The effect of the application of nomograph pros on the learning outcomes of elementary school students materials of counting intelligence operations

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Abstract
The purpose of this study was to determine the effect of the application of Nomograph teaching aids on student learning outcomes. This research was conducted at grade IV. The method used in this study is an experimental method with a one-group pre-test-post-test design. The instrument used in this study was a mathematics learning outcome test in the form of an essay. The test result data were analyzed by means of the t-test on the final result (post-test). Based on the analysis of the research data, there is an effect of the application of Nomograph teaching aids on learning outcomes.

Keywords: Nomograph pros, Learning Outcomes and Integer

INTRODUCTION

Learning is a process of human interaction with the environment in which they live that takes place simultaneously, consciously and in a plan in order to develop all abilities, both physical abilities (physical health) and spiritual abilities (thinking, feeling, intention, work, creativity and conscience) that cause changes that are positive. positive and progress. The changes in question are the cognitive, affective and psychomotor domains that take place continuously in order to achieve life goals (Bali & Musrifah, 2020; Nurhayanti & Suprapto, 2018; Reimers & Chung, 2019)

The most important factor in learning is the educator or teacher, the teacher is a component that plays an important role in success in the teaching and learning process both in the classroom and outside the classroom (Le Cornu, 2015; McKnight et al., 2016; Wolff et al., 2015). Thus educators are always faced with improving the personal and social qualities of students or students, namely being able to form students with character (virtuous, having social character as the main goal of learning itself.

Mathematics is one of the subjects that has an important role that is taught from elementary school to university, it aims to develop initial knowledge in mathematics (Hine, 2015; Kim & Bolger, 2017; Tutak & Adams, 2015). Mathematics is knowledge that does not stand alone, but can help students to understand and solve social, economic and natural problems. Meanwhile, other experts argue that mathematics is knowledge related to various abstract structures and the relationships between these structures are well organized (Besedovsky, 2018; Kleinknecht & Gröschner, 2016; Sun et al., 2018).

Students often think of mathematics as a very difficult subject, the assumption of most of these students may not be excessive because to understand a new concept, a prerequisite for understanding the previous concept is needed. The ability to understand a concept is very important because learning with understanding makes the next lesson easier to understand (Mitchell et al., 2020; Patten & Newhart, 2017; Willingham, 2021).

Students really need to learn mathematics with an active understanding of building new knowledge from previous knowledge and experience (Krahenbuhl, 2016; Olofson et al., 2016; Selvianiresa & Prabawanto, 2017). The development of understanding mathematical concepts is very much needed because it is related to the planting of concepts. These students also take part and play a role in the further development of mathematics or in applying mathematics in everyday life (Ernest et al., 2016; Gravemeijer et al., 2017; Lesh et al., 2020).

There are so many materials or sub-materials that are discussed at school, including material about numbers (numbers). This material is often used, almost every activity in human daily life. After students understand numbers, there needs to be an action on numbers that can be called operations. The simplest operations are number operations which include addition (+), subtraction (-), multiplication (x), division (:) (Koren, 2018; Liu et al., 2016; Zwillinger, 2018).

At first glance, addition is an operation that is not too difficult to teach in Elementary Schools/Madrasah Ibtidaiyah, the material taught is limited to adding positive integers to whole numbers or vice versa. However, it is different with the addition of negative numbers. This is what is often ignored by teachers, so the use of media or teaching aids is rarely used in the learning process at school.

Therefore, there needs to be a suitable method or method or media used in teaching mathematics so that students are not bored and bored in learning. One way to do this is by using the media. The suitable media that is suitable for this material is nomograph.

Nomograph comes from the Greek which means written rules, can be applied to mathematics. Nomograph is a technique with graphs for calculating and solving certain problems or equations (Bichurin et al., 2016; Potente et al., 2019; T. Aleroev, 2020; T. S. Aleroev & Erokhin, 2019) Nomograph is a system of two or more graphic scales to calculate mathematical results or equations without performing calculations (Callaghan & Walker, 2015; Williams & Walker, 2015). Meanwhile, another opinion regarding the nomograph is that the graph with the value of one variable is determined by the other two values, the nomograph is a learning medium that is formed from three number lines that are placed parallel to the nature of the scale on the number line located in the middle of which the magnitude is equal to half times the scale on the number line that flank it (Balanis, 2015; Nieder, 2016).

The results of initial observations and interviews with fourth grade homeroom teachers conducted by researchers related to the teaching and learning process of fourth grade mathematics at SD Negeri 8 Sakra found several problems related to learning mathematics, among which students still had difficulties in solving math problems in arithmetic operations material. Students find it difficult to distinguish between positive, negative and integer signs with addition or subtraction arithmetic operations. This is caused by the lack of understanding of students on the operations of adding and subtracting integers, this can be seen from the results of the fourth grade students' tests. Mathematics subjects with an average of 64.5 are still far from the minimum completeness criteria, namely 67.

The results of the researcher's interview with the homeroom teacher showed that the learning carried out tended to be monotonous, the teacher only used the lecture or conventional method, the learning process carried out was still teachers-centered. Students are rarely given the opportunity to discover and construct mathematical knowledge independently.

The problems experienced by students in learning mathematics, researchers found solutions to overcome these problems, namely by using Nomograph props in the process of learning mathematics in class IV.

METHODS

The type of approach or research method used is experimental research. This study uses a quasi-experimental design in the form of a one-group pretest-posttest design which can be seen in Table 1. The purpose of this study was to determine the effect of using Nomograph media on student learning outcomes in mathematics.

Table 1. Research Design

Group	Treatment (X)	Final Data
Pre-test (O1)	Not Using Test Props	Test
Post-test (O2)	Using Test Props	Test

Information: O1 : first test (pre-test); X : treatment (mathematics learning using Nomograph props); O2 : final test (post-test)

The design of this research is the researcher uses pre-test and post-test to determine the initial and final grades of mathematics lessons by using the Nomograph teaching aids. The aim is to find out the extent of

student learning outcomes on the subject of integer operations before using the Nomograph teaching aids and after using the Nomograph teaching aids in the mathematics learning process.

The population in this study were all students of SDN 8 Sakra and the sample of this study was class IV which consisted of 23 students. During the research process, the researcher obtained initial data from the fourth grade teacher or homeroom teacher. The first step is to determine the research sample and group them into one. At the initial stage, the researcher gave a pre-test to determine the initial condition of students or student learning outcomes before being given treatment using Nomograph props. Then in the second stage the researcher gave a post-test to measure or find out student learning outcomes by giving treatment using Nomograph props.

The data collection technique in this study was a test. The test in this study was used to measure the mathematics learning outcomes of fourth grade students. The test questions used as research instruments in the form of essays consist of 10 questions related to the material of integer arithmetic operations. This essay test is used for the initial test (pre-test) and the final test (post-test). The initial test (pre-test) is used to obtain data on students' initial abilities as well as for matching (to know the students' initial abilities before the treatment is applied), and the final test (post-test) is used to determine student learning outcomes due to treatment (treatment).

DISCUSSION

The final data analysis was carried out after obtaining the test scores for the two groups of pretest and post-test on the subject of integer arithmetic operations. The average value of student learning outcomes can be seen in Table 2 below.

Table 2. The average value of student learning outcomes

Class	Mean
Pre-test Group	58,04
Post-test Group	74,13

After calculating the results of the pretest and post-test data, they are then matched with the T table. After being matched with the T table value, the pretest group T count is 0.144 and the T table is 0.173. While the T count for the posttest group is 0.157 and T table is 0.173. The results of these calculations indicate that the pretest and posttest groups have T count < T table, then the two data obtained are normally distributed. The results of the normality test can be seen in Table 3.

After the analysis prerequisite test is carried out, the next test is hypothesis testing. Hypothesis testing is intended to determine the difference in student learning outcomes scores using Nomograph teaching aids and student learning outcomes not using Nomograph teaching aids. The results of the t-test analysis can be seen in Table 4.

Table 3. Normality Test Results

Groups	T_{count}	T_{table}	Description
Pre-test	0,144	0,173	Normal Distribution
Post-test	0,157	0,173	Normal Distribution

Table 4. Hypothesis Test Results

Groups	N	Average	t_{count}	t_{table}
Pre-test	23	58,04	21,44	2,000
Post- test	23	74,13		

From table 4, obtained t count of 21.44 and t table of 2,000, it can be said that t count is more than t table (21.44 > 2,000) with a significant level of 5% (0.05) and degrees of freedom dk = n1+ n2 – 2 = 23 + 23 – 2 = 44. Thus Ha is accepted, which means "There is an effect of using Nomograph teaching aids on mathematics learning outcomes in fourth grade students of SDN 8 Sakra in the 2020/2021 academic year" is accepted. Based on the results of data analysis carried out after being given a final test in the pretest and post-test groups, the average score of the students in the pretest group was 58.04 and the average score of the students in the post-test group was 74.13. The average value obtained by the two groups is quite significant and the difference is not too far, this is because before being given treatment and after being given treatment.

The findings in this study illustrate that the application or use of Nomograph teaching aids can improve student learning outcomes, this can

be seen from the results of hypothesis testing, namely that t count > t table is 21.44> 2,000. Of course this influence is not only influenced by the teacher as a whole, but the use of teaching aids as a tool for students in understanding and interpreting the concepts of arithmetic operations is very important. This is in line with the findings or research conducted by (Vitasari & Rahmawati, n.d.). The results of the study illustrate that the use of the Nomograph tool has an effect on learning the material for adding integers. This is indicated by an increase in the average score in the pre-test and post-test of students in both the control class and the experimental class. The average value before treatment in the experimental class was 50.6. Meanwhile, the average post-test score for the control class after being treated was 65.2 and the average score after treatment in the experimental class was 71.3.

The results of research also conducted by (Arum & Suprapto, 2021; Wang et al., 2019; Zhang et al., 2019) with the title Improving Learning Outcomes Through the Use of Nomograph Media show that the use of nomograph media can improve mathematics learning outcomes. The results of the study, in the initial conditions, the number of students who were able to reach the KKM was 11 students (47.83%). In the first cycle the number of students who were able to achieve the KKM was 16 students (6 79.57%). Cycle II again an increase in student learning outcomes. Number of students who reached the KKM 19 students (82.61%)

Obtaining pre-test data in this study by giving tests to students in the form of essay questions consisting of ten questions that have a variety of scoring for each item, each student must answer the question by

including the steps for completing each item given after the learning process takes place. the posttest group was given treatment using a Nomograph prop. The results of the tests that students get are the results of research which are then analyzed and compared so that in the end it will be the conclusion of the research.

Based on the data that has been presented, it is obtained that t count is 21.44 and t table is 2,000, so it can be said that t count is more than t table (21.44 > 2,000) with a significant level of 5% (0.05) and degrees of freedom dk = n1+ n2 – 2 = 23 + 23 – 2 = 44. Thus, Ha which reads "There is an effect of using Nomograph teaching aids on mathematics learning outcomes in fourth grade students of SDN 8 Sakra in the 2020/2021 academic year" is accepted.

CONCLUSION

The results of the research and discussion presented can be concluded that: (1) Nomograph teaching aids in mathematics learning material for integer arithmetic operations are very influential in improving student learning outcomes in class IV integer arithmetic operations. (2) the application of Nomograph teaching aids in mathematics learning on integer operations material affects student learning outcomes in class IV integer arithmetic operations. (3). Please provide input for the perfection of the results of further research and the results of this study can be used as a reference by other researchers to be used as a reference in further research.

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