Self-confidence and mathematics achievement using guided discovery learning in scientific approach

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Abstract. The aimed of this research is to describe the effect of guided discovery learning in scientific approach toward student achievement and self-confidence. This research is quasi-experiment with the pre-test post-test design. The study was conducted in grade 7, with an age range of about 12-13 years, in one of the schools in the suburbs with the quality of students input being in the middle category. The data collected by using mathematics achievement test and self-confidence questionnaire that has been declared valid by the expert team. The criterions of effective are: 1) post-test score is higher than pre-test score; 2) the average of student achievement score is higher than 75; 3) the average of self-confidence score is higher than medium category; 4) the proportion of student that pass the achievement criterion is more than 70%; and 5) the proportion of student self-confidence that reaches very high and high is more than 70%. The result of this research showed that guided discovery learning in scientific approach is effective on students’ mathematics achievement and self-confidence.

1. Introduction

The success of mathematics learning one of them can be seen from student achievement. Mathematics learning achievement is the accomplishment of mathematical competence in accordance with the applicable curriculum [1–3]. One aspect that plays an important role in the learning process of mathematics is self-confidence. Self-confidence can support one's success, including in mathematics learning. Self-confidence is one of the most influencing factors of learning [4,5]. Self-confidence is defined as believing in own capabilities, dare to express an opinion, not dependent on others, optimistic, and responsibility for completing the task [4,6–12]. Students with low self-confident in the learning process are likely to have an effect on the low learning outcomes [13].

The Indonesian government suggests learning in schools applies a scientific approach [14]. Scientific approach is defined as a learning approach that includes observing, questioning, experiencing, associating and communicating activities [14–19]. Learning using this scientific approach can be combined with other learning. This is tailored to the conditions of students, classes, learning environment, subject matter, etc. One of the learning models that can be applied together with a scientific approach is guided discovery learning, which is a learning that encourages students to carry out discovery activities to construct their own knowledge with teacher guidance [20–26]. The step of this
learning is include 1) stimulating, 2) identifying, 3) collecting, 4) processing, 5) verifying, and 6) drawing conclusions [26,27].

This learning have some advantages, such as improving mathematical knowledge [28–39], mathematical skills [32,33,37,40–42] and mathematical attitudes [30,32,41]. Example of mathematical knowledge that can be improved is mathematics achievement. Then, self-confidence is one example of mathematical attitudes that can be improved. It can be expected that this learning can improve students’ self-confidence and mathematics achievement.

2. Method

This research was a quasi experiment research that the research design was one-group pretest posttest design. This study used an experimental class that beginning with pretest, then treated in the form of mathematical learning using guided discovery learning in scientific approach, and ended with posttest. Provision of this treatment is expected to be effectively reviewed from self-confidence and mathematics achievement.

Data collection was done by test and non test technique. The test technique uses a mathematics learning achievement test instrument (14 items, 4 answer choices). The non-test techniques uses self-confidence questionnaire (20 items, 5 answer choices). Pretest and posttest problems are made differently, but the indicators and difficulty levels of each item are made relatively similar. These instruments have been declared valid by the expert team. The frameworks of self-confidence questionnaire and mathematics achievement test are as follows in table 1 and table 2.

| Table 1. The framework of self-confidence questionnaire. |
|-----------------------------------------------------------|
| Aspect | Indicator | Number item |
| Believed of the capabilities | Believed of the capabilities both when studying mathematics and at the time of the exam. | (+) 1, 5 (-) 12, 18 |
| Dare to express an opinion | Dare to express opinions in front of the class, can take the form of working on the front, presentation, presentation, or ask the teacher. | (+) 3, 20 (-) 6, 14 |
| Not dependent on others | Not dependent on others both when studying mathematics and at the time of the exam. | (+) 2, 11 (-) 4, 16 |
| Optimistic | Positive thinking about what will be achieved. | (+) 9, 15 (-) 13, 19 |
| Responsibility for completing the task | Completing the task seriously | (+) 8, 10 (-) 7, 17 |

| Table 2. The framework of mathematics achievement test. |
|--------------------------------------------------------|
| Aspect | Indicator | Number item |
| Know and analyze situations related to social arithmetic | Distinguish the condition of profit/loss and determine the amount or percentage | 1, 2 |
| | Determine the selling price/purchase price if known one of them and known big profit/loss or percentage | 3, 4 |
| | Determine the unknown elements in the case of a discount. | 5, 6 |
| | Determine the unknown elements in the case of savings or loans that apply the concept of a single interest. | 7, 8 |
| | Mention the relationship between gross, net, and tare or determine the magnitude of one if the other 2 are known. | 9, 10 |
| Solve problems related to social arithmetic. | Determine the solution to the problem of selling (may include selling price, purchase price, profit, loss, discount, gross, net, tare). | 11, 12 |
| | Determine the solution of a related problem about the concept of a single interest on a savings or loan case. | 13, 14 |
The study was conducted in grade 7, with an age range of about 12-13 years, in one of the schools in the suburbs with the quality of students input being in the middle category. The population in this study consists of 210 students who are divided into 7 parallel classes. Samples selected 1 class consisting of 30 students (M: 12, F: 18) of 7 classes available at random.

This learning was said to be effective if: 1) post test score is higher than pre test score; 2) the mean of student achievement score is higher than 75; 3) the mean of self-confidence score is higher than medium category; 4) the proportion of student that pass the achievement criterion is more than 70%; and 5) the proportion of student self-confidence that reaches very high and high is more than 70%.

3. Results and discussion

3.1. Results

Students were given a confidence questionnaire and a mathematics achievement test before and after the learning process. The self-confidence score has an interval of from 20 to 100, while the interval for the mathematics achievement score is from 0 to 100. The data from both assessments are described in table 3.

Table 3. Description of data.

| Description        | Self-confidence | Mathematics achievement |
|--------------------|-----------------|-------------------------|
|                    | Pre test        | Post test               | Pre test | Post test |
| Mean               | 66.6            | 75.27                   | 57.14    | 84.76     |
| Std. Deviation     | 4.58            | 5.58                    | 17.60    | 8.94      |
| Variance           | 21.01           | 31.17                   | 309.64   | 79.99     |
| Range              | 21              | 23                      | 64.29    | 35.71     |
| Maximum            | 78              | 88                      | 78.57    | 100.00    |
| Minimum            | 57              | 65                      | 14.29    | 64.29     |

In general, based on table 3 it is known that the post-test score is higher than the pre-test score. However, it is necessary to analyze inferences to draw conclusions.

3.1.1. Criteria 1: The mean of post test score is higher than the pre-test score. It is necessary to test the assumptions first. From the normality test, sig. of pre-test self-confidence data is 0.313, post-test self-confidence data is 0.279, pre-test mathematics data is 0.924, and sig. of pre-test mathematics data is 0.793. Using $\alpha = 0.05$, we know that the data from pre-test of self-confidence, post-test of self-confidence, pre-test of mathematics achievement, and post-test of mathematics achievement come from normally distributed data. Besides that, we also tested the homogeneity between pre-test and post-test scores. The pre-test and post-test self-confidence scores come from homogeneous populations (sig. = 0.429). The pre-test and post-test mathematics achievement scores come from homogeneous populations (sig. = 0.264).

Because these data come from normally distributed data and homogeneous populations, we can use the t-test. Based on the results of analyzing student confidence data, showed that the mean post-test score was significantly higher than the pre-test score (p value = 0.000 < 0.05). We also know that the mean post-test mathematics achievement score was significantly higher than the pre-test score (p value = 0.000 < 0.05).

3.1.2. Criteria 2: The mean of student achievement score is higher than 75. We only pay attention to the post-test score to analyze the data on these criteria. We use t test with $\mu_0 = 75$. We use $\mu_0 = 75$ because the school use 75 as a minimal mastery criteria. The result is sig. = 0.028 < 0.05. Thus, we can conclude that the mean of student achievement score is higher than 75.
### 3.1.3. Criteria 3: The mean of self-confidence score is higher than medium category.

After obtaining the measurement data of students’ self-confidence, the total value of each unit is categorized based on predetermined criteria. The total score of all units that have been collected is then calculated the percentage for each category in table 4, which is very high, high, medium, low, and very low.

| Interval | Category       | Pre test |          |          | Post test |          |          |
|----------|----------------|----------|----------|----------|-----------|----------|----------|
|          |                | Frequency| Percentage| Frequency| Percentage |
| X > 84   | Very high      | 0        | 0 %      | 4        | 13.33 %   |
| 68 < X ≤ 84 | High          | 9        | 30 %     | 23       | 76.67 %   |
| 52 < X ≤ 68 | Medium      | 21       | 70 %     | 3        | 10 %      |
| 36 < X ≤ 52 | Low          | 0        | 0 %      | 0        | 0 %       |
| X ≤ 36   | Very low      | 0        | 0 %      | 0        | 0 %       |

From table 4, we only pay attention to the post-test score to analyze the data on these criteria. We use t-test with \( \mu_0 = 68 \). The result is sig. = 0.013 < 0.05. Thus, we can conclude that the mean of self-confidence score is higher than medium category.

### 3.1.4. Criteria 4: The proportion of student that pass the achievement criterion is more than 70%.

Table 5 will show the frequency and percentage the number who pass and who fail in mathematics achievement test.

| Category       | Student number | Percentage |
|----------------|----------------|------------|
| Pass (x > 75)  | 26             | 86.7 %     |
| Fail (x ≤ 75)  | 4              | 13.3 %     |

After that, we do testing to draw conclusions in general. The result is sig. = 0.036 < 0.05. Thus, we can conclude that the proportion of student that pass the achievement criterion is more than 70%.

### 3.1.5. Criteria 5: The proportion of students’ self-confidence that reaches very high and high is more than 70%.

Table 6 will show the frequency and percentage the number who pass and who fail in self-confidence measuring.

| Category                  | Student number | Percentage |
|---------------------------|----------------|------------|
| Pass (high & very high)   | 27             | 90 %       |
| Fail (very low, low, & medium) | 3           | 10 %       |

After that, we test to draw conclusions in general. The result is sig. = 0.014 < 0.05. We can conclude that the proportion of students’ self-confidence that reaches very high and high is more than 70%.

### 3.2. Discussion

Based on the result of this study, Guided Discovery Learning in Scientific Approach has been proven empirically effective on student achievement and self-confidence. This is in accordance with some research that states that guided discovery learning can improve mathematics learning achievement [28–
32,34,39,40]. Guided discovery learning also can improve some attitude, include self-confidence [30,32,41].

It occurs because the learning steps can support both capabilities. In scientific approach using guided discovery learning, teachers help students to construct their knowledge by engaging actively in the process of knowledge construction, thus developing the thinking abilities of students [31]. Because of it, the mathematics achievement will automatically increase. Besides that, there are steps that exist in a scientific approach that can support self-confidence, for example they can explore to obtain a concept and they must communicate to classmates.

In addition, the use of guided discovery learning in mathematics learning received good responses from students [43]. This is also one of the reasons that makes guided discovery learning good to be combined with a scientific approach suggested by the government.

4. Conclusion

The result of this study are: 1) the mean of post test score is higher than the pre test score, both mathematics achievement and self-confidence score, 2) the mean of student achievement score is higher than minimal mastery criteria, 3) the mean of self-confidence score is higher than medium category, 4) the proportion of student that pass the achievement criterion is more than 70%, and 5) the proportion of students’ self-confidence that reaches very high and high category is more than 70%. Thus, we can conclude that that guided discovery learning in scientific approach is effective on students’ mathematics achievement and self-confidence.

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