14	5	30	0.64
15	4	31	0.68
16	8	34	0.72
17	9	34	0.71
18	6	34	0.74
19	5	36	0.79
20	4	30	0.65
21	8	33	0.69
22	7	35	0.76
23	9	34	0.71
24	3	34	0.76
25	11	34	0.70
26	7	32	0.68
27	6	33	0.71
28	6	33	0.71
29	7	30	0.62
Average	6.65	33.07	

Based on the data in table 3. above, the results of the comparison of

the *pretest* and *posttest* will be presented in the form of the following bar chart:

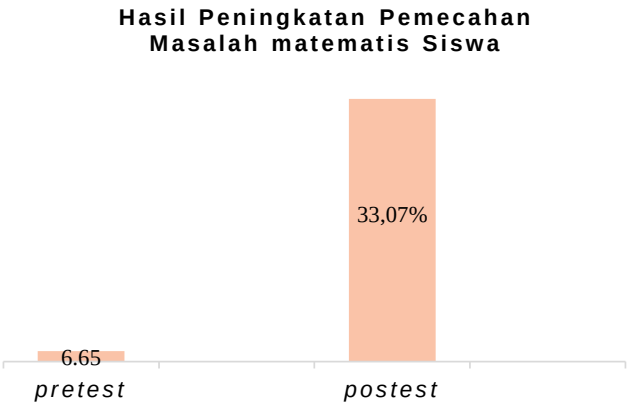

Figure 5. Improvement Results

Based on Figure 5. above, the average value of the *pretest* data results is 6.65 and the average post*test* data results are 33.07, showing an increase in mathematical problem solving. From the average *pretest* and *posttest*, the *N-Gain* value will be sought to interpret the improvement of mathematical problem solving. Here is the calculation of *N-Gain* :

$$G = \frac{\text{Posttest average} - \text{Pretest average}}{44 - \text{Pretest average}}$$

$$= \frac{33.07 - 6.65}{44 - 6.65}$$

$$= \frac{26.42}{37.35}$$

$$= 0.71$$

Based on the results of the *N-Gain* calculation above, the comparison of the *pretest* and *posttest* scores in the fraction board-assisted learning process is 0.71 with the interpretation of "High" so it can be said that there is an increase in mathematical problem solving. Based on the calculation of the comparison of the average *pretest* and *posttest scores* and the *N-Gain* calculation above, it can be concluded that the fraction board teaching aid can improve mathematical problem solving for seventh grade students of SMPN 10 Lhokseumawe.

4. DISCUSSION

This study develops a form of props board product fractions using the ADDIE model of which has five steps: analysis (*Analysis*), design (*Design*), development (Development),

implementation (Implementation), and evaluation (Evaluation). This research and development aim to determine the feasibility of fraction board teaching aids and improve mathematical problem solving with the help of fraction board teaching aids.

The fraction board teaching aid was developed based on the needs analysis in VII SMPN 5 Lhokseumawe and SMPN 10 Lhokseumawe. The needs analysis was obtained from an interview by one of the mathematics teachers at SMPN 5 Lhokseumawe and SMPN 10 Lhokseumawe. The interview results show that the development of the fraction board teaching aids needs to be done because the lack of learning media does students less active and less creative thinking, resulting in a lack of students' mathematical problem solving. The lack of students' mathematical problem solving is due to abstract mathematical objects, resulting in difficulties that students must face in learning mathematics and teachers in teaching mathematics. According to (Yohanes, 2020) mathematics teaching aids are learning media that can help students concretize abstract concepts to become easy to understand. Thus, the development of this broken board teaching aid needs to be done.

After analyzing the needs of the students, then designing the fractional board props starting from the purpose of making the broken board props then choosing the tools and materials to make the broken board props. After designing the teaching aids, then designing research instruments and learning instruments where the research instruments are in the form of validation questionnaires and learning instruments for test questions, syllabus, and lesson plans.

After the props and instruments have been designed, the next stage is the development stage, namely the process of making broken board teaching aids. After the teaching aids have been developed, they will be validated by a team of experts, namely one media expert, one material expert and five small group students, which aims to see the feasibility of the fraction board teaching aids developed. Based on the questionnaire results for the validation of the fraction board teaching aids, each validator, namely media experts, obtained a percentage of 78.24% in the "Good" category. Material experts obtained a percentage of 86% in the "Very Good" category. Small group students obtained a percentage of 83.5% in the "Very Good" category. The average percentage of the three validators is 82.63% in the "Very Good" category. Thus, the fraction board teaching aid is declared feasible to be used in the learning process.

The validation sheet includes suggestions, feedback, and comments helpful in revising the fraction board props for the better. Before the fraction board teaching aid is implemented, it will be revised according to the validator's suggestions, input, and comments. After the teaching aids have been revised, they are ready to be implemented in large students.

After the fraction board teaching aid is validated and then revised, it will be implemented in large groups of students to find out the improvement of mathematical problem solving with the help of fraction board teaching aids in the learning process. The large group of students is the seventh grade students of 5 Lhokseumawe Junior High School, totaling 30 students and the seventh grade students of 10 Lhokseumawe Junior High School, totaling 29 students. To find out the improvement of students' mathematical problem solving, they will be given a *pretest* and *posttest questions* with indicators of students' mathematical problem solving. The results of increasing mathematical problem solving with the help of fraction board props are used to determine the level of improvement in students' mathematical problem solving in fractional material.

5. CONCLUSION

Based on the results of research and development that have been carried out regarding the development of fractional board teaching aids used in the learning process to improve mathematical problem solving for class VII students of SMPN 5 Lhokseumawe and class VII

students of 10 Lhokseumawe on the material fractions, it can be concluded that: (1) The fractional board teaching aid in the fractional material developed is suitable for use in class VII SMPN 5 Lhokseumawe. The feasibility results were obtained based on the validation questionnaire of the fraction board teaching aids of each validator, namely media experts who obtained a percentage result of 78.24% with the "Good" category. Material experts obtained a percentage of 86% in the "Very Good" category. Small group students obtained a percentage of 83.5% in the "Very Good" category. The average percentage of the three validators is 82.63% in the "Very Good" category. Thus, the fraction board teaching aid is declared feasible to be used in the learning process. (2) Fractional board teaching aids can improve mathematical problem solving for seventh grade students of SMPN 5 Lhokseumawe and VII SMPN 10 Lhokseuamwe on fractions. These results are based on the results of the average *pretest*, *posttest* and *N-Gain* calculations. In grade VII students of SMPN 5 Lhokseumawe, the average *pretest* was 6.93, the average *posttest* was 36.23 and the *N-Gain* calculation was 0.79 and for grade VII students of SMPN 10 Lhokseumawe obtained the average *pretest* was 6.65, the average *posttest* was 33.07 and the *N-Gain* calculation was 0.71, so it can be concluded that there was an increase in students' mathematical problem solving.

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