The effect of guided discovery learning on student self-efficacy

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Abstract. The aim of this research is to describe the effect of guided discovery learning on student self-efficacy. This research is quasi-experiment with pretest-posttest design. The research samples consisted of 34 of 200 students. The data collected by using self-efficacy questionnaire that has been declared valid by the expert team. The data analysis used t-test. The criterions of effective are 1) posttest score is higher than pretest score; and 2) the proportion of student self-efficacy that reaches very high and high category is more than 70%. This could be happened because students self-efficacy in filling the self-efficacy questionnaire has increased. The result of this research showed that guided discovery learning is effective on student self-efficacy based on those three criterions.

1. Introduction

The quality of learning process is important to be considerate to improve the quality of human resources. To enhance the quality of human resources, learning process should be arranged interactive, inspiring, fun, challenging, and motivating students to participate actively. It also should provide sufficient space for initiative, creativity and independence according to students' physical and psychological talents, interests and development [1]. To accomplish this kind of learning process, student must have belief in their skill. The student's belief in his skill is known as self-efficacy.

Self-efficacy is a person's belief to organize and implement the sequence of actions required to produce the desired achievement and perform behaviors at some level [2–5]. Specifically, self-efficacy is a person's belief in his skill to accomplish tasks, set goals, and achieve the results that he arranged before [6–9]. There are two levels of self-efficacy in a person that is high and low. A person with high self-efficacy will be more productive and more likely to solve the problem than someone with low self-efficacy. Furthermore, high self-efficacy will guide students in setting up challenges they are able to achieve, lack of anxiety to gain goals, be able to survive and be calm in doing difficult tasks, enjoying more of their work, and being proud of himself [4,10–12]. The level of one's self-efficacy is different from one another depending on the difficulty level of the task/problem at hand. Self-efficacy in a person is said to be high if he is diligent and persistent in his efforts to complete the task. Meanwhile, a person with low self-efficacy will be anxious when faced with a given task [3].

It's important to pay attention to students' self-confidence in mathematics and belief in their skills (self-efficacy) to math, because it will have an impact on their interest and motivation in mathematics [13]. Other researcher argues that the enhancement of positive identity (self-efficacy) can have an impact on improving mathematics learning and student achievement [14].
Some aspects that can be scaled to measure self-efficacy in a person are level, generality, and strength. Level is a person's belief in his skill in leveling the difficulty of the task he encounter. Generality is a belief that applies to any activities or conditions. Strength is the power level of someone's belief or expectation of his skill [3]. Practical experiences are stated as the most powerful source of creating a strong sense of efficacy. Students performing a task while applying knowledge and skills within demanding situations [15]. Students now need learning that trains them to assess, decide, and act in their lives. This means learning is not only designed to focus on students' knowledge, but also the development of social and emotional abilities [16]. One of innovative learning design that conduct practical experiences is guided discovery learning.

Guided discovery is a planned, targeted, and intervention-supervised method during the discovery process to gain meaningful learning and understanding for each student [17]. Guided discovery approaches require teachers to provide guidance in the form of questions, directions, or other tools that can assist students in the process of conceptual discovery [18,19]. Three general approaches which have been shown to facilitate guided discovery learning are: strategic presentation of the initial task/problem experience, consequential feedback for the task solution, and probing questions and self-explanations for the sake of refinement and restructuring of concepts and strategies [20].

Based on the other research, the implementation of guided discovery learning can improve student’s skill of doing observation, discussion and conclusions and communication [21]. Other research shows that guided discovery learning success in gaining low, medium, and high students’ performance score [22].

Guided discovery has advantages that are student is more active, growing the inquiry attitude, developing problem solving, giving space for student-teacher interaction, and giving long-term memory for student conception [23]. Guided discovery models have the following learning formats: 1) identification of topics/problems; 2) organizing students in learning; 3) guided individual/group discovery; 4) presentation of results of activities; and 5) evaluation of learning activities [24].

If the students are used to learning through guided discovery method so the students will have self-efficacy to gain knowledge itself, not receiving the knowledge. The student belief will be developed by some guided activities between student and teacher like observing, discussion, reflection, and presentation [25].

The aimed of this research is to describe the effect of guided discovery learning on student self-efficacy. This research method is quasi-experiment with pretest-posttest design. Pretest and posttest is designed in the form of questionnaire. The application of pretest and posttest is to explore the increasing of students’ self-efficacy.

2. Method

The population is all 10th grade students (age 16-17). The sample was taken using one group, it was obtained one class as the experimental group. The research samples consisted of 34 of 200 students. The type of this research method is based on researchers who do not create new classes for research, but use existing classes with the assumption that the classes are the same. The data collected by using self-efficacy questionnaire that has been declared valid by the expert team. The data analysis used t-test. The following Table 1 is presented a grid of the student's self-efficacy questionnaire instrument.

### Table 1. Framework of the self-efficacy questionnaire.

| Aspect     | Indicators                                                                 | Number |
|------------|-----------------------------------------------------------------------------|--------|
| **Level**  | Confidence in finding Trigonometric formulas in varying level of difficulty  | 1, 2   |
|            | Confidence in finding solutions from Trigonometry problems in varying level  | 3, 4   |
|            | of difficulty                                                               |        |
| **Generality** | Belief in understanding each sub-chapter                                      | 5, 6   |
|            | Confidence in dealing with various conditions and situations in Trigonometry  | 7, 8, | 9, 10 |
|            | learning                                                                     |        |
| **Strength** | Confidence in the effort in finding the Trigonometry formula                  | 11, 12 |
|            | Confidence in potential in solving the Trigonometry problem                   | 13, 14, 15, 16, 17, 18 |
This questionnaire contains a statement consisting of 18 items using a likert scale. The statement in the questionnaire consists of positive statements and negative statements. The positive statements are 9 and the negative statements are 9. The amount of Likert scale used is five, namely: Always (SL), Frequent (SR), Sometimes (KK), Rare (JR), and Never (TP).

The other learning tools in this research include lesson plan and student worksheet as shown in Figure 1. The lesson plans and student worksheets are prepared based on guided discovery learning.
Figure 1. Student worksheets based on guided discovery learning.

The criterions of effective are: 1) post-test score is higher than pre-test score; and 2) the proportion of student self-efficacy that reaches a minimum high category of more than 75%.
3. Results and discussion

Student self-efficacy questionnaire data on mathematics learning was analyzed based on self-efficacy questionnaire data analysis, then determined the criteria of effectiveness of the questionnaire results.

Normality test was conducted with the aim to know the data came from the population that was normally distributed or not. The data to be tested the normality were pre-test and post-test data. The decision criterion $H_0$ is accepted if the significance is $>\alpha = 0.05$, meaning that the data is obtained from a normally distributed population. Test results can be seen in Table 2.

| Table 2. Normality tests of self-efficacy questionnaire. |
|----------------------------------------------------------|
| Shapiro-Wilk                                             |
| Statistic | Df | Sig.  |
| pre-test | ,948 | 34 | ,105  |
| post-test | ,960 | 34 | ,240  |
| a. Lilliefors Significance Correction                     |

Based on the above table, it is found that the significance of the pre-test self-efficacy questionnaire data is 0.105 and the post-test self-efficacy questionnaire is 0.240. Both values are more than $\alpha = 0.05$, which means that the pre-test and post-test data used are from normally distributed populations.

Hypothesis test aimed to determine the effectiveness of learning devices in terms of student self-efficacy. There were two statistical tests used to measure the effectiveness of learning in terms of student self-efficacy. The first hypothesis testing, namely paired t-test. This test aimed to determine whether the mean final self-efficacy questionnaire score was more than the average initial questionnaire score. This test was using pre-test and post-test results with paired samples test statistics. The decision criterion is $H_0$ rejected if the significance value $<\alpha = 0.05$, meaning the mean final self-efficacy score is more than the initial average score. The test results will be shown in Table 3.

| Table 3. Self-efficacy analysis with paired samples test. |
|----------------------------------------------------------|
| Pair 1                                                   |
| PRETEST – POSTTEST                                      |
| Mean | -13,294 |
| Std. Deviation | 11,461 |
| Paired Differences | 1,966 |
| Std. Error Mean | 1,966 |
| 95% Confidence Interval | Lower | -17,293 |
| of the Difference | Upper | -9,295 |
| T | -6,763 |
| Df | 33 |
| Sig. (2-tailed) | .000 |

Based on the above table obtained a significance of 0.000 where the value is less than $\alpha = 0.05$. These results indicate that $H_0$ is rejected and $H_1$ is accepted, which means the final self-efficacy questionnaire score is greater than the average initial self-efficacy questionnaire score.

Testing the second hypothesis, namely the test of proportion. This test aims to determine the effectiveness of the learning device in terms of student self-efficacy. This test uses post-test result data. Then analyzed using the test statistic $Z$ [26]. The decision criterion is $H_0$ rejected if $Z > Z_\alpha$ with
significance level $\alpha = 0.05$, meaning the proportion of student who reaches the minimum self-efficacy score more than 75%. Based on the above calculation, $Z = 2.178 > Z_\alpha = 1.645$. This indicates that $H_0$ is rejected, so $H_1$ is accepted. This means that the proportion of students who scored achieves a minimum high category of more than 75%. Based on the specified effectiveness criteria, it can be concluded that the mathematics learning based guided discovery approach is effectively reviewed from the self-efficacy questionnaire.

Increased student self-efficacy can also be derived from the average scores obtained on each aspect and self-efficacy indicators in Table 4. The indicators contained in Table 4 is the development from self-efficacy’s aspects. The average is calculated for both initial score and final score of self-efficacy questionnaire results.

| No | Aspect | Indicator | Initial Score | Final Score |
|----|--------|----------|---------------|-------------|
| 1. | Level  | Confidence in finding Trigonometric formulas in varying degrees of difficulty | 101.5 | 124.5 |
|    |        | Confidence in finding solutions from Trigonometry problems in varying degrees of difficulty | 102 | 119 |
| 2. | Generality | Belief in understanding each sub-chapter | 100 | 126.5 |
|    |        | Confidence in dealing with various conditions and situations in Trigonometry learning | 107.5 | 133 |
| 3. | Strength | Confidence in the effort he did in finding the Trigonometry formula | 107 | 133.5 |
|    |        | Confidence in his potential in solving the Trigonometry problem | 104 | 131.33 |

Based on the above table, it can be seen that each indicator of self-efficacy of students has increased score.

Based on the data analysis above, it can be concluded that in general self-efficacy has increased seen from the distribution of self-efficacy score before and after the research. Before the trial, there was one student who was on very low criteria. In addition, only 52.94% of students meet the high criteria. This percentage then rose to reach 91.18% after a trial run. Students who are on very low criteria no longer exist. This suggests that learning tools can be said to be effective.

Implementation of learning using guided discovery approach is expected to improve student self-efficacy after learning. In more detail, each indicator of self-efficacy is improved. The most significant improvement was obtained in the indicator of "confidence in his potential in solving the Trigonometry problem". The potential is more toward the students' emotional stance when faced with a variety of Trigonometry problems. Broadly speaking, students' improvement in each self-efficacy indicator is due to the application of a guided discovery approach. This approach trains students to assess, decide, and act in their lives, so that students are able to build confidence in their ability to solve Trigonometry problems. Increased student self-efficacy can occur because students are active in learning activities [27]. The guidance given to this approach is also adjusted to the ability of each student so that the abilities and self-efficacy of each individual can develop to the fullest [28]. This means learning is not only designed to focus on students' knowledge, but also the development of social and emotional abilities [16]. Therefore, students must have confidence in their ability (self-efficacy) so as to judge, decide, and act on the problems it faces. Student who has high self-efficacy will be more persistent and motivated in the face of difficult tasks or achieving the goal [29,30].
4. Conclusion
Based on the results of data analysis and discussion, it can be concluded that the learning of mathematics with guided discovery learning is effectively viewed from the criterion of self-efficacy of high school students. The criterions of effective are: the mean of posttest score is higher than pre-test score; and the proportion of students who scored achieves a minimum high category of more than 75%. This study has limitations that is when using questionnaire of self-efficacy to students. For example the seriousness of respondents when filling the questionnaire. There is a possibility that the respondent feels assessed or fears his or her condition is known to teachers or others. So in the end they provide answers that tend to be positive towards the proposed statement.

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