The effect of using group investigation learning model and prior knowledge toward student problem solving skills on Mathematics subject at junior high school

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The effect of using group investigation learning model and prior knowledge toward student problem solving skills on Mathematics subject at junior high school

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Abstract. Towards the 21st century, technological and social change has developed rapidly. Educational practices must develop as well over time. The role and function of mathematics becomes an inevitable need. In order to meet the needs in adapting to these changes, problem solving is one of the mandatory skills that must be mastered by students. Problem solving skills are influenced by several factors, including learning models and student abilities. Therefore, this article aims at investigating whether a difference in mathematical problem solving skills emerges between the students involved in the learning group investigation learning model and those in the direct learning model, according to the high, medium, and low initial skills of 8th grade students of a junior high school (SMP) in Pekanbaru. The quasi-experimental method was used in the study. Based on the t-test analysis, the use of group investigation learning model in terms of initial skills, in general, influences the students' mathematical problem solving skills.

1. Introduction

Mathematics constitutes one of the basic sciences that plays an significant role in the mastery of science and technology. This is because mathematics is curriculum content that functions as a problem deepening tool and is widely used in all areas of life, so that learning mathematics becomes necessary [1]. The mathematics learning aims at having students acquire the ability to think logically, analytically, systematically, critically, and creatively, as well as the ability to work together in learning mathematical concepts [2]. Mathematical learning has proven to cause a difficulty for students [3]. The difficulty is due to the fact that students are often mistaken in understanding mathematical concepts [4]. In fact, the problem-solving skills, information processing, and communication have become important requirements in work [5]. Thus, students must be taught to read through a mathematical viewpoint [6].

The problem-based learning is not easy to apply for teachers and students [7]. But problem solving is a very important part of math learning to apply in everyday life [8]. In achieving the goals of mathematics learning, a good learning process is required [9]. A good learning process is not only focused on the teacher (Teacher Centered), but the students must also have a more active role (Student Centered), meaning that the teacher acts as a facilitator for the students. One solution that fits this situation is the use of group investigation learning model which requires students to be active in improving their problem-solving skills.

The group investigation learning model can be used to guide students to think in a systematic, critical, analytical manner, and to actively participate in learning and creative culture through problem solving activities [10]. In group investigation learning, teachers are considered facilitators of students' intellectual and social development [11]. In the end, it is expected that students are able to learn and understand the problems given in teaching material by themselves. Previous research revealed that group investigations resulted in significant differences between the two class treatment [12], [13]. However, the problem-solving activities through this learning model are thought to be strongly influenced by students' prior knowledge. Students' early abilities have long been considered an important factor that can influence student learning and achievement [14]–[17]. This is because the prior knowledge can provide an indication of the extent to which the students have understood the learning material presented [18].

The prior knowledge is needed in group investigation activities for creating heterogeneous groups of students. This is intended to bring interdependence of students with certain prior knowledge, either high, medium, or low, during learning so that the process of investigating a problem given can be undertaken properly, as expected by the teacher. Based on the ideas above, this article is focused on obtaining a picture of the effect of using the group investigation learning model and prior knowledge on the mathematical problem-solving skills of the students of a junior high school (SMP) in Pekanbaru.

2. Methods

The Quasi experiment was used in the present study, in which the variables were not fully controlled [19], [20]. Moreover, the Post-test Only Control Design was utilized. The variables consist of 3 types, i.e. independent variable, dependent variable, and moderate variable. The independent one includes the implementation of group investigation learning model; the dependent includes the students' mathematical problem-solving skills; and the moderate includes the student's mathematical prior knowledge. In this study, the researcher determines the criteria were employed as guidelines in determining the students' prior knowledge, shown in Table 1.

Table 1. Criteria for prior knowledge grouping

Criteria	Description
x ≥ (Mean + Standard Deviation)	High
(Mean - Standard Deviation) < x < (Mean + Standard Deviation)	Medium
x ≤ (Mean - Standard Deviation)	Low

The research population includes all of 8th grade students at a junior high school in Pekanbaru, 276 students in total out of 9 different classes. The selected sample consists of two classes, namely the experimental class which was provided with the group investigation learning strategy and the control class with the direct learning. The *purposive sampling* technique was employed, by considering the convenience factor for the researcher in the sampling process as well as the recommendation from a Mathematics teacher at the school. According to the teacher's assessment, Class 8B and Class 8D share the same characteristics. It is also supported by the analysis of the mathematical prior knowledge in which both classes are normal and homogeneous and there is no difference between the two classes.

The data were first analyzed using the pre-requisite tests including the normality and the homogeneity test. The normality test was calculated by using the chi-square, while the homogeneity by the f-test. If the analyzed data were found to be normally distributed and homogeneous, the further analysis in this study would be conducted using the t-test statistics. Meanwhile, if the data indicated normal distribution but no homogeneity, the t'-test statistics were employed.

3. Result and Discussion

3.1. Result

Before researchers applied the treatment to the class of experimentation and control classes, the researcher had given a test of mathematical prior knowledge to both classes. The test was designed and developed using the indicators of problem-solving skills. The test results are presented in table 2.

Table 2. Recapitulation result test data of mathematical prior knowledge

Test	Calculate Value		Table Value		Conclusion
	Class Experiment	Class Control	Class Experiment	Class Control	
Normality test	10.981	8.807	19.675	22.362	Data is normally distributed
Homogeneity test		1.13		1.94	Variance of both data is homogeneous
t-test		0.10		2.01	No difference in prior knowledge between the two classes

Based on the data in Table 2, it can be concluded that the two classes do not differ significantly. Hence, these classes are qualified to be used as the research sample.

Furthermore, the results of the test of mathematical prior knowledge were analyzed in order to determine the grouping of students' prior knowledge based on the criteria as described in Table 1. The results of the analysis are exhibited in Table 3.

Table 3. Student grouping based on prior knowledge

	Experimental Class	Control Class
Mean	56.231	58.25
SD	18.170	20.163
High Group	$\geq$74.401	$\geq$78.413
Medium Group (x)	38.061<x<74.401	38.087<x<78.413
Low Group	$\leq$38.061	$\leq$38.087
Number of Students in High Group	6	4
Number of Students in Medium Group	13	18
Number of Students in Low Group	7	6
Total Number of Students	26	28

Based on Table 3 it can be summarized that in the experimental class 6 students are indicated to possess high prior knowledge, scoring above 74.401; 13 students to medium prior knowledge, scoring between 38.061 and 74.401; and 7 students to low prior knowledge, scoring below 38.061. Besides, in the control class 4 students are indicated to possess high prior knowledge, scoring above 78.413; 18 to medium prior knowledge, between 38.087 and 78.413; and 6 to low prior knowledge, below 38.087.

After being grouped into each of their prior knowledge, the students with high, medium, low, and overall the prior knowledge were analyzed separately after the particular treatments were given, namely the group investigation learning model on the experimental class and the direct learning on the control class, as well as a post-test that would be given after the treatments. The post-test given was emphasized on examining the students' mathematical problem-solving skills. The post-test was designed and developed according to the indicators of problem-solving skills. Based on the results of the analysis of high, medium, low, and the overall prior knowledge, this post-test full-fills both pre-requisites, i.e. the normal and homogeneous aspects.

Because all four types of data are normally distributed and homogeneous, the hypothesis testing was performed through the t-test statistics. Based on the t_{score} obtained from the hypothesis testing of t-test statistics, Base on the t-score obtained from the hypothesis testing of the t-test statistics, it is shown that

there are differences in the mathematical problem-solving skills between the students involved in the group investigation learning and those in the direct learning. This can be displayed in a recapitulation in Table 4.

Table 4. Recapitulation of the hypothesis testing

	t-count	t-table	Conclusion
Post-test score of high-skilled students	2,44	2,31	There was a difference
Post-test score of medium-skilled students	1,41	2,04	There was no difference
Post-test score of low-skilled students	2,95	2,20	There was a difference
Post-test score of overall students	2,60	2,01	There was a difference

3.2 Discussion

According to Table 4, it can be concluded that the implementation of group investigation learning model and prior knowledge can affect the students' mathematical problem solving skills in a junior high school in Pekanbaru in the school year 2016/2017. However, after being analyzed based on the prior knowledge of students, the use of group investigation learning model exhibits no significant effect on the medium-skilled students in the experimental class compared to the control one. According to the researchers' observation, the medium-skilled students become indifferent during the group discussion. This is due to the deceptive topic, such as the "Determining the cube and cuboid webs as well as the surface area", which may look easy but actually difficult to execute if not being thorough. Also, it is worsened by their decreased enthusiasm since their sources for asking questions in groups (the high-skilled students) pay very much attention on teaching the low-skilled students.

The advantage of group investigation learning is to get the students used to collaboration and interaction, especially between the high-skilled and the low-skilled students. However, if the discussion runs less effectively, obstacles will be encountered, like what the researchers detected in the medium-skilled students. This is in accordance with Aris Shoimin stating that one drawback of the group investigation learning model is that obstacles will be encountered when the discussion becomes ineffective [21]. The researcher's difficulty in noticing the students' constraints in groups personally also constitutes one of these constraints.

In order for the students with medium prior knowledge were involved in the discussion effectively, the researcher initiated an impromptu quiz during the learning process, by the rule that the quiz scores were regarded as individual scores, not for groups. Moreover, in ending the learning process, the researcher provided the students with medium prior knowledge with motivation after evaluating the overall students. The solution given by the researcher have not reach the maximum, because the impromptu quiz was not applied at each of the meetings (only when the researcher noticed obstacles). However, by viewed from the mean score, the implementation of group investigation model has already influenced the medium-skilled students, although the difference of average score between this group and those in the class with direct learning model is only 7.774. Therefore, the use of group investigation model, as a whole, has influenced the mathematical problem-solving skills of junior high school students in Pekanbaru.

4. Conclusion

Based on the findings as explained above, it can be concluded that the present study has proven that the group investigation learning model and prior knowledge influences the mathematical problem-solving skills of junior high school students in Pekanbaru. Thus, the research problems are answered, which is elaborated as follows: (1) There is a significant difference in the mathematical problem-solving skills between the high-skilled students involved in the group investigation learning model and the high-skilled students in the direct learning; (2) There is no significant difference in the mathematical problem-solving skills between the medium-skilled students involved in the group investigation learning model and the medium-skilled students in the direct learning; (3) There is a significant difference in the

mathematical problem-solving skills between the low-skilled students involved in the group investigation learning model and the low-skilled students in the direct learning; (4) There is a significant difference in the mathematical problem-solving skills between the students involved in the group investigation learning model and those in the direct learning.

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