The Effect of Direct Learning on Students' Proof Construction Ability of Palembang High School

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ABSTRACT
The purpose of this study is to comprehend the effect of direct learning on Palembang High School Students' proof ability. The research subjects were 38 students of class X IPA 5 SMAN 10 Palembang as an experimental class and 30 students of class X IPA 4 SMAN 10 Palembang as a control class. The learning process is conducted by direct learning steps. The data collection technique was a written test consisting of 3 questions. The data analysis was paired sample t-test. The results showed that the significant value was less than 0.05 so that Ho was rejected, meaning that there was a significant mean difference between the experimental and the control class. This shows that direct learning given in the experimental class by providing explanations of definitions and the process of proof taught in depth to students can help students in mathematical proof.

Keywords: *The effect, Direct learning, Proof construction ability, Palembang high school.*

1. INTRODUCTION

One of the most important things in learning is to choose a learning model. The material we will teach must be adapted to the learning model that we choose [1]. One learning model that we still encounter is the direct learning model. Direct learning is a learning model that is teacher center [2]. Central to direct learning is the teacher who focuses on clear communication [3]. The direct learning model can encourage students to be active in learning, whether expressing opinions, asking questions or answering questions. The direct learning model used has a good effect on mastery of the material because students will be guided more deeply, students' understanding will be examined by the teacher, students are given feedback, and accustoming students to apply learning outcomes that have been learned before not just memorizing the subject matter [4].

Proof is the fundamental of mathematics understanding and is essential to develop, build, and communicate in mathematics [17]. The aim of a mathematical proof can be stated as proving the trueness or falseness of an argument for every case and condition [3-5]. Proof construction is one of the ability to be considered in mathematics learning because little or many experiences that students have in proof construction in high school will have an impact on proof construction ability when were in college [14]. Construction of mathematical proof is a mathematical task in which students are provided with assumptions, axioms, definitions and asked to apply inference using previous facts and applying theorems until the expected conclusions are reached [11], [12], [13], [18]. A research result showed that that the majority of prospective teachers can't construct completely formal proof for secondary school mathematics subject [5], [10], [19].

Direct learning in this study that is seen is learning done by researchers and learning done by teachers. Direct learning by researchers is done by explaining exponential definitions at the beginning of learning and when the learning process the researcher explains the exponential rules and then explains the proof of those rules. Whereas direct learning by the teacher is done by not giving an exponent definition at the beginning of learning and when the learning process the teacher only tells the nature of the exponent without explaining the proof of the rules. Then after carrying out learning, the teacher tends to give questions instead of proof type questions. Thus the researcher wants to know the effect between direct learning conducted by researchers by providing an exponent definition at the beginning of learning and when the learning process the researcher explains the exponential rules and then explains the proof of these rules. While, learning by the teacher not explain an exponent definition at the beginning learning without explaining the proof of exponent rules.

2. METHOD

This study utilized quantitative research design that aims to determine the effect of direct learning. The method used in this study is an experimental method with true experiment design using the type of posttest only control group design. The experimental class in this study is a class that is given direct learning by the researcher by explaining the definition of exponents at the beginning of the lesson, and during the learning process the researcher explains the exponential rule then explains the proof of the rule. The data collection technique used is a test. The test consist of 3 questions in the form of description with the type of proof questions that aim to determine the students' construction proof ability. Direct learning was conducted by researchers in class X IPA 5 SMAN 10 Palembang with 38 students as subjects. Whereas learning was conducted in a control class with 30 students, the definition of exponents was not explained directly at the beginning of the lesson, and the exponential rules were not explained. The following are the guidelines for scoring the proof construction ability test which are presented in Table 1 below.

Table 1. Scoring Guidance for Proof Construction Ability Test

Scoring Criteria	Score
Perfect answer, the resolution is written completely and correctly	4
Correct answer, but the resolution given has one significant mistake	3
Correct answer, but the resolution given has more than one significant mistake	2
Wrong answer, the resolution is incomplete but at least has one correct argument	1
Wrong answer, the resolution is based on wrong argument or no answer at all	0

3. RESULT AND DISCUSSION

To determine the normality of the post test data of the experimental class and control class students performed a normality test using the Shapiro-Wilk Test. The hypothesis for drawing conclusions from the normality test is as follows.

h_0 : : the sample is normally distributed;

h_1 : The sample is not normally distributed

According to Santoso [15] in the Shapiro-Wilk test the data is said to be normally distributed if the significant value is greater than 0.05. A summary of the results of the normality test is presented in table 2.

Table 2. Normality Test

Group		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Stat	Df	Sig.	Stat	Df	Sig.
Result	A	,325	30	,000	,692	30	,000
	B	,123	38	,159	,924	38	,013

Table 2 shows that the probability (significant) for each learning group is less than 0.05. This means that Ho is rejected so that it can be concluded that the data in this study are not normally distributed. Then the researchers conducted a Mann Whitney test to see whether there was an influence on direct learning using mathematical evidence on the ability of students to construct evidence. The following is the basis for decision making that is used as a reference in Mann Whitney if the significant value is smaller than the probability of 0.05, then h_adm accepted. But if the significant value is greater than the probability of 0.05 then Ha is rejected. Here is the Whitney man test table.

Table 3. Test Statistics[a]

	Result
Mann-Whitney U	175,000
Wilcoxon W	640,000
Z	-4,983
Asymp. Sig. (2-tailed)	,000

Based on table 3 it can be seen that the significant value of 0,000. This means that the significant value is less than 0.05, the decision taken is Ha, it means that there is a difference between the experimental class and the control class. The difference between the experimental class and the control class can be seen from the results of the students' answers. In the experimental class, students tend to be able to carry out proof using exponent definitions and rules. Whereas in the control class, the students' answers indicated that the arguments used were incorrect, even some students could not prove it at all. Learning should provide a generic 'bridge' to smooth the transition to formal proof. Besides, teacher must encourage students to use aspects of mathematics such as concept and definition to solve proving problems. Thus, students' difficulties in constructing mathematical proofs can be reduced [12]. The following will present the first problem and the findings of the work of MJP (experimental class students) in the first problem where learning is used, namely direct learning that begins by giving an exponent definition at the beginning of learning and when the learning process the researcher explains the exponent's rules and then explains the proof from these rules, shown in Figure 1 and Figure 2.

Prove that if a is real number with a > 0 , $\frac{m}{n}$ and $\frac{p}{n}$ is fraction with $n \neq 0$, so

$$\left(a^{\frac{m}{n}}\right)\left(a^{\frac{p}{n}}\right) = (a)^{\frac{m+p}{n}}$$

Figure 1. Problem 1

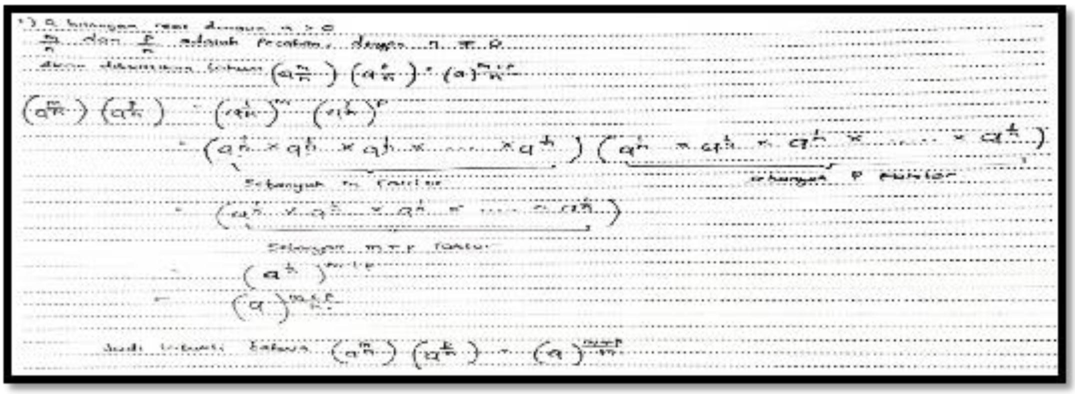

Figure 2. MJP's answer to problem 1

Figure 2 shows that ARF in the first problem as a whole can already use definitions and rules in proving it, this can be seen from the students' answers from each step of the answer, which is as follows: In step 1, ARF can change $\left(a^{\frac{m}{n}}\right)\left(a^{\frac{p}{n}}\right)$ becomes $\left(a^{\frac{1}{n}}\right)^{m}\left(a^{\frac{1}{n}}\right)^{p}$, this shows that ARF has been able to use the definition of real number rank with the rank of fractions. Then in step 2, ARF writes the multiplication of $a^{\frac{1}{n}}$ by m factors and the multiplication of $a^{\frac{1}{n}}$ by p factor, this shows that ARF has been able to use the definition of a positive round rank. In step 3, ARF writes the multiplication $a^{\frac{1}{n}}$ by $m+p$ factors, this shows that ARF has been able to use the multiplication rules of numbers. In step 4, ARF writes $\left(a^{\frac{1}{n}}\right)^{m+p}$, this shows that ARF has been able to use the definition of positive round power. In the last step (Step 5), ARF writes $(a)^{\frac{m+p}{n}}$, this shows that ARF has been able to use the definition of real number rank with fraction rank. Because ARF has been able to use definitions and rules in proving the first problem, it can be concluded that ARF is capable of constructing proof correctly.

Following will be presented the first problem and the findings of the work of NAN (control class students) in the first problem where learning is used ie direct learning that starts with no definition of exponents at the beginning of learning and when the learning process the teacher only explains the exponent rules without explaining proof of these rules, shown in figure 3 and figure 4.

Prove that if a is real number with $a > 0$, $\frac{m}{n}$ and $\frac{p}{n}$ is fraction with $n \neq 0$, so

$$\left(a^{\frac{m}{n}}\right)\left(a^{\frac{p}{n}}\right) = (a)^{\frac{m+p}{n}}$$

Figure 3. Problem 1

Figure 4. NAN's answer to problem 1

Figure 4 shows that NAN on the problem 1 which as a whole has not been able to use exponential definitions and rules in conducted proof, according to [16], students 'difficulties in constructing evidence are often due to students' lack of understanding of the prerequisite material, definitions and certain rules that are used as components in proving something. This can be seen from the students' answers from each step of the answer students complete the proof using this number in line with research conducted by [8] which states that students tend to use numbers in proving activities should not prove using numbers.

4. CONCLUSION

The results showed that there was a difference between the experimental class and the control class, this can be seen from the significant value of 0,000, which means a significant value of less than 0.05, the decision taken was reject Ho. It shows that the definition and process of proof taught in depth to students can help students prove mathematics. Furthermore, students who were not given an explanation of the definition experienced difficulties to prove formally, not becouse of a lack of knowledge about the material, but students could only explain it informally so that it was difficult to use the definition to contruct proof. As a result, students focus on procedures rather than content.

AUTHORS' CONTRIBUTIONS

All authors contributed to compling, designing, and implementing this research.

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