Effectiveness of the Application of Cooperative Learning Models Type Group Investigation on Discrete Mathematics Courses at Informatics Engineering Study Program of Polytechnic of South Aceh

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ABSTRACT

The results of student learning in the Informatics Engineering Program in the Discrete Mathematics course showed unsatisfactory results. There were 40 students who took part in the lecture. Students who get D and E scores are 18 people. The value of students who do not pass reaches 45%. In addition, student activities during the course of learning are very passive. Students only receive material delivered by lecturers and are not actively involved in learning. The problem formulation in this study is how the learning outcomes and learning activities of students are taught using the cooperative learning model type Group Investigation and conventional learning models in Discrete Mathematics courses in the Informatics Engineering Study Program in South Aceh Polytechnic?. The purpose of this study was to find out the learning outcomes and student activities while learning using the Group Investigation model. This type of research is a pure experiment with random design, pre-test, post-test. Research procedures go through several stages, namely initial observation, preparation, implementation, evaluation, and final results. The research subjects were Informatics Engineering students of South Aceh Polytechnic Semester II consist of two group, namely classes 2A and 2B. The data in this study is the test value on sequence and number series materials; and the observation of student activities during the learning process. Data collection techniques used in this study were test questions and student activity observation sheets. The analysis technique used were t-test statistical data and percentage formula. The results of the final test data analysis in both the experimental class (2A) and the control class (2B) using the t-test of two parties at a significant level α = 0.05 were obtained $t_{count} \approx 1{,}71$ and $t_{table} \approx 1{,}71$. So the relationship obtained $t_{count} > t_{table}$ or $1{,}71 > 1{,}69$. It can be concluded that student learning outcomes with cooperative learning model Group Investigation type are better than learning without using cooperative learning model Group Investigation type (conventional model) in Discrete Mathematics courses especially in Sequence and Series sub material in Informatics Engineering Study Program South Aceh Polytechnic. The average percentage of student activity during the three meetings was 75.40% and was in the very active category.

I. Introduction

A. Background

The learning outcomes in the Informatics Engineering Program in the Discrete Mathematics course showed unsatisfactory results. Students who attended the lecture numbered 40 people. Students who get D and E scores are 18 people. The value of students who failed reaches 45%. In addition, student activities during the course of learning are very passive. Students only receive material delivered by lecturers and are not actively involved in learning. Based on the values obtained by the student, the researcher took an action to develop cognitive aspects and student activities through the application of the cooperative learning model type Group Investigation in Discrete Mathematics courses in the Informatics Engineering Study Program.

Students are divided into several small groups and then given problems regarding the material contained in the Discrete Mathematics course. Students are asked to find solutions to problems related to the material provided. The solution is solved by students using the steps of the cooperative learning model type Group Investigation. Students design their own problem solving in groups and discuss it, and draw conclusions in groups, so students are actively involved in the learning process. The limitation of the problem in this study is the material discussed about the sequence and series of numbers which are sub-material from the Discrete Mathematics course.

B. Problem formulation

The problem formulation in this study is how the learning outcomes and student learning activities using the cooperative learning model of the Group Investigation type and conventional learning models in the Discrete Mathematics course in the Informatics Engineering Study Program of South Aceh Polytechnic?.

C. Research Objectives

The purpose of this study was to find out the learning outcomes and learning activities of students who were taught using the Group Investigation type cooperative learning model and without cooperative learning model Group Investigation in the Mathematics Discrete Mathematics course at the Informatics Engineering Study Program of South Aceh Polytechnic.

II. Literature Review

A. Effectiveness of Learning Models

According to [1] effectiveness is interpreted as influence, effect, and bring results. Based on the dictionary, it can be interpreted that effectiveness is a result of the treatment given to the object of an object. The effectiveness of the application of the Group Investigation cooperative learning model in this study can be seen from the learning outcomes and student activities during the learning process. Good student learning outcomes and effective student activities are characteristics that the effectiveness of the Group Investigation learning model that is applied successfully.

According to [2] that the effectiveness of learning can be seen from student activities during learning takes place, students 'responses to learning and mastery of students' concepts. To achieve an effective and efficient learning concept, there needs to be a reciprocal relationship between students and teachers to achieve a goal together. Then [3] explains that effective learning is a combination that consists of human, composed of material, facilities, equipment and procedures directed at changing student behavior toward a positive and better in accordance with the potential and differences that students have to achieve the set learning goals.

B. Cooperative Learning Models

Cooperative learning is one of the learning models where learning activities are carried out by the teacher by creating learning conditions that enable the learning process of fellow students. The interaction process will be possible if the teacher organizes learning activities in a setting of students working in a group. According to [4] that cooperative learning methods can: (a) teach students to trust lecturers; (b) thinking ability; (c) seek information from other sources and learn from other students; (d) encourage students to express their ideas verbally and compare with their friends' ideas; (e) help students learn to respect each other smart students and students who are lacking and can accept differences. [5] States that cooperative learning is peer learning where students work in small groups with different abilities.

C. Cooperative Learning Model Type Group Investigation

The cooperative learning model of type Group Investigation is a model that emphasizes the search process of knowledge rather than the transfer of knowledge [6]. Students are subject to learning that needs to be actively involved in the learning process through various activities so students are directed to discover facts, build concepts, and new values needed for their lives. Then [7] that investigation group learning is a learning model that directs students to solve problems

together as group assignments with individual responsibility, so that students can be critical and creative in exploring knowledge.

Based on the quotation, it can be concluded that the cooperative learning model of Group Investigation is a learning model designed through the division of students in small groups. Students are given problems about the material to be taught then plan investigations, carry out investigations, prepare reports, presentations, and evaluations. The steps of the cooperative learning model type Group Investigation can be seen in Figure 1.
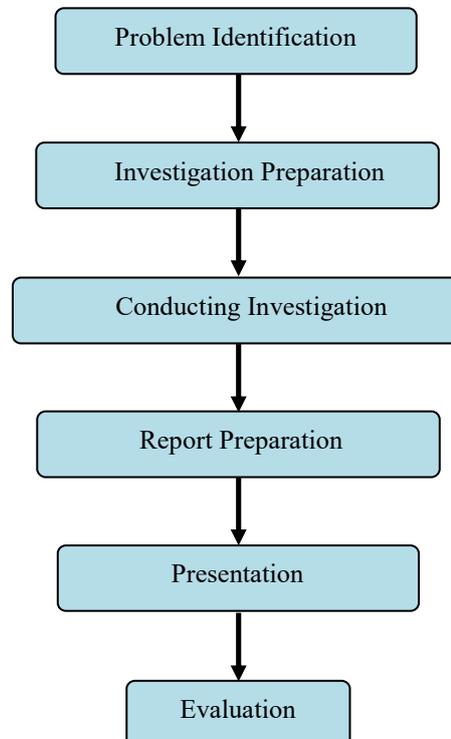

Figure 1. Syntax of Cooperative Learning Model Type Group Investigation

D. Sequence and series material

The material to be discussed in this study are sequence and number series which include 1) number pattern, 2) arithmetic sequence and series, 3) geometry sequence and series, and 4) infinite geometric sequence and series.

III. Research Methods

A. Type and design of research

The type of research used is pure experimental research, while the research design is random-pre-test-post-test.

B. Research procedure

The procedures in this study are 1) preliminary observations, 2) preparation stages, 3) implementation stages, 4) evaluation stages, and 5) final results. The procedure of the research carried out is explained in Figure 2.
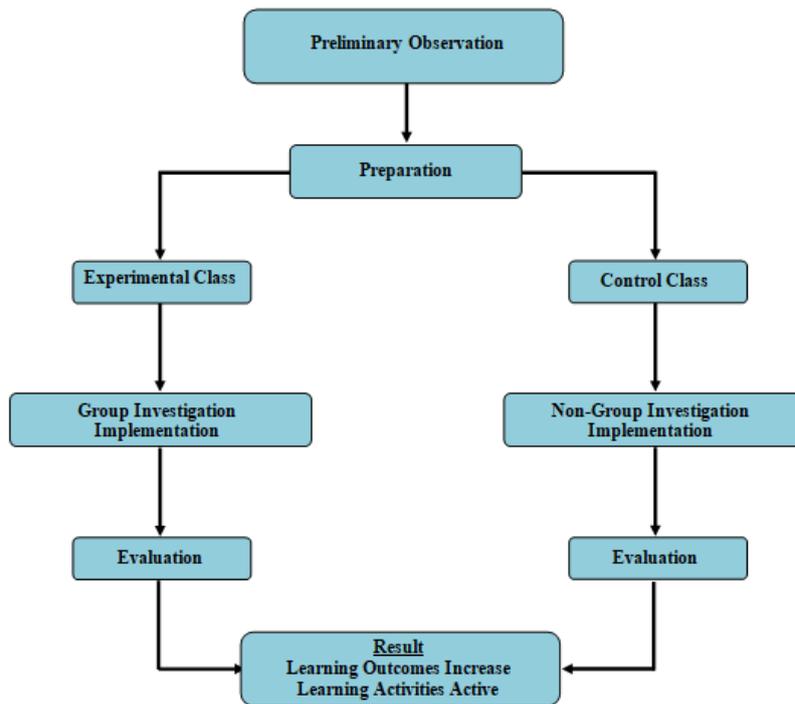
Figure 2. Research Procedure

C. Research Subjects and Location

The subjects in this study were semester II students of the Informatics Engineering Study Program of South Aceh Polytechnic who were selected by random sampling. Classes taken in classes 2A and 2B.

D. Data Collection Techniques

Data collection techniques used in the form of test questions and student learning activities observation sheets.

E. Data Analysis Techniques

Analysis of student learning outcomes data was analyzed using formulas:

$$t = \frac{\bar{x}_1 - \bar{x}_2}{S^2 \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}} \tag{1}$$

Information:

t	:	value t_{table} atau t_{count}
$\bar{x}_1$	:	The average value of the experimental class
$\bar{x}_2$	:	The average value of the control class
S^2	:	Combined standard deviation
n_1	:	Number of students in the experimental class
n_2	:	Number of students in the control class

Hypothesis testing:

$H_0: \mu_1 = \mu_2$ Student learning outcomes taught with cooperative learning model Group Investigation type are the same as student learning outcomes taught without using the cooperative learning model Group Investigation (conventional models) in Discrete Mathematics courses, especially sub-material Sequence and Series in Informatics Engineering Study Program South Aceh Polytechnic.

$H_1: \mu_1 > \mu_2$ Student learning outcomes taught with cooperative learning type Group Investigation models are better than learning without using the cooperative learning model type Group Investigation (conventional models) in Discrete Mathematics courses, especially sub-material Barisan and Series in Informatics Engineering Study Program South Aceh Polytechnic.

Because the test performed is the right-hand test, the applicable testing criteria are: "Accept H_0 if $t < t_{(1-\alpha)}$ and reject H_0 if t have other prices. The degree of freedom for distribution lists (t) is ($n_1 + n_2 - 2$) with opportunity $(1 - \alpha)$ and $\alpha = 0,05$.

To show student activities in carrying out learning, a scale is used. On this scale, the highest initial score is 4 and the lowest score is 1, that is, 4 (very active), 3 (active), 2 (quite active), and 1 (inactive). Assessment using formulas [8], namely:

$$\text{Students Activity Percentage (p)} = \frac{\text{Gained Score}}{\text{Total Score}} \text{x} 100\% \tag{2}$$

Description of the rating scale as follows:

Very Active   : $75\% \leq p \leq 100\%$
Active   : $50\% \leq p < 75\%$
Moderate   : $25\% \leq p < 50\%$
Low   : $0\% \leq p < 25\%$

The observation sheet of student activities used in the study as in Table 1.

Table 1. Student Activity Observation Sheet

No	Activities	Score 1 2 3 4
1	**Visual activities** a. Reading b. Pay attention to the explanation of learning objectives c. Pay attention to the explanation of the learning model	
2	**Oral activities** a. Asking questions. b. Giving opinions c. Participating in discussion	
3	**Listening activities** a. Paying attention on others opinion b. Listening to the discussion	
4	**Writing activities** a. Doing some exercise materials b. Making resume	
5	**Presentation** Pay attention on the presentation	
6	**Mental activities** Reflect, remember, solve problems, analyze factors, see relationships, and make decisions	
7	**Emotional state** a. Enthusiastic and enthusiastic in following the lessons b. Brave and calm in learning	

IV. Results and Discussion

A. Post-Test Results Experimental and Control Classes

Table 2. *Post-Test Results Experimental Classes*

Students	Post-Test Value	Students	Post-Test Value
Student 1	60	Student 9	94
Student 2	73	Student 10	65
Student3	80	Student 11	50
Student 4	75	Student 12	70
Student 5	80	Student 13	45
Student 6	60	Student 14	65
Student 7	65	Student 15	55
Student 8	70	Student 16	62

Table 3. *Post-Test Results Control Classes*

Students	Post-Test Value	Students	Post-Test Value
Student 1	40	Student 10	62
Student 2	90	Student 11	75
Student3	45	Student 12	55
Student 4	60	Student 13	45
Student 5	65	Student 14	50
Student 6	48	Student 15	75
Student 7	60	Student 16	70
Student 8	55	Student 17	56
Student 9	35		

B. Data Analysis of Research Results

a) Homogeneity of Variance and Normality of Distribution of Final Test Data

The results of the analysis of the final test data in both the experimental class and the control class obtained the average value, variance, and standard deviation for each class are:

$$\bar{x}_1 = 67.625 \qquad S_1^2 = 122.917 \qquad S_1 = 11.087$$
$$\bar{x}_2 = 60.088 \qquad S_2^2 = 193.382 \qquad S_2 = 13.91$$

Informations:

S_1^2 :   Experimental class variance
S_2^2 :   Control class variance
S_1 :   Standard deviation of the experimental class
S_2 :   Standard deviation of the control class

Using the average value, variance, and standard deviation of the two classes tested the homogeneity of the variance of the final test data and the results show that the two classes of variance are homogeneous for the final test data. Furthermore, the normality test for the distribution of the final test data was obtained that the experimental class and control were normally distributed.

b) Hypothesis Testing

Hypothesis testing is done by using equation (1) at a significant level $\alpha = 0.05$ and the degree of freedom $dk = n_1 + n_2 - 2 = 31$, so that it is obtained $t_{(1-\alpha)}(n_1 + n_2 - 2) = t_{(0.95)}(31) = 1.69$. Based on these results obtained relationships $t_{count} > t_{table}$ or $1.71 > 1.69$. Thus according to the applicable testing criteria, it was concluded that student learning outcomes taught by cooperative learning model Group Investigation type were better than learning without using the Group Investigation type (conventional models) in Discrete Mathematics courses especially the Sub-Sequence and Series material in the Study Program Informatics Engineering South Aceh Polytechnic.

c) Students Learning Activities

The average student learning activity can be seen in Table 4.

Table 4. Average Data on Student Learning Activities

Session -	1	2	3	Rata-rata
Percentage	64.28%	69.64%	89.29%	75.40%
Criteria	Active	Active	Very Active	Very Active

Based on Table 2 it can be concluded that student learning activities during the learning process in conducting research are in the very active category.

V. Conclusion and Suggestion

A. Conclusion

Based on data analysis, learning outcomes tests and student activities in the learning process, it can be concluded that the effective cooperative learning model of Group Investigation (GI) type is applied to teach Discrete Mathematics courses, especially material of Sequence and Number Series in the Informatics Engineering Study Program of South Aceh Polytechnic. This is seen from the results of the research obtained, namely:
a) Student learning outcomes with cooperative learning model Group Investigation type is better than learning without using cooperative learning model Group Investigation type (conventional model) in Discrete Mathematics courses, especially sub-material Barisan and Series in Informatics Engineering Study Program South Aceh Polytechnic.
b) Student activities during the learning process in conducting research are in the active category.

B. Recommendation

Based on the conclusions that have been described, as for the advices:
a) Given that the learning model has a positive influence on student learning outcomes, it is expected that lecturers can apply a cooperative model of the Group Investigation type in an effort to improve student learning outcomes, especially in mathematical material.
b) Lecturers are expected to be able to use various models or learning approaches that are appropriate in teaching mathematics, so that students' interest in learning mathematics increases.

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