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The Effect of Blended Learning on Students' Mathematical Proving Ability

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ABSTRACT
The blended learning given in this study is divided into two, namely face-to-face learning and electronic learning using the Moodle application. Blended learning for the first time was carried out in the Department of Mathematics Education at Musamus University. The ability to prove mathematically is one of the abilities that students majoring in Mathematics Education must have as a basic asset to teach mathematics to students at school. This ability has a high level of difficulty because it requires good mathematical reasoning and communication, therefore it is necessary to make efforts to develop an effective and efficient mathematical proofing ability. The research that has been conducted is to determine the effect of the implementation of blended learning on the mathematical proof ability of students majoring in Mathematics Education in the third semester of Musamus University. This type of research is an experimental study with a one group pretest posttest design, while the hypothesis testing uses a paired sample t-test. The results obtained are the gain value of 0.60 in the medium category and for the hypothesis the value of t count is 30.382 while the value of t table is 1.69. So, it can be concluded that the implementation of blended learning has an influence on students' mathematical proof ability.

Keywords: *The effect, blended learning, mathematical proof*

1. INTRODUCTION

Strategies in learning need to be applied by a teacher / lecturer, as one of the media in order to improve the lack of learning outcomes that are less than optimal. Weak quality and control of the e-learning learning model, such as the inability of students to manage time and process information independently, is a separate problem in implementing this learning model. Face-to-face learning also has weaknesses, which tends to make students saturated and passive. Therefore, there is a need for a combination / combination of learning. One strategy that can be done is the application of blended learning or mixed learning between face-to-face learning and electronic learning (e learning). Provide several definitions of blended learning, namely (1) a combination of traditional learning with a web-based learning approach, (2) a combination of media and tools in an e-learning environment, (3) a combination of several learning approaches, the use of learning technology [1]. Implementation of Blended Learning has two main categories, including: (1) Increasing the form of face-to-face activities. Most teachers use the term "blended learning" to refer to on the use of information technology and communication in face-to-face activities advance, either using bonded networks (web-dependent) as well as as web-supplemented that doesn't change the activity model. (2) Mixed learning (hybrid learning). Learning this model reduced face-to-face but didn't eliminate it, and make it possible learners to learn online.

The objectives of blended learning are (1) To help students understand the concept according to their respective learning styles. (2) Provide practical-realistic opportunities for teachers / lecturers and students to carry out learning independently and be more focused. (3) The use of flexibility for students by combining the best aspects of face to face and electronic learning [2]. Blended learning uses teaching materials in the form of text and videos. The videos used in the lessons were obtained from the YouTube site.

Mathematics as an important subject in everyday life requires a good level of understanding. Studying mathematics is not only limited to counting numbers, but also studying theorems that require proof of their truth. The mathematical proof method consists of the direct

proof method and the indirect method of proof. The two methods of proof have different paths so that it requires proficiency in their use. According to [3] the ability of mathematical proof is the ability to understand mathematical statements or symbols and provide reasons / evidence for the correctness of the solution. Mathematics allows students to have the ability to organize, think logically and prove logically and systematically. A logical thinking process and a mathematical proof process are needed by students to solve mathematical problems. According to [4] proof is applied to prove the theorem in the form of the implication p ⇒ q. Here p as a hypothesis is used as a known fact or as an assumption. Next, using p we must denote that q is valid. Logically this direct proof is equivalent to proving that the statement p ⇒ q is true where it is known that p is true. However, the mathematical proving ability of students of Mathematics Education at Musamus University is still low, this is based on the results of interviews with lecturers who teach subjects related to mathematical proof, for example transformation geometry and algebraic structures. Indicator of evidentiary ability Mathematically according to [3] between others: (1) Reading mathematical proof. (2) Performing mathematical proofs, directly, indirectly or with mathematical induction (3) Criticizing proof by adding, reduce or reconstitute a mathematical proof. Meanwhile, the indicators used in this study are being able to use appropriate mathematical symbols in proof, giving sentences according to the definition or theorem used.

Technology devices that can be used by students in the learning process are computers and smartphones. Almost every student has a smartphone, where the smartphone is able to have a positive impact on the learning process in the classroom [5].

2. RESEARCH METHOD

The research method used in this study is an experimental method using pre-experimental research design, namely one group pretest-posttest. The data in this study were obtained through written tests. The written test contains descriptions of mathematical proof. The research subjects were students of the Department of Mathematics Education at Musamus University who took number theory courses in the third semester of the 2019/2020 academic year, totalling 30 students. The data analysis technique in this study used descriptive statistics and inferential statistics. Descriptive statistical analysis used is the calculation of the maximum value, minimum value, median, average value, standard deviation, variance and normalized gain score test. Descriptive statistics are statistics that describe the object under study through sample data. To find out the criteria for increasing the pretest and posttest scores, a normalized gain score is used equation:

$$g = \frac{S_{post} - S_{pre}}{100 - S_{pre}} \quad (1)$$

g = gain score

S_{post} = posttest score

S_{pre} = pretest score

100 = ideal score

The qualification criteria can be seen in Table I below:

Table 1. Criteria for normalized gain

Gain Index	Criteria
$g > 0.7$	Height
$0.3 \leq g \leq 0.7$	Medium
$g < 0.3$	Low

Inferential statistics serves to analyse the research hypothesis. Hypothesis testing consists of testing using parametric and non-parametric statistics. To test parametric statistics, the normality test and homogeneity test were carried out and then used the t-test. Because paired data is used, the paired sample t-test hypothesis is used. Hypothesis testing in this study is formulated as follows.

$$H_0 = \mu_0 \leq 0$$
$$H_a = \mu_0 > 0$$

With $\mu_0 = \mu_2 - \mu_1$

H_0 : there is no effect of the implementation of blended learning on students' mathematical proof ability.

H_a : there is an effect of the implementation of blended learning on students' mathematical proof ability

μ_1 : parameter average pretest score

μ_2 : parameter average posttest score

Then the formula used:

$$t = \frac{Mg}{\sqrt{\frac{\sum g^2 - \frac{(\sum g)^2}{n}}{n(n-1)}}}$$

$$Mg = \frac{\sum g}{n}$$

Mg : average gain between pretest and posttest

g : gain scores of each subject

n : number of subjects

Table Head	Table Column Head		
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The test criteria are accepted H_0if $t_{\_hitung} \leqslant t_{\_table}$ and reject H_0 if $t_{hitung} > t_{\_table.}$ To determine the degree of freedom used dk = n – 1 and the level of significance α = 5 %.

3. RESULTS AND DISCUSSION

Data from the pretest and posttest results can be seen in Table 2

Table 2. Data for pretest and posttest

Statistics	Statistical Value	
	Pretest	*Posttest*
Sample	31	31
ideal score	100	100
Maximum Score	62	100
Minimum Score	15	47
Median	40	72,50
Average	39,69	74,69
Standard Deviation	10,69	13,86
Variance	114,31	192,16

Based on the results of the calculation of the pretest data in Table 2, the average value obtained is 39.69 and the median is 40, this shows that more than 50% of students scored below 40. Meanwhile, for the posttest results, the average score was greater than median value, indicating that more than 50% get a value above 72.50. The spread of data (variance) at the pretest and posttest is 114.31 and 192.16, this shows that the distribution of the two data is around the average value. Furthermore, when compared between the distribution of pretest and posttest data, the distribution of posttest data is greater because the data range is larger. Therefore, it can be concluded that the distribution of the posttest data is more varied than the pretest data. Furthermore, to see the criteria for the ability of mathematical proof, a gain score is calculated. Based on the pretest average value of 39.69 the posttest average value of 74.69 and the maximum value of 100, then the calculation of the gain score is 0.60. From these results, the students' mathematical proof ability is in moderate criteria. Hypothesis testing is carried out after obtaining the pretest and posttest scores using the paired sample t-test. Based on the t-test calculation of 5% and dk of 33, it was obtained 30.382 and 1.69236, this shows that>, then rejected and accepted, which means that there is an effect of the implementation of blended learning on the mathematical proof ability of students of the Department of Mathematics Education at Musamus University. This agrees with [6] that learning mathematics by applying the blended learning model can improve students' mathematical proof abilities and the achievement of students' mathematical proof abilities. The ability of mathematical proof can also increase mathematical communication skills because in the proving process, the mathematical communication skills of students who get learning using e-learning are better than students who use e-learning. conventional learning

4. CONCLUSION

Based on the results of research and discussion, it can be concluded that the implementation of blended learning on the mathematical proof ability of students of the Department of Mathematics at Musamus University based on the calculation of the gain score is in the moderate criterion of 0.60.

Development for blended learning can continue to be done on other materials and to measure other abilities such as independent learning or creativity.

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