

# THE USE OF PRELOVED PRODUCTS BASED ON EKSPERIENTIAL LEARNING TOWARDS STUDENTS' ABILITIES IN FORMULATING THE CONJECTURES AND MATHEMATICAL JUSTIFICATIONS

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**Abstract.** This study is based on the fact that students have low abilities in formulating conjectures and mathematical justifications. In order to solve the problem, this study is carried out by utilizing preloved products based on experiential learning. This is a quasi design - an experimental through nonequivalent control group design by using purposive sampling technique. The populations of this study are the 7<sup>th</sup> grade students of junior high school in Serang City – Banten academic year 2018/2019. The samples are the 7<sup>th</sup> grade students of a junior high school in Serang. The instruments employed in this study are as follow : tests of formulating the conjecture and students' mathematical justifications, attitude scales, and also observation sheets of teacher and students' activities. Quantitative analysis is performed by applying the mean difference tests. The results of this study show these following things : (1) Students who are exposed to using preloved products based on experiential learning improve their ability in formulating the conjecture better than those who are exposed to conventional learning approach in terms of total students and their prior levels of mathematical knowledge (high, medium and low); (2) Students who are exposed to using preloved products based on experiential learning improve their abilities in mathematical justifications better than those who are exposed to conventional learning approach in terms of total students and their prior levels of mathematical knowledge (high, medium, and low).

**Key words** : Preloved products, conjecture, justification, experiential learning

## 1. Introduction

The word conjecture is not a common term in mathematics; in fact (Bergqvist, 2005) have stated that the use of conjecture is students' initial attempt in mathematical objects that are relatively abstract by correlating a theory through assumption of the facts obtained. (Reid, 2002) states that conjecture ability is the first step in determining mathematical concepts to define new theorems. Meanwhile, in an attempt to verify the relations between those assumptions in formal evidence, the ability to formulate the conjecture does not end in the process itself but students must be able to prove the evidence (Zakeri & Ghasemi, 2016) (Alm & Andrews, 2019). Referring to Wilson's (Wilson, 1998) (Bergqvist, 2005) research results, getting students to formulate a conjecture to become a valid justification would let them be capable of thinking critically and creatively as well as conveying and granting mathematical arguments.



In learning mathematics, justification is one of the important components to build students' abilities in mathematical reasoning aspects, understanding mathematical concepts impeccably as well as mathematical communication (John, 2017). Meanwhile, through their research, (Dündar & Gündüz, 2017) (Oktaviyanthi, 2015) discover that justification ability of the teachers' candidates in the materials of congruence and similarity in triangles is at low level. It is shown by the numbers of their inaccurate answers because they found difficulties in answering the questions to match the materials in their actual daily lives. Same study is carried out by Cioe et. All (Supriani, Fardillah, & Herman, 2019) who find out that students do not understand what justification is and they could not respond some questions, such as "Justify your answer," or "Why did you do what you have done?", or "Are you sure to give the right answer?" Students only focus on employing steps in problem solving without naming the relationships between the materials and their daily lives.

Those problems above show that students must be capable of giving alternative answers from various references as their prior knowledge in the next steps. Hence, students need to be able to plan solutions in order to increase their abilities in formulating questions and answers, some of the activities that could be done in this step are: trying to find out or recall problems that have been solved previously which are similar to the actual problems, finding out the patterns or rules, and arranging procedures to solve the problems.

Learning model plays important roles in providing, elaborating, giving examples and exercises to students to reach specific goals. In accordance to Curriculum 2013 that emphasizes learning using scientific approaches in which the approaching steps in learning processes are through getting information from observation, asking, experiment, then processing those data or information, continued to analyzing, reasoning, and concluding or creating (Oktaviyanthi & Supriani, 2015) (Tambunan, 2019). For this reason, Turmudi in (Fardillah, Sutaagra, Supriani, & Farlina, 2019) states that there are changes in viewpoints of learning from "closed to open", "transmission to participation," also "accepting to constructive." These changes require that learning processes, that once dominated by the teachers, give wide opportunities to students to learn and explore. As a result, learning processes should emphasize on the students' learning experience. It is relevant to the ideas of Beard & Wilson (Wilson, 1998) (Oktaviyanthi, 2015) who state that learning based on utilizing new experience and learning reaction towards their experience to build understanding and transfer knowledge, experience, and attitude. One of the learning models that emphasizes on experience is experiential learning model.

Experiential learning process which prioritizes experience must employ proper learning media. In this study, the writers use preloved products or secondhand products. In Oxford Dictionary, preloved products means goods that are not new; owned by somebody else before. People have different points of views regarding preloved products, some people think that preloved products could be anything that is still can be used and it is not necessarily clean (Yap, In, & 2017, 2017).

## 2. Research Methods

This is a quasi experiment in which the research design employed is nonequivalent control group design (Ruseffendi, 2005). The populations of this study are students of junior high school in Serang City academic year 2018/2019. The samples are taken by using purposive sampling. The samples are students of class VII A and VII B in a junior high school in Serang City. The instruments employed in this study are tests of formulating conjecture and students' mathematical justifications abilities.

## 3. Result and Discussion

At this time, we have seen many existing resources or used goods that produce new items that are very useful and used, which underlie the authors using preloved product media in the process of learning mathematics in class VII students of Serang State Middle School in the measurement material, point and so on. With experience-based learning that emphasizes not only teacher-centered but also

students, making students because they make their own media learning, the results seen from the pre-test results with the results of the post-test.

The discussion of the research results is based on some factors observed and found in the study.

**a. Improvement in abilities to formulate the conjectures based on learning process**

Below is the general review of the N-Gain mean scores of students' abilities in formulating the conjectures based on learning process.

**Table 1.** N-Gain Mean Scores of the ability to formulate the conjectures

Classes	N-Gain mean scores	Classification
Experimental	0.43	Middle
Control	0.24	Low

Table 1 above shows that the N-Gain mean score of experimental class is 0.45 and it is classified as middle; meanwhile, the N-Gain mean score of control class is 0.24 and it is classified as low. Hence, it could be concluded that the N-Gain mean score of experimental class is higher than the control class in terms of formulating the conjectures. It shows that using preloved products through experiential learning provides better contribution than the conventional leaning approach towards students' abilities in formulating the conjectures.

Further, to verify that the N-Gain mean score of students' abilities in formulating the conjectures in experimental class is better than that in control class, N-Gain difference test score is carried out through nonparametric test (Mann-Whitney). Below is the summary of the N-Gain difference test score with the significant level  $\alpha = 0.05$ .

**Table 2.** Results of the N-Gain difference test score in term of students' abilities in formulating the conjectures

Statistic	Scores	Information	Conclusion
Mann-Whitney	334.000	H0 rejected	Hypothesis accepted
Z	-4.598		
Asymp. Sig. (2-Tailed)	0.000		
Asymo. Sig. (1-Tailed)	0.000		

From the Mann-Whitney test above, it could be seen that the p-value or sig (1-tailed) is  $0.000 < \alpha = 0.05$ . It shows that H0 is rejected. It means that students' improvement in terms of abilities to formulate the conjectures is better when exposed to learning using preloved products based on experiential learning than those who are exposed to conventional learning approach.

**b. Improvement in abilities to formulate the conjectures based on mathematical prior knowledge and the learning process**

Below is the general review of the mean score improvement in formulating the conjectures based on mathematical prior knowledge and the learning process.

**Table 3.** N-Gain Mean Scores of students' abilities in formulating the conjectures based on mathematical prior knowledge

Abilities measured		Conjecture Abilities		
Learning Model		PE	PK	Mean
KAM Categorization	High	0.64	0.42	0.22
	Middle	0.41	0.23	0.18
	Low	0.36	0.11	0.25

## Information:

KAM : mathematical prior knowledge

PE : experiential learning

PK : conventional learning

From table 3 above, it could be seen that students categorized as low in KAM who are exposed to learning using preloved products based on experiential learning achieve more improvement compare to those who are categorized as high and middle in KAM. It is shown by the contrasting N-Gain mean scores of the students' abilities in formulating the conjectures in every KAM category, as for the difference in high category of KAM is 0.22, the difference in middle category of KAM is 0.18, and the difference in low category of KAM is 0.25. There is a difference in students' improvement between those who are exposed to learning using preloved products based on experiential learning and those who are exposed to conventional learning approach. As for students who are exposed to learning using preloved products based on experiential learning, there is 0.23 difference point between high and middle KAM categories; 0.28 difference point between high and low KAM categories; and 0.05 difference point between middle and low KAM categories.

On the other hand, group of students who are exposed to conventional learning approach, there is 0.19 difference point between high and middle KAM categories; 0.31 difference point between high and low KAM categories; and 0.12 difference point between middle and low KAM categories. These facts show that the higher mathematical prior knowledge that students have, the higher abilities in formulating the conjectures they achieve. It indicates that there is a correlation between students' mathematical prior knowledge and students' abilities in formulating the conjectures. To test whether there is a difference in term of improvement in students' ability to formulate the conjectures between those who are exposed to preloved products based on experiential learning (experiment class) and those who are exposed to conventional learning approach (control class) reviewed from mathematical prior knowledge (high, middle, and low), test of difference N-Gain mean scores needs to be carried out. Below is the result of the difference N-Gain mean scores test with the significant level  $\alpha = 0.05$ .

**Table 4.** Results of the difference N-Gain mean scores test in abilities to formulate the conjectures based on students' prior mathematical knowledge and the learning process

KAM	Learning process	Comparison of the means	Sig.	Conclusions
High	PEL : PK	0.64 : 0.42	0.159	H0 accepted
Middle	PEL : PK	0.41 : 0.23	0.004	H0 rejected
Low	PEL : PK	0.36 : 0.11	0.000	H0 rejected

Referring to table 4 above, it could be concluded that students who are categorized as high in mathematical prior knowledge improve their abilities in formulating the conjectures better when exposed to using preloved products based on experiential learning than those who are exposed to conventional learning approach. Students who are categorized as middle and low in mathematical prior knowledge improve their abilities in formulating the conjectures better when exposed to using preloved products based on experiential learning than those who are exposed to conventional learning approach. Further, those who are categorized as low in mathematical prior knowledge improve their abilities in formulating the conjectures better when exposed to using preloved products based on experiential learning than those who are exposed to conventional learning approach.

### c. Improvement in mathematical justification abilities based on the learning process

Below is the general review of the N-gain mean scores of students' mathematical justification abilities based on the learning process.

**Table 5.** N-Gain mean scores of students' mathematical justification abilities

Classes	N-Gain mean scores	Clasification
Experiment	0.83	Middle
Control	0.29	Low

Table 5 above shows that the N-Gain mean score of the experiment class which is classified as middle is 0.83; on the other hand, the N-Gain mean score of the control class which is classified as low is 0.29. As a result, it can be concluded that the N-Gain mean score of the students' mathematical justification abilities in the experiment class is bigger than those in control class. It shows that the use of preloved products through experiential learning provides better contribution towards students' mathematical justification abilities compare to the conventional learning approach.

To test whether the N-Gain mean scores of the students' mathematical justification abilities in the experiment class is better than that in control class, test of difference N-Gain mean scores is carried out by using non-parametric test (Mann-Whitney). Below is the result of the difference N-Gain mean scores test with the significant level  $\alpha = 0.05$ .

**Tabel 6.** Results of the difference N-Gain mean scores of students' mathematical justification abilities

Statistic	Scores	Information	Conclusion
Mann-Whitney	110.000	H0 rejected	Hypothesis accepted
Z	-6.793		
Asymp. Sig. (2-Tailed)	0.000		
Asymo. Sig. (1-Tailed)	0.000		

Referring to the results of Mann-Whitney test above, it could be concluded that p-value or sig. (1-tailed) is  $0.000 < \alpha = 0.05$ . It shows that H0 is rejected. It means that students' improvement in terms of mathematical justification abilities is better when exposed to learning using preloved products based on experiential learning than those who are exposed to conventional learning approach.

#### d. Improvement in mathematical justification abilities based on mathematical prior knowledge and the learning process

Below is the general review of the mean score improvement in students' mathematical justification abilities based on mathematical prior knowledge and the learning process.

**Table 7.** N-Gain mean scores of students' mathematical justification abilities based on mathematical prior knowledge

Abilities measured		Mathematical justification abilities		
Learning Model		PE	PK	Mean Scores
KAM Categories	High	0.82	0.32	0.50
	Middle	0.79	0.31	0.48
	Low	0.94	0.25	0.69

From table 7 above, it could be seen that students who are exposed to learning using preloved products based on experiential learning achieve better improvement in those who are categorized as low in KAM than those who are categorized as high and middle in KAM. It is shown by the contrasting N-Gain mean scores of the students' mathematical justification abilities in every KAM category, as for the difference point in high category of KAM is 0.50, the difference point in middle category of KAM is 0.48, and the difference point in low category of KAM is 0.69. There is a difference in terms of students' improvement in mathematical justification abilities between those who are exposed to

learning using preloved products based on experiential learning and those who are exposed to conventional learning approach. As for students groups who are exposed to learning using preloved products based on experiential learning, there is 0.03 difference point between high and middle KAM categories; 0.12 difference point between high and low KAM categories; and 0.15 difference point between middle and low KAM categories.

On the other hand, in groups of students who are exposed to conventional learning approach, there is 0.01 difference point between high and middle KAM categories; 0.07 difference point between high and low KAM categories; and 0.06 difference point between middle and low KAM categories. The facts show that the higher mathematical prior knowledge that students have, the higher their mathematical justification abilities achieved. It indicates that there is a correlation between students' mathematical prior knowledge and students' mathematical justification abilities.

To test whether there is a difference in terms of students' improvement in mathematical justification abilities between those who are exposed to learning using preloved products based on experiential learning (experiment class) and those who are exposed to conventional learning approach (control class) reviewed from their mathematical prior knowledge (high, middle, and low), test of difference N-Gain mean scores needs to be carried out. Below is the result of the difference N-Gain mean scores test with the significant level  $\alpha = 0.05$ .

**Table 8.** Results of the difference N-Gain mean scores test of students' mathematical justification abilities based on their prior mathematical knowledge and the learning process

KAM	Learning process	Comparison of the means	Sig.	Conclusion
High	PEL : PK	0.82 : 0.32	0.007	H0 rejected
Middle	PEL : PK	0.79 : 0.31	0.001	H0 rejected
Low	PEL : PK	0.94 : 0.25	0.000	H0 rejected

Referring to table 8 above, it could be concluded that students who are categorized as high in mathematical prior knowledge improve their mathematical justification abilities better when exposed to using preloved products based on experiential learning than those who are exposed to conventional learning approach. Students who are categorized as middle and low in mathematical prior knowledge improve their mathematical justification abilities better when exposed to using preloved products based on experiential learning than those who are exposed to conventional learning approach. Further, those who are categorized as low in mathematical prior knowledge improve their mathematical justification abilities better when exposed to using preloved products based on experiential learning than those who are exposed to conventional learning approach.

It is reasonable that there are differences between students' improvements in terms of abilities to formulate the conjectures and mathematical justifications when they are exposed to using preloved products based on experiential learning and those who are exposed to conventional learning approach. Theoretically, the application of using preloved products based on experiential learning would differ from the conventional learning approach. In addition, the application of using preloved products based on experiential learning would result in some positive effects that are not available in the conventional learning approach. Hence, if we maximize those positive effects, the learning processes would be much better.

Below are the documentations of the learning processes using preloved products based on experiential learning in which students create the learning media themselves while the teacher serves as the facilitator.



Picture 1.  
Plastic ropes to determine the lines



Picture 2.  
Satay sticks to determine the angles



Picture 3.  
Broom sticks to determine the lines



Picture 4.  
Ice cream sticks to determine the two-dimensional figures

#### 4. Conclusion

- 4.1 Students who are exposed to using preloved products based on experiential learning improve their ability in formulatong the conjecture better than those who are exposed to conventional learning approach in terms of total students and their prior levels of mathematical knowlede (high, medium and low);
- 4.2 Students who are exposed to using preloved products based on experiential learning improve their abilities in mathematical justifications better than those who are exposed to conventional learning approach in terms of total students and their prior levels of mathematical knowledge (high, medium, and low).

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