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JURNAL PENDIDIKAN MASYARAKAT DAN PENGABDIAN
Magister Pendidikan Nonformal
Pascasarjana Universitas Negeri Gorontalo
Volume 03 (2), June 2023
http://ejurnal.pps.ung.ac.id/index.php/dikmas

The Effect Of Using Abacus Media On Students' Ability In Arithmetic Operations On The Addition Of Whole Numbers

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Received: 23 January 2023; Revised: 12 February 2023; Accepted: 27 February 2023
DOI: http://dx.doi.org/10.37905/dikmas.3.2.311-318.2023

ABSTRACT
Mathematics is essential since its application cannot be separated from our daily lives. Moreover, mathematics can also develop an awareness of essential values. Arithmetic operations are one of the mandatory topics in mathematics education at the elementary school level. Addition and subtraction of tens and hundreds are taught in Grade 1 of elementary school. In this grade, mathematics serves as the initial process for students to learn arithmetic operations, which are part of mathematical skills. Counting activities in a simple context have been introduced before students enter elementary school age. However, the abstract nature of mathematics makes it difficult for many students to learn. This phenomenon is evident in the low arithmetic skills of students, as reflected in the low average scores for mathematics, especially in the arithmetic topic.

INTRODUCTION

Observations on the homeroom teacher of Grade 1 of SDN 7 Batudaa Pantai Gorontalo showed that in the learning process, students often went in and out of class and paid little attention to the teacher explaining the teaching material. Several students even played around during the learning process. In learning mathematics in Grade 1, some students seemed not proficient in arithmetic and often needed to remember certain numbers. Meanwhile, other students could perform arithmetic but still made many mistakes in working on the questions regarding the addition of whole numbers given by the teacher. Therefore, the students' ability to operate the arithmetic addition of whole numbers still needs to improve. The same difficulties were also experienced by the students in the subtraction topic.

This phenomenon is consistent with the study by Sari et al. (2021), which showed that many students face difficulties in learning mathematics due to its abstract nature, as reflected in their low arithmetic skills. The average score for mathematics, especially arithmetic topics for Grade 1 students of SD IT Al Izzah Dumai, is 48.25, lower than the Minimum Completeness Criteria (KKM) set at 55.

The results of situation analysis, surveys, and team interviews with teachers and Grade 1 students at SDIT Al Izzah Dumai show that students' low arithmetic skills are attributed to the conventional teaching methods used by teachers, such as monotonous and uninteresting teaching styles and the use of traditional teaching materials such as textbooks and blackboards.

Therefore, the authors initiated a study titled "The Effect of Using Abacus Media on Students' Ability in Arithmetic Operations on the Addition of Whole Numbers at SDN 7 Batudaa Pantai Gorontalo".

Priyani (2006:19-20) suggests that the abacus is a traditional calculating tool commonly used in Japan and China. It is a rectangular box divided into two parts, top and bottom, with beads representing one value in the bottom part (Syifa & Simatupang, 2015).

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Abacus provides several benefits to students, including: 1) optimizing the function of the right and left brain by allowing students to concentrate on arithmetic and use their imagination and logic, 2) developing imagination, creativity, logic, systematic thinking, and concentration, 3) increasing speed, accuracy, and precision in thinking, 4) stimulating students to be more sensitive to spatial arrangements by visualizing using an abacus in their minds, and 5) enhancing students' memory (Rahmi et al., 2020).

Furthermore, the study by Wijayanti et al. (2022) shows that the use of the abacus has a variety of positive impacts. One of them is increasing students' interest to prevent them from feeling bored. Thus, the use of the abacus as a learning media can improve student learning outcomes, especially in mathematics, as supported by the findings of the study by Ray et al. (2023) that students who could use an abacus could count more quickly and accurately than students who could not use it.

METHOD

A. Research Design

The study employed a Non-equivalent control group design, with a pre-test and post-test before and after treatment.

Table 1 Non-equivalent Control Group Experiment Design

Group	Pre-test (Initial test)	Treatment	Post-test (Final test)
Experiment	O1	X	O3
Control	O2	C	O4

Information:
O1 = Experiment Class (pre-test)
O2 = Control Class (pre-test)
O3 = Experiment Class (post-test)
O4 = Control Class (post-test)
X = Experiment Class (using an abacus)
C = Control Class (not using an abacus)

B. Research Variables

1. Independent Variable (X): The abacus as a medium
2. Dependent Variable (Y): the ability to operate arithmetic addition of whole numbers.

C. Population and Sample

1. Population

The population of this study was all 38 Grade 1 students at SDN 7 Batudaa Pantai Gorontalo in the academic year 2022/2023.

2. Sample

The selected sample is saturated sampling by using the entire population of 38 students to obtain data.

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Table 2 Number of Grade 1 Students

Class	The Number of Students		Total
	Male	Female	
Experiment Class	9	10	19
Control Class	9	10	19

E. Data collection technique

1. Observation
2. Test
3. Documentation

F. Testing of Instrument Test

1. Validity Test

Determination of validity employs the biserial correlation formula (Matondang, 2009: 92 in Harim, 2019) as follows:

Information:

$$r_{bis(i)} = \frac{\overline{Xi} - \overline{Xt}}{St} \sqrt{\frac{pi}{qi}}$$

$r_{b(i)}$= correlation coefficient between the score of item i with the total score
$\overline{Xi}$= the average score of respondents who answered correctly item i
$\overline{Xt}$= the average total score of all respondents
St = standard deviation of the total score of all respondents
pi = the proportion of students who answered correctly for item i
qi = the proportion of students who answered incorrectly for item i

2. Reliability Test

The reliability test employs the 20th Kuder and Richardson formula (KR20), which can be described as follows:

$$r_i = \frac{k}{(k-1)} \left\{ \frac{s_{t^2} - \sum piqi}{s_{t^2}} \right\}$$

(Sugiyono, 2014)

Information:

r_i = instrument internal reliability
k = the number of question items in the instrument
pi = the proportion of the number of subjects who answered each question item
qi = 1 - pi
s_t2 = total variance

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G. Data analysis technique

1. Data Normality Test

The data normality test employs the Kolmogorov-Smirnov technique with the help of IBM SPSS Statistics 26, where the basis for the decision is that data is normal if the value is sig. >0.05.

2. Homogeneity Test

The homogeneity test employs the variance test with the help of IBM SPSS Statistics 26. The basis for the decision is that the data is homogeneous if the sig. > α (0.05).

3. Hypothesis Test

Hypothesis testing is carried out through a two-party test using parametric statistics with the following t-test formula:

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{S_1{}^2}{n_1}\frac{S_2{}^2}{n_2} - 2r\left(\frac{S_1}{\sqrt{n_1}}\right)\left(\frac{S_2}{\sqrt{n_2}}\right)}}$$

(Sugiyono, 2019)

Information:

t = t_{count}
$\bar{x_1}$ = experimental class average
$\bar{x_2}$ = Control class average
$S_1 2$ = experimental class sample variance
$S_2 2$ = control class sample variance
n_1 = the number of respondents in the experimental class
n_2 = the number of respondents in the control class
r = correlation between variables

The basis for making decisions in this test is that H_0 is accepted if the sig. (2-tailed) > α (0.05) and vice versa, or H_0 is accepted if the value of t count <t table. The hypothesis formula is as follows:

$H_0 : \mu_1 = \mu_2$
$H_1 : \mu_1 \neq \mu_2$

H_0: There is no effect of using the abacus media on the ability of Grade 1 students at SDN 7 Batudaa Pantai in arithmetic operations on the addition of whole numbers.

H_1: There is an effect of using the abacus media on the ability of Grade 1 students at SDN 7 Batudaa Pantai in arithmetic operations on the addition of whole numbers.

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RESULTS

A. Testing of Test Instruments

1. Results of Testing the Validity of Test Instruments

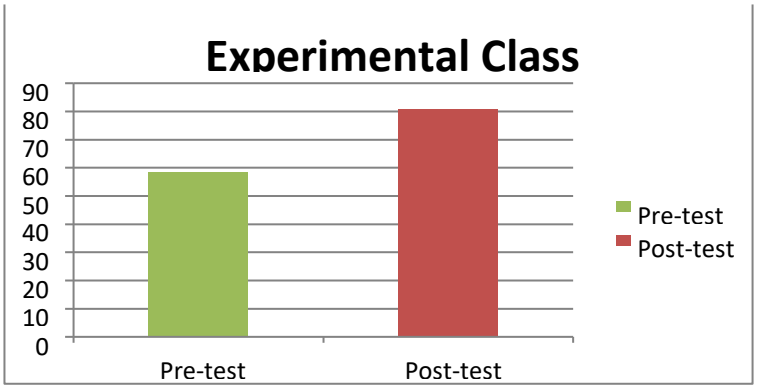
Calculations with the help of Microsoft office excel 2007 produced 20 valid questions and 15 invalid questions.

2. Results of Testing the Reliability of Test Instruments

The reliability test result on test questions with the help of Microsoft Office Excel 2007 is 0.936. Based on reliable criteria, the score of the test item instrument is very high, so it is declared reliable.

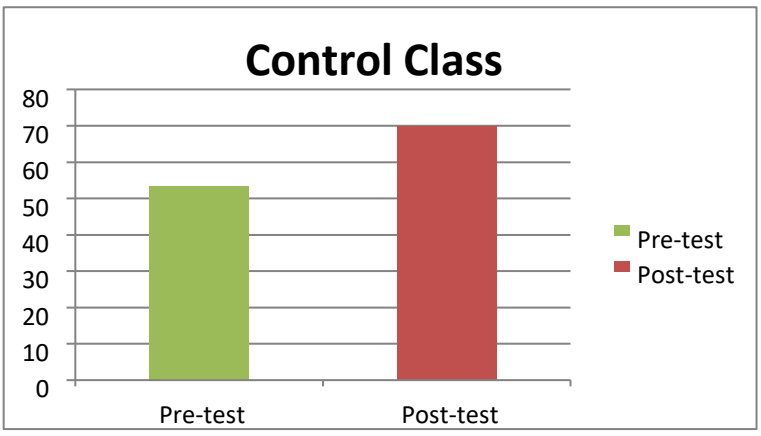
B. Pre-test and Post-test Data Results of Experimental Class

Figure 1 Diagram of Pre-Test and Post-Test of Experimental Class



C. Pre-test and Post-Test Data Results of Control Class

Figure 2 Diagram of Pre-Test and Post-Test of Control Class



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D. Difference between Pre-Test and Post-Test Data

Figure 3 Diagram of Pre-Test and Post-Test of Experimental and Control Class

E. Hypothesis Test

1. Data Normality Test Results

The initial data on the normality test through the pre-test showed a probability value of 0.200 > 0.05 in the experimental class and 0.099 > 0.05 in the control class. Meanwhile, the final data (post-test) showed a probability value of 0.200 > 0.05 in the experimental class and 0.200 > 0.05 in the control class.

Table 3 Normality Test Results

Class	Significance Value
Pre-test in Experimental Class	0,200
Post-test in Experimental Class	0,200
Pre-test in Control Class	0,099
Post-test in Control Class	0,200

2. Data Homogeneity Test Results

The homogeneity test results with the help of IBM SPSS Statistics 26 show a sig.0.426 value > 0.05. Thus, it is declared homogeneous since the value of sig. > alpha (0.05).

3. Hypothesis Testing

The results of hypothesis testing with the help of IBM SPSS Statistics 26 show the sig. (2-tailed) 0.002 < 0.05. The basis for the decision is that H_0 is rejected if the sig. (2-tailed) < 0.05 and vice versa, or H_0 is accepted if $t_{count} < t_{table}$. In this study, the value of t_{count} (3.322) > t_{table} (2.031). Thus, H_0 is rejected, and H_1 is accepted. It means that using the abacus media affects the ability of Grade 1 students at SDN 7 Batudaa Pantai Gorontalo in arithmetic operations on the addition of whole numbers.

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DISCUSSION

Based on processed data in the experimental class, the lowest pre-test score was 25, the highest score was 90, the lowest post-test score was 60, and the highest score was 95. Meanwhile, in the control class, the lowest pre-test score was 15, and the highest score was 95, whereas in the post-test, the lowest score was 50, and the highest score was 90.

The pre-test and post-test data obtained after the data collection process can be seen in Table 4 below:

Table 4 Recapitulation of Pre-Test and Post-test on Research Results

Data	Total		Average Score	
	Experiment	Control	Experiment	Control
Pre-test (O1)	1110	1015	58,42	53,42
Post-test (O2)	1535	1325	80,79	69,74

Based on the table, the average post-test score was 80.79 in the experimental class and 69.74 in the control class. That means that the average score of students who use the abacus media is higher than those who use the conventional model (without using an abacus).

Thus, the research hypothesis, which states that the use of abacus media affects the ability of Grade 1 students at SDN 7 Batudaa Pantai Gorontalo in arithmetic operations on the addition of whole numbers, can be accepted. This statement is proven by the results of hypothesis testing with sig. (2-tailed) of 0.002 <α = 0.05 or the value of t count (3.322) > t table (2.031).

CONCLUSION

Based on the results and discussion, using the abacus media affects the ability of Grade 1 students at SDN 7 Batudaa Pantai in arithmetic operations on the addition of whole numbers. The value of sig. (2-tailed) is 0.002 < 0.05 in the experimental class and 0.002 < 0.05 in the control class, so H_0 is rejected and H_1 is accepted.

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