The Effectiveness of Proportional Material in Representing Place Values in The Mathematics Learning of 2nd Grade Elementary School Students

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***Abstract*—Teaching mathematics in elementary school without using props is impossible. Mathematics learning requires the right teaching aids in each learning by paying attention to the material and cognitive development of students. Material props that are often used can be grouped into two, namely proportional and non-proportional teaching aids. According to Kennedy, et al (2008), block dienes are about proportional props. The proportional props show the value of the material size. When manipulative pieces representing one unit are determined, tens pieces are 10 times more than units and hundreds of pieces are 10 times that of tens. This study aims to test the effectiveness of block dienes on the learning outcomes of mathematics in material in grade II of the class II Gugus Kawi Elementary School Semarang. The study design used quasi experimental design with nonequivalent control group design. The population of this study was class II elementary school Gugus Kawi Semarang consisting of 6 elementary schools, taking samples using cluster random sampling. The results showed that the props block dienes of the experimental class I were more effective than the props of the experimental class II. The completeness of learning experiments I and II reached 75%. The results of the t test are t count (5.632)> t table (2.019) and the experimental class I has a value of N-Gain (0.63) higher than the experiment II (0.61). Based on these results it can be concluded that block dienes are more effective than the stands of mathematics learning outcomes of class II students.**

Keywords*— *elementary school, learning mathematics, place values, proportional material.

I. INTRODUCTION

According to the Badan Standar Nasional Pendidikan (National Education Standards Agency) [3], mathematics is a universal science that underlies the development of modern technology, has an important role in various disciplines and advances human thinking power. Mathematics subjects need to be given to all students starting from elementary school to equip students with the ability to think logically, analytically, systematically, critically, and creatively, and the ability to cooperate. Supaarni [18] argues that mathematics is deductive, abstract, full of symbolic languages that are dense in meaning and such.

In Indonesia, many students who consider mathematics subjects are difficult subjects. Mathematics is the basis of all science, but most students have problems learning mathematics [15]. In fact, what happens in elementary schools, the quality of learning is not as expected. The media and teaching aids used by the teacher are inadequate so that the lack of enthusiasm and thoroughness of the students has an impact on student learning outcomes, especially in material that has counts (addition and subtraction). These problems were also found in SD Gugus Kawi Semarang. For this reason, improvements need to be made in the learning process by using teaching aids because mathematics is an abstract science that requires concrete objects to be more clearly understood.

Asyhar [2] argues that teaching aids are media that have characteristics and / or forms of teaching material concepts that are used to demonstrate the material so that learning material is easier for students to understand. According to S. Rachmawan (2013: 28) props are one of the abstract models that can support mathematics learning. Teaching aids that can help students understand the concept of operating counting numbers, especially addition and subtraction, are block dienes and decks. Block dienes are teaching aids developed by Zoltan Paul Dienes that aim to improve students' understanding of chopped numbers, counting operations (addition, subtraction, multiplication and division), and geometry [1]. Dekak-dekak is a tool that is used as a teaching aid that functions to model numbers in a concrete manner [10]. Clarified by the opinion of Ruseffendi in Hidayati [7], the stands are one of the mathematical teaching aids that can be used to explain the concepts or notions of

place values of a number (units, tens, hundreds, thousands) and addition and mixing operations.

Ananda's research on block dienes and stands has been carried out by Ananda [1], the results of the study show that using Blok Dienes can improve students' understanding and learning outcomes in enumeration learning in grade I mathematics subjects at SDN 016 Bangkinang City. Other research conducted by Hawani et al. [6], the results of the implementation of mathematics learning research using the stands in class 1 of SDN 01 Serimbu were categorized as Good. *Dekak-dekak* can improve student learning outcomes in grade 1 SDN 01 Serimbu.

The purpose of this study is (1) To test the effectiveness of props block dienes with media images. (2) To test the effectiveness of *dekak-dekak* with image media. (3) To test the effectiveness of block dienes with *dekak-dekak*.

II. METHOD

This study uses quasi-experimental research with a population of second grade students of SD Gugus Kawi Semarang in the academic year 2018/2019. The research design used was nonequivalent control group design [16]. The population in this study were second grade students of SD Gugus Kawi Semarang. The sampling technique uses cluster sampling. The sampling technique uses cluster sampling. In a study conducted by Fatah et al. [5] with a quasi-experimental design using a form of nonequivalent control group design and the selection of samples not done entirely randomly because it is not possible to create a new class. So, use existing classes to use. The researcher agrees with the opinion of the research conducted by Fatah, et al. The results of determining the sample showed that there were three classes used, namely class II of Tegalsari 1 SDN 1 as experimental class I, class II of Tegalsari 3 SDN as experimental class II, SD Muhammadiyah 16 as control class and SD Wonotingal as instrument trial class. The variables in this study consisted of: (1) independent variables namely block dienes and decks as well as image media; (2) the dependent variable is the learning outcomes of class II students in mathematics. Data collection techniques using tests and non-tests in the form of observation, interviews and documentation. The test instrument before being used is analyzed by a test device, namely the validity, reliability, level of difficulty, and the power of the different questions. Learning outcomes data were analyzed by z test, right hand one t test, and N-gain test. The research hypotheses are: (1) testing the effectiveness of block dienes with picture media; (2) test the effectiveness of *dekak-dekak* with picture media; and (3) test the effectiveness of block dienes with *dekak-dekak*.

III. RESULT AND DISCUSSION

In the experimental class I used block dienes, the experimental class II used stacks, and the control class used the image media. The number of experimental class I meetings, experimental class II and control class is the same, each class starts with a pretest and then holds a meeting 4 times and ends with posttest.

Results of Preliminary Data Analysis

Data analysis for normality test using Liliefors test. The calculation results using the Liliefors test with a significance level of 0.05 indicate that in the experimental class I the value of Lcount(0.1131) <Ltable (0.193) then H0 is accepted which means the value of the pretest of experimental class I is normally distributed. Experimental class II value of Lcount(0.1767) <Ltable(0.189) then H0 is accepted which means the pretest value of experimental class II is normally distributed. In the control class the value of Lcount(0.1226) <Ltable(0.185) is obtained, then H0 is accepted which means the value of the pretest of the control class is normally distributed. It can be concluded that the preliminary normality test data shows pretest value data in experimental class I, experiment II and control class with normal distribution. Data analysis for homogeneity test using barlett test. The calculation results using the test barlett with a significance level of 0.05 indicate that in experimental class I, experiment II and control class obtained values obtained X2 count (1.6258) X X2 table (5.9915) then H0 is accepted which means the pretest value of experimental class I, experiment II and control class have the same variant (homogeneous). The similarity test results of the average pretest value using the Anova test (Analysis of Variance) in one direction with a significance value of 0.05 indicates the value of F count (0.052) <Ftable (3.143) then H0 is accepted which means students of experimental class I, experiment class II, and the control class has the same initial abilities. Based on preliminary data analysis, it can be concluded that the pretest values of the three classes are normally distributed, have the same variant (homogeneous) and in the condition of the same initial ability of students.

Final Data Analysis Results

The normality of the final data (posttest) in experimental class I, experiment II and control class used the Liliefors test with a significance of 0.05. The results of the posttest normality test in the experimental class I showed the value of Lcount (0.1596) <Label (0.193) so that the posttest value of the experimental class I was normally distributed. The results of the posttest normality test in the experimental class II showed the value of Lcount (0.1797) <Label (0.189) so that the posttest value of the experimental class II was normally distributed. The results of the posttest normality test of the control class showed the value of Lcount(0.1675) <Ltable (0.185) so that the posttest value of the control class was normally distributed. The final data homogeneity test (posttest) uses the F test with a significance of 0.05. In experimental class I and control class, Fcount (1.1453) <Ftable (2.0707) was obtained so that H0 was accepted so that the posttest data between experimental class I and control class was homogeneous. For experimental class II and control class, Fcount (1.7516) <Ftable (2.0733) is obtained, so H0 is accepted

so that the posttest data between experimental class I and control class is homogeneous. Then the experimental class I and experimental class II obtained the value of Fcount (2.006) <Ftable (2,096) then H0 was accepted so that the posttest data between the experimental class I and the experimental class II was homogeneous. Analysis of hypothesis 1 test is to test the effectiveness of block dienes with image media using the z test, the right t test, and n-gain. The significance level used is 0.05. The value of zcount = 1.134 and ztable = 0.1736 in the experimental class I then H0 is rejected because the value of zcount> ztabel means that the experimental class I proportion of students who complete learning reaches 75%. Whereas in the control class, zcount = -1.565 and ztable = 0.1736, H0 is accepted, meaning that the control class of the proportion of students who have finished learning does not reach 75%.

Furthermore, a test of the difference in the average use of props block dienes with image media using the right t-test. This obtained tcount (2.115)> t table (2.018) so that H0 is rejected, which means that learning mathematics using props block dienes has an average of more than the average mathematics learning using media images of learning outcomes of class II SD Gugus Kawi Semarang addition material and reduction of chopped numbers. After testing the difference in average learning outcomes, then next calculate the increase in students' ability between before and after giving treatment (treatment) in the experimental class I and control using n-gain. Data increases the average value of the pretest and posttest of experimental class I, and the control class is presented in a line diagram (figure 1)

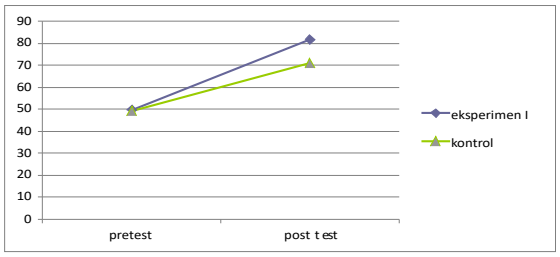

Figure 1. Diagram N-Gain Experiment I and Control Class

The average experimental class I pretest was 49,714, and the posttest average increased to 81,547. The N-Gain results are 0.63 with the medium criteria because 0.30 < 0.63 < 0.70. The average control class pretest was 49,184 and the posttest average increased to 70,923. The control class N-Gain results are 0.42 with the medium criteria because 0.30 < 0.43 < 0.70. So, the N-Gain class that uses block dienes in the experimental class I is higher than the control class even though the same criteria is moderate. This is in line with the research conducted by Oktarandi K [14], that the use of Block Dienes media can increase compiled summaries for students who have learning difficulties. Another study using Block Dienes teaching aids was also carried out by Yulastri (2017: 57-66) that using Block Dienes can improve student learning outcomes in reducing number material in class I mathematics subjects at SD Negeri 21 Batang Anai, Padang Pariaman Regency.

Analysis of Hypothesis 2 test is to test the effectiveness of the decks with image media using the z test, the right t test, and n-gain. The significance level used is 0.05. The results of the calculation of learning completeness test on the side with picture media is the value of zcount = 0.7385 and ztable = 0.1736 then H0 is rejected because the value of zcount> ztabel means that the experimental class II the proportion of students who complete learning reaches 75%. Whereas in the control class, zcount = -1.565 and ztable = 0.1736, H0 is accepted, meaning that the control class of the proportion of students who have finished learning does not reach 75%. Furthermore, a test of the difference in the average use of props with the image media using the right t test. obtained tcount (2.115)> t table (2.018) so that H0 is rejected which means that learning mathematics using a props has a mean more than the average of mathematics learning using media images on the learning outcomes of class II SD Gugus Kawi Semarang addition and reduction of whole numbers.

After testing the difference in average learning outcomes, then next calculate the increase in students' ability between before and after treatment (treatment) in the experimental class II and control using n-gain. Data increases the average value of the pretest and posttest of experimental class II, and the control class is presented in a line diagram (figure 2)

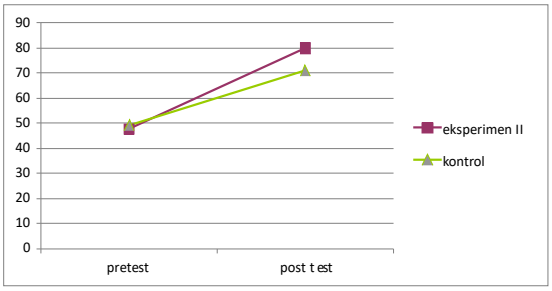

Figure 2. Diagram N-Gain Experiment II and Control Class

The average experimental class II pretest was 47,727 and the posttest average increased to 79,829. N-Gain results are 0.61 with moderate criteria because 0.30 30 0.63 < 0.70. The average control class pretest was 49,184 and the posttest average increased to 70,923. The control class N-Gain results are 0.42 with the medium criteria because 0.30 < 0.43 < 0.70. So, the N-Gain class using props in the experimental class II is higher than the control class even though the same criteria is moderate. This is in line with the research conducted by Marzuki [10], that learning by using a chair can improve student achievement in grade IV of SD Negeri 4 Bireuen.

Analysis of the hypothesis 3 test is to test the effectiveness of block dienes with a chair by using the z test, the right t test, and n-gain. The significance level used is 0.05. The results of completeness test calculations learn to block dienes with the dekak-dekak.

Obtained zcount = 1.134 and ztable = 0.1736 in the experimental class I then H0 is rejected because of the value of zcount> ztable. In the experimental class II the value of zcount = 0.7385 and ztable = 0.1736, H0 is rejected because of the value of zcount> ztable. So, the experimental class I and II, the proportion of students who complete learning reaches 75%.

Furthermore, the test of the difference in the average use of props block dienes with the decks using the right t-test. Obtained tcount (5,632)> t table (2,019) so that H0 is rejected, which means that learning mathematics using block dienes has an average of more than the average mathematics learning using the approach to the learning outcomes of class II SD Gugus Kawi Semarang in addition and subtraction material whole numbers. After testing the difference in the average learning outcomes, then further calculating the increase in student abilities between before and after treatment (treatment) in the experimental classes I and II using n-gain. Data increases the average value of the pretest and posttest of experimental class I, and the control class is presented in a line diagram (figure 3).

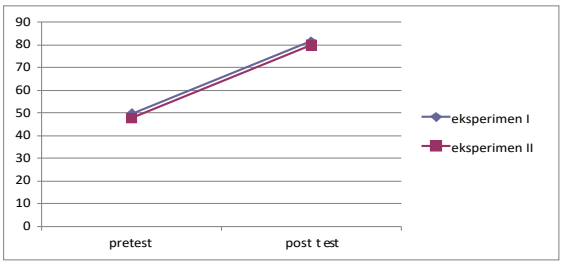

Figure 3. Diagram N-Gain Experiment I and Experiment II Class

The average experimental class I pretest was 49,714, and the posttest average increased to 81,547. The N-Gain results are 0.63 with the medium criteria because 0.30 < 0.63 < 0.70. In the experimental class II the average pretest was 47,727 and the posttest average increased to 79,829. N-Gain results are 0.61 with moderate criteria because 0.30 < 0.61 < 0.70. So, the N-Gain class that uses block dienes in the experimental class I is higher than the experimental class II using the props in the deck even though the same criteria are medium. This is in line with the research conducted by Murdiyanto [12] using a quasi-experimental method. The results of the study showed that the teaching and learning process using the learning media block dienes produced good learning achievement compared to using learning media on the side. Students who have high interest or low interest in their achievement in the teaching and learning process using block dienes media are better than using dekak-dekak media.

The difference in learning outcomes is because learning using image media carried out in the control class has not given concrete things to students because it is only limited to seeing pictures and making it difficult for students to understand the addition and subtraction material. Whereas props block dienes and decks provide concrete things and students get hands-on experience when counting. This is in line with the research conducted by M. Furner, et al [11], the purpose of the study was carried out because they saw educators who lacked manipulative media in learning mathematics. Though manipulative media is very helpful for students to understand the subject matter.

The manipulative media suggested for mathematics learning, namely tangram, banknotes, stem blocks or block dienes, pattern blocks, clocks, abacus or decks, and scales. But the props on the sides are not as clear as the props block dienes because their values are symbolized. According to Kennedy, et al [8], block dienes and decks show proportional props and disproportionate props. The proportional props show the value of the material size. For example if 1 stick of ice cream is 1 unit, then a pack or 10 sticks of ice cream represent tens and 10 bundles of ice cream sticks are hundreds. Disproportionate props can also represent place values, even though one to ten relationships are not indicated in the size of the material. An example is money.

IV. Conclusion

Conclusions in this study are (1) block dienes props are more effective than control class image media. (2) The *dekak-dekak* media are more effective than the control class image media. (3) Props to block dienes are more effective than props on the *dekak-dekak*. So that in general it can be concluded that the learning outcomes using props block dienes are most effective compared to using *dekak-dekak* and media images in the control class

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