The effect of inquiry in scientific learning on students’ self-confidence

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Abstract. The study investigated the effect of inquiry in scientific learning on secondary school students’ self-confidence in mathematics. The design of the study was quasi-experimental with 70 students in two different classes in the 11th grade of this school participated in the study. The result of the research showed a significant difference between self-confidence scores of the experiment group and the control group. It was also found out that inquiry in scientific learning was more effective in the positive development of the students’ self-confidence. At the end of the research, it is revealed that the students who are educated by inquiry in scientific learning are more successful than the students who are educated by the traditional instructional learning.

1. Introduction

Mathematics is one branch of science that has a very important role in life. The development of ICT (information and communication technology) today is inseparable from the interference of mathematics. As NCTM said that those who understand and can use mathematics will have significant opportunities and choices to build their future [1]. It means those who have ability in mathematics will be better at preparing their future. That's what causes mathematics needs to be learned from primary education to higher education. However, although mathematics has been introduced as early as the primary school level, most students still have difficulty in solving basic mathematics questions at higher education. According to Iskandar, et al. this might be due to students' mathematics achievement related to their psychological factors [2]. The most important psychological factor related to mathematics achievement is self-confidence. In line with research conducted by Frank and David that students’ confidence in mathematics problem-solving skills is related to their problem-solving competence [3].

In addition to its relationship with mathematics achievement, students’ confidence has associated with many aspects of education, including motivation to learn, interest in particular subjects, and with choices of what subjects to study [4-6]. In terms of the importance of confidence in mathematics, Laurie mentioned “Confidence is an important affective variable in mathematics education…Confidence in learning mathematics is a particular component of self-concept that is specific to mathematics. In order to understand confidence is helpful to understand the broader construct of self-concept” [7] (p. 559). Manisha and Preeti also mentioned that “Self-confidence is essentially an attitude which allows us to have a positive and realistic perception of ourselves and our abilities. It is characterized by personal attributes such as assertiveness, optimism, enthusiasm, affection, pride, independence, trust, the ability...
to handle criticism and emotional maturity… Self-confident people are willing to risk the disapproval of others because they generally trust their own abilities” [8] (p. 90-91). So, it can be said that the existence of self-confidence is very important because it will allow students to be able to believe their own ability, not easily give up when faced the problems so that students are able to complete all tasks provided independently with maximum results. But in fact, students' confidence in learning mathematics is still relatively low. In research conducted by Noor and Halimah mentioned that in general, students have a low confidence level in learning mathematics [9]. Similarly, research conducted by Iskandar, et al. states that although most students had positive self-confidence in mathematics, the level of confidence was not as high and depended on the students’ situations and current environment [2]. In addition, based on pre-research results by distributed self-confidence questionnaires to 95 students in Indonesia found that as many as 57.72% of students still had low self-confidence when learning mathematics.

Problems can be caused by many factors, one of which is the lack of precise selection of model/method of learning in the classroom. Implementation of the model/method of learning that is less precise can make students become passive and had no interest in mathematics. Whereas in learning mathematics students are expected to be active in constructing their own knowledge while the teacher is only as a facilitator. Among the learning models that can be an alternative to improve students’ self-confidence one of them is the inquiry-based learning.

According to Teresa “Inquiry learning is defined by experience and exploration, it involves students in the process of learning so they acquire a deeper understanding of the material being taught” [10] (p. 1). In line with the opinions mentioned by NCTM that inquiry is the process that students should use to learn science. They should be able to ask the question, use their question to plan and conduct a scientific investigation, use appropriate science tools and scientific techniques, evaluate, evidence and use it logically to construct several alternative explanations, and communicate (argue) their conclusions scientifically [11] (p. 185).

The learning of mathematics with inquiry emphasizes the students’ ability to conduct investigations and explain unusual phenomena [12]. The goal is that students can learn to ask why things can happen, collect and process data logically, and develop strategies that they can use to know the occurrence of a particular phenomenon or event. The steps in inquiry learning include identify and clarify a problem, form hypotheses, collect data, analyze and interpret the data to test the hypotheses, and draw conclusions [13]. This study was conducted with the aim to examine the effect of learning using inquiry model to students' self-confidence. The hypothesis of this study is the learning with inquiry model affects the students' self-confidence.

2. Method
This type of research is a quasi-experimental study. In this study, the researchers used two groups of samples from one school. The first group (experimental group) was given treatment with a scientific study using inquiry in one class, and the second group (control group) was given treatment with scientific study using the teacher method as the benchmark with the same class number as the group first. The design of this study used the non-equivalent control group design.

The research was conducted at a senior secondary school in South Borneo, Indonesia. The study was carried out in the academic year 2017-2018 with the 11th grade (15 – 17 years old) students from four different classes majoring science in the school. The samples in this study were selected two of the four classes used purposive sampling technique. Both classes were selected based on suggestions from the mathematics teacher where the two classes had relatively similar abilities and number of students. Two intact classes were chosen randomly to one experimental and control group with 35 students for each group.

In this study, the instrument for data collection was self-confidence questionnaire included 36 items: 18 items were positive statements and 18 items were negative statements. Each item was constructed on a 5-points Likert-type-scale from Never to Always. The aspects were measured in this confidence instrument were adapted to the characteristics of self-confidence advanced by Goel and Aggarwal
(2012), among others are trust their own abilities, independence, willing to risk, have a positive perception of their selves, and emotional maturity. The instrument was content validated by two experts and Cronbach Alpha formula was used for testing reliability.

The first questionnaire was given in the first week of research in both classes in both experimental and control classes to determine the level of initial confidence of students in learning mathematics before treatment. The treatment was done strictly on selected topic drawn from senior secondary school syllabus which included: Derivative. The experimental group was subjected to treatment of inquiry model, while the control group was taught using the teacher method. The questionnaire was administered to both the experimental and control groups after 2 weeks of instruction. The hypotheses were tested using univariate t-test with Benferroni criterion which hypothesis is rejected if $t_\alpha$ more than $t_{table}$. $t_\alpha$ was measured using formula [14]:

$$t = \frac{\bar{y}_1 - \bar{y}_2}{\sqrt{\frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2} \left( \frac{1}{n_1} + \frac{1}{n_2} \right)}}$$

3. Results and discussion

3.1. Result

Table 1. The result data of students’ self-confidence questionnaire.

| Teaching method | Inquiry       | Teacher       |
|-----------------|---------------|---------------|
|                 | Pretest       | Posttest      | Pretest       | Posttest      |
| Mean            | 113.23        | 143.54        | 113.06        | 131.91        |
| SD              | 15.18         | 13.54         | 15.89         | 10.23         |
| Var             | 230.36        | 183.31        | 252.41        | 104.61        |

The descriptive statistic in Table 1 revealed that the mean score of the students taught with inquiry before treatment was 113.23, while the control group taught with teacher method before treatment has mean score of 113.06. While the mean score of the students taught with inquiry after treatment was 143.54, while the control group taught with teacher method after treatment has mean score of 131.91. This data indicated that there is an increase in mean score of students’ self-confidence in the class with inquiry learning is 30.31, while in the teacher’s method is 18.25.

The result of univariate t test with Benferroni criterion on students’ self-confidence data after treatment obtained $t_\alpha = 4.05$. Since the $t_{table}$ (1,99) is less than $t_\alpha$, the null hypothesis of no affect is rejected, meaning inquiry teaching gives effect to students' self-confidence in mathematics.

3.2. Discussion

The result address the objectives and hypothesis of the study in determining the influence of inquiry teaching method on students’ self-confidence in mathematics. The findings of this study are discussed under instructional methods and students’ self-confidence in mathematics. Firstly, the result of the study revealed that the experimental and control groups had a similar mean at pretest level (before treatment). Secondly, the result of the study also revealed that the experimental group performed significantly better than the control group at the post-test level (after treatment).

Furthermore, the students in the inquiry group of the study (the experimental group) performed significantly better than their counterparts in the teacher group of the study (the control group) because of their physical involvement in the lesson and the teachers’ teaching technique. The result of this study agrees with the studies of Christopher and Lawrence, Anthony, et al, and Peggy, et al. They agree that students learn more and comprehend better when they are actively involved the lesson. This is because any teaching procedures which involve students in some positive activity, as did the inquiry, are
generally more effective than any other method which does not give room for students’ active participation as epitomized in the case of the lecture method of teaching mathematics [15-17].

4. Conclusions
In this study, we can conclude that learning with inquiry model affects the students' self-confidence. Besides that, inquiry teaching method is better than teacher method. Theoretically, inquiry becomes an alternative that can be used to train and improve students’ self-confidence. Based on result of data analysis, inquiry gives effect to students’ self-confidence. Inquiry focuses more on students’ activeness during the learning process, especially when students deliver their ideas. The implication of this study, inquiry is recommended in mathematics learning, but to get optimal results requires careful preparation.

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