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The Use Of Props As To Increase Interest And Understanding Mathematics Concepts Ability Elementary School Students

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Abstract

This Researched study is a mixed methods (Mixed Method) type "Embedded Design" with an experimental type of study design shaped models with pretest-posttest control group design, which aims to conduct studies that focus on the use of teaching props that could be expected to improve the understanding of mathematical concepts and their impact on student interest in Elementary School. Instruments used in this research are to test the ability to understand mathematical concepts, students' interest questionnaire with the Likert scale, observation sheets, and interviews. Based on data analysis we concluded that (1) The ability to understand mathematical concepts of superior and low students who use props better than the ability to understand mathematical concepts of superior and low students who obtain conventional learning, (2) The ability to understand mathematical concepts of the superior and low students using props by cooperative learning type. (3) There is a significant correlation between students' understanding of mathematics and students' interest in learning mathematics.

Keywords: *Props, Understanding of Mathematical Concepts Ability, Student Interest*

Introduction

Most students perceive mathematics as a very challenging subject compared to other subjects. This perception is based on students' experiences that learning mathematics requires a high level of understanding because mathematics is not just about memorization but also understanding concepts related to numbers, symbols, and formulas. According to Ruseffendi (2006), the direct objects in mathematics are facts, skills, concepts, and rules. Mathematical concepts are hierarchically structured, so there should be no steps or concept stages skipped in learning mathematics. Mathematics should be learned systematically and regularly, presented with a clear structure, and adapted to the intellectual development and prerequisite abilities of the learners. Thus, mathematics learning can be carried out effectively and efficiently.

Another factor for the assumption that math is difficult may be the way the material is delivered that is less interesting, monotonous, or the way of delivery is not by the stage of child development which may be difficult for students to understand so that students' interest in mathematics is low. According to Piaget (2009: 55) at the concrete operational stage (7-11 years), generally children are studying in elementary school. At this stage, a child can make inferences from a real situation or by using concrete objects and can consider two aspects of a real situation together. By media teaching concrete, that matter may make it easier for students to understand a material logically. Teaching aids as part of learning resources should be provided by teachers to develop students' attitudes, skills and knowledge in studying mathematics, in accordance with the mandate of the 2013 curriculum (Ministry of Education and Culture, 2012).

Mathematical concepts can be learned well if the representation starts with concrete objects, related to various kinds of everyday life (contextual), so that by applying the material concretely students can appreciate mathematical concepts. The expected ideal condition of understanding concept understanding is still lacking, this is in accordance with the existence of some students still consider math difficult and meaningless (Jeheman, et.al, 2019). Many sources explain that teaching props act as a concrete bridge from concrete to abstract (Heddens in Marshall, 2008 and Kelly, 2006). In this case, language has an important role in helping students create a bridge from the concrete to the abstract (Kelly, 2006). Through teaching props, interaction in class can be developed, so that learning mathematics becomes fun and students' understanding increases.

The Student Teams Achievement Divisions (STAD) model is one type of cooperative learning model that emphasizes team achievement obtained from the sum of all individual progress scores of each team member (Yanuar, et.al, 2019). In the KTSP curriculum, the concept of fractions has usually been introduced since grade 3, but still in grade 5 there are students who still do not really understand the concept of fractions, for example the concept of multiplying fractions and dividing fractions. In connection with this, the researcher tried teaching using other media/aids, namely with folding paper props, it is hoped that it can increase interest and understanding of mathematical concepts.

Method

The research method that will be used in this research is a Mixed Method type Embedded Design with the type of Embedded experimental model. Embedded experimental model is qualitative data used in experimental design, both in pure experiments and quasi-experiments. The main priority of this model is developed from quantitative, experimental methodology, and qualitative data follows or supports the methodology. The research design used in this study is a pretest-postest control group design or with a group design, then selecting three classes that are equal in terms of academic ability. The first class obtained learning using teaching aids (experimental class 1), the second class obtained learning using teaching aids with the STAD-type cooperative model (experimental class 2), and the third class obtained conventional learning. This design can be described as follows: (Ruseffendi, 2005)

O X O
\- - - - - - - - - - - - - -
O O

Keterangan:

X: Props

O: Pretes and posttest ability to understand mathematical problems

\- - -: Subjects are not grouped randomly

Meanwhile, the relationship between the independent variables (props and STAD-type cooperative model), the control variable (initial mathematical abilities) and the dependent variable (ability to understand mathematical concepts and students' interest in learning) is expressed in the Weiner Table 1 model as follows:

Table 1. Weiner Table Relationships Between Independent Variables, Dependent Variables and Control Variables

Class / **KAM**	**Mathematical Concept Undertsanding**		
	Experimental 1 (E1)	Experimental 2 (E 2)	Control
Excellent	$\bar{X}$PKMEU 1	$\bar{X}$PKMEU 2	$\bar{X}$ PMKKU
Poor	$\bar{X}$PKMEA 1	$\bar{X}$PKMEA 2	$\bar{X}$ PMKKA

- PKMEU 1: Mathematical Concept Understanding Ability of Experimental Group Excellent-Achieving Students
- PKMEA 1: Mathematical Concept Understanding Ability of Experimental Group 1 Poor-Achieving Students
- PKMEU 2: Mathematical Concept Understanding Ability of Experimental Group 2 Excellent-Achieving Students
- PKMEA 2: Mathematical Concept Understanding Ability of Experimental Group 2 Poor-Achieving Students
- PMKKU: Mathematical Concept Understanding Ability of Control Group Excellent-Achieving Students
- PMKKA: Mathematical Concept Understanding Ability of Control Group Poor-Achieving Students

Initial mathematics abilities are classified into two categories, they are high and low. To categorize students into KAM categories, the researcher administered a prerequisite test related to the research material. KAM scores were obtained from the first-semester student report card with the data results provided in the appendix. The maximum score is 100.

The data in this research were collected through instruments administered to the research subjects. The instruments used include both tests and non-tests. The tests consist of open-ended questions, both pretest and posttest questions. These tests were given to assess students' understanding of mathematical concepts related to the taught material. On the other hand, the non-test data collection methods included the use of interest scales, observations, and interviews. The purpose of these methods was to directly observe the process of mathematics learning activities using teaching aids, understand student responses, and gauge students' interest in learning mathematics.

Research Results and Discussion

Research Result

1. **Analysis of Pretest Data on Mathematical Concept Understanding Ability**

The pretest data results were analyzed to assess students' mathematical concept understanding abilities before conducting the research. The first step involved descriptive data analysis, with the pretest results presented in the following table.

Table 2. Descriptive Statistics Pretest Data on Mathematical Concept Understanding Ability

	Experimental Class 1(AP)	Experimental Class 2 (AP STAD)	Control Class
N	20	20	21
Mean	37,0000	22,8500	30,4048
Median	34,0000	19,0000	30,0000
Std. Deviation	10,41254	18,03294	20,28030
Variance	108,421	325,187	411,290
Range	37,00	75,00	85,00
Minimum	23,00	8,00	5,00
Maximum	60,00	83,00	90,00
Sum	740	457	638,5

Based on Table 4.1, it is evident that the mean scores of the pretest results for mathematical concept understanding ability differ among the three classes. To determine whether the differences in the mean pretest scores among these three classes are significant or not, statistical tests were conducted using SPSS 21.0, following the steps outlined below:

a. Normality Test

The results of the pretest data normality analysis can be seen in Table 4.2 below:

Table 3. Result of Pretest Data Normality Test Mathematical Concept Understanding Ability

Tests of Normality							
	Kelas	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	Df	Sig.	Statistic	Df	Sig.
pretes	Kontrol	,259	21	,001	,843	21	,003
	eksperimen 1 (AP)	,150	20	,200*	,945	20	,298
	eksperimen 2 (AP STAD)	,238	20	,004	,744	20	,000

The significance values for the control class are 0.003, for experimental class 1 are 0.298, and for experimental class 2 are 0.000. The significance value for experimental class 1 is ≥ 0.05, but the significance values for experimental class 2 and the control class are < 0.05. Therefore, H_0 (null hypothesis) is rejected, and H_1 (alternative hypothesis) is accepted, meaning that the pretest data for experimental class 1, experimental class 2, and the control class are not normally distributed.

b. Mean Difference Test

Due to the data not following a normal distribution, the next step is to use a non-parametric statistical test, namely the Kruskal-Wallis test, as there are three classes of data. The results of the hypothesis test are as follows:

Table 4. Results of Kruskal-Wallis Test for Pretest Data on Mathematical Concept Understanding Ability

Test Statistics[a,b]	
	Pretes
Asymp. Sig.	,001

The significance value obtained is 0.001, which is less than 0.05. Therefore, H_1 (alternative hypothesis) is accepted, indicating that there is a difference in the mean initial mathematical concept understanding abilities among the three classes.

2. **Normalized Gain Analysis of Mathematical Concept Understanding Ability**

To determine the improvement in students' mathematical concept understanding ability, the gain score is examined. A recapitulation of test score data related to the gain in students' mathematical concept understanding ability is presented in Table 4.4 below:

Table 5. Data Recapitulation of Mathematical Concept Understanding Ability by KAM Category

KAM	**Experimental Class 1 (Props)**						**Experimental Class 2 (Props with STAD)**						**Control Class (Conventional Learning)**					
	pretes		**Postes**		**N-Gain**		**Pretes**		**Postes**		**N-Gain**		**Pretes**		**Postes**		**N-Gain**	
	$\bar{X}$	S	$\bar{X}$	S	$\bar{X}$	S	$\bar{X}$	S	$\bar{X}$	S	$\bar{X}$	S	$\bar{X}$	S	$\bar{X}$	S	$\bar{X}$	S
Excellent	42,75	8,99	75,08	22,22	,57	,35	38,50	25,65	90,83	7,36	,75	,34	51,8	29,75	78,4	11,87	,50	,18
Poor	28,38	5,07	46,5	23,11	,27	,31	16,14	7,79	50,29	21,34	,41	,27	23,72	10,59	48,75	14,98	,31	,23
Total	37,00	10,41	63,65	26,25	,45	,36	22,85	18,03	62,45	26,25	,51	,32	30,40	20,28	55,81	19,08	,35	,23

To see the difference in the average increase in gain between the 3 groups, a research hypothesis was carried out in two groups. Then the following steps are carried out:

a. Normality Test

Table 6. Normality Test Results of Normalized Gain Data Mathematical Understanding Ability Experiment Class 1 and Control Class

	Class	Shapiro-Wilk		
		Statistic	Df	Sig.
N-Gain	Control	,933	21	,159
	experimental 1 (AP)	,889	20	,025

The significance value of the control class is 0.159 and the significance value for experimental class 1 is 0.025. The significance value of the control class ≥ 0.05, while the significance value of the experimental class 1 < 0.05 so that H_0 is rejected and H_1 is accepted, meaning that the normalized gain data for experimental class 1 is not normally distributed.

b. Mean Difference Test

Table 7. Kruskal Wallis Test Results Data N-Gain Ability to Understand Mathematical Concepts Experimental Class 11 and Control Class

Test Statistics	
	N_Gain
Asymp. Sig.	,028

The significance value obtained is 0.028 < 0.05, so H_0 is rejected, meaning that the increase in the ability to understand mathematical concepts of students in experimental class 1 (class using props) is better than the control class (class using conventional learning) based on KAM (High-Low). Increasing students' ability to understand mathematical concepts using teaching props with the STAD-type cooperative learning model and students' understanding of mathematical concepts using conventional learning. The following steps were carried out, the initial stage carried out was a descriptive analysis of the data as follows:

a. Normality Test

Table 8. Normality Test Results of Normalized Gain Data Ability to Understand Mathematical Concepts Experimental Class 2 and Control Class

	Class	**Shapiro-Wilk**		
		Statistic	**Df**	**Sig.**
N-Gain	Control	,933	21	,159
	experimental 2 (AP STAD)	,912	20	,071

The significance value of the control class was 0.159 and that of the experimental class 2 was 0.071. The significance value of both ≥ 0.05 so that H_0 is accepted, meaning that the gain data is normalized for the experimental class 2 and the control class is normally distributed

b. Homogeneity Test

Table 9. Normalized N-Gain Data Homogeneity Test Results Ability to Understand Mathematical Concepts Experimental Class 2 and Control Class

Test of Homogeneity of Variances			
N-Gain			
Levene Statistic	df1	df2	Sig.
4,720	2	58	,013

The significance value obtained is 0.013 < 0.05, so H_0 is rejected, so the normalized gain data for the two classes is not homogeneous. Because the data is normally distributed and not homogeneous.

c. Mean Difference Test

Table 10. Brown Forsythe Test Results Normalized N-Gain Data Mathematical Understanding Ability

Robust Tests of Equality of Means				
N_Gain				
	Statistic[a]	df1	df2	Sig.
Brown-Forsythe	4,260	3	18,011	,019

The significance value obtained is 0.019 < 0.05, so H_0 is rejected, meaning that the increase in the mathematical understanding ability of students in experimental class 2 (class using teaching aids) is better than the control class (class using conventional learning) based on KAM (Excellent-Poor).

Then, to find out the results of normalized gain data on the improvement of students' mathematical concept understanding ability using props and students' mathematical concept understanding ability using props with the STAD-type

Cooperative learning model. Furthermore, the following steps were taken. The initial stage is descriptive analysis of the data as follows:

a. Normality Test

Table 11. Normalized Gain Data Normality Test Results Ability to Understand Mathematical Concepts Experimental Class 1 and Experimental Class 2

Tests of Normality							
	Class	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	Df	Sig.	Statistic	Df	Sig.
N-Gain	experimental 1 (AP)	,175	20	,110	,889	20	,025
	experimental 2 (AP STAD)	,215	20	,016	,912	20	,071

The significance value of the experimental class 1 was 0.025 and that of the experimental class 2 was 0.071. The significance value for experimental class 1 < 0.05 and the significance value for experimental class 2 ≥ 0.05. So H_0 is rejected and H_1 is accepted, meaning that the normalized gain data for experimental class 1 is not normally distributed

b. Mean Difference Test

Table 12. Kruskal Wallis Test Results Data N-Gain Mathematical Understanding Ability Experimental Class 1 and Experimental Class 2

Test Statistics[a,b]	
	N_Gain
Chi-Square	8,141
Df	3
Asymp. Sig.	,043

The significance value obtained was 0.043 <0.05, so was rejected, meaning that the average increase in the ability to understand mathematical concepts in experimental class 1 was better than in experimental class 2 based on KAM.

From the data obtained, it can be concluded that at α = 0.05, the increase in the ability to understand mathematical concepts of students who learn using teaching aids is better than the ability to understand mathematical concepts of students who learn using teaching aids with the STAD type cooperative model and the ability to understand concepts mathematics students who receive conventional learning.

To determine whether there is a difference in the average of six groups of student data (excellent and poor), it is calculated using the Kruskal Wallis test. The results of statistical calculations are as follows:

Table 13. Kruskal Wallis Test Results Normalized Gain Score based on the Excellent-Poor Group

Test Statistics[a,b]	
	N-Gain
Chi-Square	12,817
Df	5
Asymp. Sig.	,025

Based on Table 4.12. Asymp value. Sig. 0.025 <0.05. The statistical test results H_0 were rejected. This means that there is a significant difference in the average normalized gain value of the excellent experimental group 1, experimental poor 1, excellent experimental 2, poor experimental 2, excellent control and control poor.

To see the interaction between early math skills (superior-asor) and learning models, in this case we tested the hypothesis with 2-way ANOVA using SPSS 21.0, the calculation results are as follows:

Table 14. Normalized Gain Two Way Anova Test Results based on Initial Mathematics Ability Factors

Tests of Between-Subjects Effects					
Dependent Variable: N_Gain					
Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	4,003[a]	28	,143	2,645	,004
Intercept	9,750	1	9,750	180,393	,000
Class	,691	2	,346	6,394	,005
Values_KAM	2,770	18	,154	2,847	,005

Tests of Between-Subjects Effects					
Dependent Variable: N_Gain					
Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Class * Values_KAM	,825	8	,103	1,908	,093
Error	1,730	32	,054		
Total	17,341	61			
Corrected Total	5,732	60			
a. R Squared = ,698 (Adjusted R Squared = ,434)					

The following is an explanation based on the table above; class has a sig value of 0.005; because the class sig value is < 0.05, then H_0 is rejected. This means that there is a significant difference in students' ability to understand mathematical concepts between experimental class 1, experimental class 2, and control.

Initial Mathematics Ability (KAM) has a sig value = 0.005; because the class sig value is < 0.05, then H_0 is rejected. This means that there is a significant difference in students' ability to understand mathematical concepts between excellent and poor students.

Class*KAM has a sig value of 0.093; because the Class*KAM sig value is > 0.05, then H_0 is accepted. This means that there is no interaction between the learning model and KAM, or it can be said that there is no influence of KAM on the three classes of learning models in terms of ability to understand mathematical concepts.

3. Correlation Analysis

In this study, the independent variable is mathematical comprehension ability and the dependent variable is students' learning interest in estimating and or predicting the average (mean) of the independent variables. The formulation of the test hypothesis is as follows:

Ho : There is no significant correlation between the results of math comprehension ability (X) and students' interest in learning (Y).

H1: There is a significant correlation between the results of math comprehension ability (X) and student interest in learning (Y)

The test criteria are as follows:

If sig (2-tailed) ≥ α then H0 is accepted and H1 is rejected.

If sig (2-tailed) < α then H0 is rejected and H1 is accepted

The test results with a significant level α = 0.05 were as follows:

Table 15. Regression Coefficients

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	75,267	2,613		28,800	,000
	Postes	,087	,040	,272	2,174	,034

From the table above, the significance value of the regression coefficient is 0.034 <0.05, meaning that H0 is rejected and H1 is accepted, meaning that there is a significant correlation between the results of the ability to understand mathematical concepts and the results of students' learning interest. Furthermore, this table also illustrates the regression equation as follows:

$$Y = 75.267 + 0.087 X$$

Description

X = data on the ability to understand mathematical concepts

Y = student learning interest data

Discussion

Based on the calculations obtained, the ability to understand mathematical concepts of high and low ability students who use teaching aids is better than the ability to understand mathematical concepts of high and low ability students who get conventional learning. These findings are in accordance with Sasmita's research that there is an effect of learning models assisted by props on the ability to understand mathematical concepts of students classified as high (Sasmita, et.al, 2019). The mathematical concept understanding ability of students who use teaching aids with STAD type cooperative model is better than the mathematical concept understanding ability of students who receive conventional learning. In accordance with the results of Maulidi's research which concluded that learning the STAD Type Cooperative approach can improve student learning activities and results (Maulidi, 2022). There is a significant relationship between the ability to understand mathematical concepts of high and low ability students with low category student learning interest. However, it is different from Masni's findings which obtained the results that there is a positive and significant relationship between learning interest and student learning outcomes in the moderate category (Masni, et.al, 2021). From the description of the results of data testing using multiple regression, the results show that there is a significant effect of interest in learning on the ability of mathematical concepts partially. This is in accordance with Arifin's research that there is a significant effect of interest in learning on the ability to understand mathematical concepts (Arifin, et.al, 2022).

Conclusion

Based on the results of data processing and the findings obtained in this research, it can be concluded that the ability to understand mathematical concepts of students who use visual aids is better than the ability to understand mathematical concepts of students who receive conventional learning. The ability to understand mathematical concepts of students who use visual aids with the STAD-type cooperative model is better than the ability to understand mathematical concepts of students who receive conventional learning. There is a significant correlation between students' understanding of mathematics and their interest in learning mathematics.

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