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by Lilis Marina Angraini

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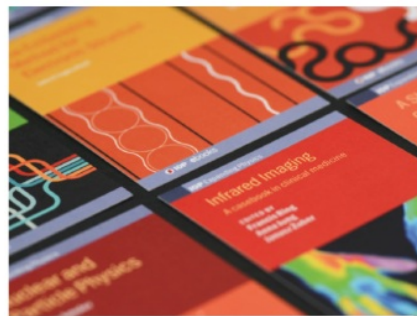
The Improvement of mathematical generalization reasoning of university students by concept attainment model

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Abstract. This study aims to look for the improvement students of university on mathematical generalization reasoning by concept attainment looked from overall, Prior Mathematical Knowledge (PMK) and interaction between learning models and PMK toward mathematical generalization reasoning. This research is designed by Quasi experiments. The one of State Islamic Universities is the place of this research. This research used Kolmogorov-Smirnov test, Levene test, t-test, two-way for analysing the data. The results of this study are: (1) The students' improvement on mathematical generalization reasoning who taught by concept attainment model is better than those who taught by conventional learning looked from overall; (2) There is interaction between learning models and PMK toward students' improvement on mathematical generalization reasoning.

1. Introduction

Mathematical reasoning is a process that always takes place in the mind that must be developed consistently using various contexts. This means that mathematical reasoning is the ability to analyze mathematical situations that take place, then the results of the analyzing process reach a concrete conclusion.

Loc & Uyen [1] said reasoning is a thought process that links facts that are known to lead to a conclusion. This is in line with what is expressed by Mofidi [2] which states reasoning as the process of drawing logical conclusions based on facts and available sources. Based on the two opinions above, it can be concluded that reasoning ability is needed to obtain a conclusion based on the facts before taking a decision. Reasoning is the process of human thought that tries to arrive at a new statement which is a continuation of another known statement. The known statement is called the premise, while the new statement is called a conclusion. From the opinions above it is concluded that reasoning is a thought process carried out by someone to obtain a new idea.

Priestley [3] revealed that mathematics is a science obtained through reasoning, mathematics is a knowledge of logical reasoning and knowledge of logical structures. While according to Jacobs [4] mathematics is formed as a result of thoughts related to an idea, process and reasoning. This means that to understand mathematics, someone needs to do reasoning.

Zalaghi [5] says that the reasoning which concludes a general conclusion of the premises in the form of an empirical proposition is called generalization. Ellis [6] reveals that generalization is a process of reasoning that is based on examination of things sufficiently then to get a conclusion for everything or most of it. In the process of learning, when faced with a mathematical problem by examining the facts of a problem can be drawn a conclusion from a concept.

The indicators of the ability of mathematical generalization in this research are: (1) symbolic expression of generality, students have been able to produce a general rule and pattern; (2) manipulation of generality, the student is able to use the generalization result to solve the problem.

Generalization based on the principle of what happens several times in certain conditions can be expected to always occur if the same conditions are met, therefore the results of this reasoning are only in the form of expectations or expectations. Furthermore, generalizations include observing specific facts and finding patterns or rules that underlie them. This is in line with Bakker [7] who revealed that making generalizations is making estimates or guesses based on knowledge developed through specific facts.

Generalizing broader structures in mathematics learning is a difficult process for some students. Students must have good mathematical reasoning skills. Nutchey [8] said generalization is an extension of understanding of the application of existing processes and structures to a wider collection of phenomena or problems. The expansion of understanding must be logical is the result of the application of existing processes and structures from several reasoning phenomena. Strachota [9] said the results of generalizing reasoning are only a hope or a guess. Estimates or guesses are based on knowledge developed through specific facts.

According to Bruner [10] learning mathematics is learning about the concepts and structure of mathematics contained in the material studied, then looking for relationships between the concepts and mathematical structures. When a person is faced with a new knowledge, a person must go through certain stages, in order to learn knowledge optimally.

Joyce & Weil [11] said the system needed in concept attainment model is a system that provides many examples and not examples. This support system is needed so that students see sufficient examples, and ultimately master the concepts contained in these examples. So, students do not find new concepts, but master existing concepts, through observing examples.

The stages carried out in learning are giving direction to students about the concept attainment model, then presenting data in the form of positive and negative examples of numbers. A positive example is an example that shows a picture or a real form of the concept to be introduced, while a negative example is an example that illustrates or forms that are not in accordance with the concept.

formulation of the problems there are: (1) Is the improvement on mathematical generalization reasoning who taught by Concept Attainment Model (CAM) is better than those who taught by Conventional Learning (CL) looked from the overall and looked from the PMK? (2) Is there interaction between models and PMK toward students' improvement on mathematical generalization reasoning?

2. Methods

The method in this research is a quasi experiment. The number of classes in this research is two classes. The experimental is a class that gets learning with a concept attainment model and the control is a class that gets learning with a conventional model.
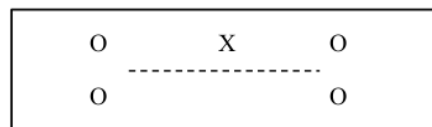
The design in this research is illustrated as follows:

| O | X | O |
| O | | O |

Figure 1. Design a plan. [12]

Information:
O: Pretest and postest
X: Learning concept attainment model

The variables in this study are 3, namely independent variable, dependent variable and control variable. The independent variable of this research is learning with concept attainment model applied to mathematics courses in the experimental class, and conventional learning applied to the control

class, the dependent variable is the mathematical generalization reasoning, and the control variable in this study is prior mathematical knowledge (high, medium and low).

In each implementation of the study does not rule out the possibility of other variables that will also affect the dependent variables, such as the length of time to study, additional learning, class conditions and so on. In order for the external variables that occur in this study not to significantly affect the dependent variable, control was carried out during the study by: (1) habituating to students in applying CAM learning for a half semester; (2) it is permissible to conduct discussions outside the learning period provided that the discussion will be discussed again in class.

3. Results and Discussion

During the learning process using CAM the student as a whole looks carefully at it. The role of students in the presentation phase of the data is to observe it, capture the purpose and meaning, analyze the characteristics possessed by the concept. Students are asked to discuss to identify the characteristics of the concepts learned then find concepts based on the characteristics they have found. The role of the lecturer here provides stimuli so that they are able to find concepts through their own discoveries.

During the discussion process, the lecturer gave confirmation about the accuracy of the concepts learned, so that students who were not right in the process of finding the concept got directions about the mistakes they made.

During the learning process in the conventional class students did not ask too many questions, they only received explanations from the lecturer. When the lecturer asks about what has not been understood, they rarely answer there. The conventional learning process takes place well and exciting. The lecturer began to explain the material accompanied by one to two examples. Often time is not enough to work on the existing problem exercises, let alone discuss them in class, because lecturer gives more apperception and student motivation at the beginning of learning.

Based on the results of the test post test CAM class, no errors were found that were too important. Errors made are only due to lack of accuracy when adding up, or incorrect formulas. Based on the results of conventional class posttest trials, no errors were found in the completion of algebra conducted by students who received conventional learning. This also proves that conventional class students do not have problems related to algebraic operations.

Based on the results of observations during the study it was found that:

- Giving apperception and motivation is better in conventional class than CAM class. This is because lecturer who teach in conventional class have more experience than lecturer who teach in the CAM class, so the motivation given is more diverse and apperception is also more profound.
- Selecting problems in the class is more diverse in the CAM class than the conventional class, this is because the CAM class is given an worksheet that contains a variety of problems that require resolution, while in conventional class lack of time in learning because many are used to explain concepts.
- Encouraging students to solve the problems given is not too often done in the CAM class, because students are quite capable of completing it by discussing with their group colleagues. While in conventional classrooms, lecturer always encourage students to find solutions to the exercises given.
- Creating discussions between students in groups in the CAM class is rarely done because the learning system is more dominated by lecturer.
- Setting the time to solve the problems given in CAM class is rarely done, because during learning often lacks time, so often the exercises given are used as homework.
- Observing and directing student activities is rarely done because the learning system applied is conventional learning, so group discussions rarely occur.
- Conduct question and answer with the lecturer about the material being studied and the problem proposed, the average is lower in the conventional class because learning often uses the expository method, so the lecturer is more dominant during learning.

- Expressing ideas to solve problems given is rarely done by students in conventional class, they often exchange opinions with their next friends, students seem reluctant to ask their lecturer.
- Providing opinions on solving problems raised by other students is rarely in conventional classrooms, due to time constraints during learning, so the exercises given by lecturer are rarely discussed together.
- Convincing other students about the accuracy of the responses submitted is not seen in conventional classrooms, because they are more often used during learning time to understand learning material and examples given by lecturer.

Furthermore, because the data gain group normalized the CAM class and the conventional class have homogeneous variances and both are normally distributed, to determine the significance of the differences in the mean of the two groups, a two-way variance analysis is conducted. This analysis was conducted to see the direct effect of the two different behaviors given to the students' mathematical generalization according to the learning model and the prior mathematical knowledge and their interactions.

Table 1. The Variance Analysis of the Mathematical Generalization Reasoning

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	0,607ª	5	0,121	4,605	0,002
Intercept	25,068	1	25,068	950,591	0,000
Learning	0,293	1	0,293	11,094	0,002
Prior mathematical knowledge	0,077	2	0,039	1,467	0,241
Learning * Prior mathematical knowledge	0,237	2	0,119	4,497	0,016
Error	1,266	48	0,026		
Total	26,941	54			
Corrected Total	1,873	53			

a. R Squared = ,324 (Adjusted R Squared = ,254)

The results of this study are as follows:

- The improvement on mathematical generalization reasoning who taught by concept attainment model is better than those who taught by conventional learning looked from overall.
- The improvement on mathematical generalization reasoning who taught by concept attainment model is not better than those who taught by conventional learning looked from the PMK
- There is interaction between models of learning and PMK toward students' improvement on mathematical generalization reasoning ability. However, the learning factors have a significant affect on students' mathematical generalization reasoning and PMK does not have a significant affect on students' mathematical generalization reasoning.

4. Conclusion

Based on the analysis, we conclude that the students' improvement on mathematical generalization reasoning who taught by concept attainment model is better than those who taught by conventional learning looked from overall. There is interaction between learning models and PMK toward students' improvement on mathematical generalization reasoning.

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