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Abstract. The efforts to improve student's reflective thinking and self-learning can be done through a learning process by providing contextual problems that generate curiosity, recognize what is known and what is needed from the problem, and provide opportunities for students to work, and draw conclusions from the problem. One learning model that can facilitate these activities is guided discovery learning. This developmental research aims to: 1) Design and develop guided discovery learning models to improve reflective thinking ability and student self-learning, 2) Analyze the effectiveness of model and learning tools that are developed towards improving reflective thinking ability and student self-learning. The population subjects in this study were all eighth-grade students of the State Junior High School in Bandar Lampung City. Each one of the sample schools was randomly selected from the high-rank and middle-rank schools. In each school, the sample was taken randomly in two classes. One class as an experimental class applied guided discovery learning, one class as a control class, which is applied to conventional learning. The instrument used is a test of reflective thinking ability and student self-learning scale, interview guidelines, observation sheets, and questionnaires. Based on the study it was concluded that: 1) The guided discovery model that was developed has met valid and practical criteria, 2) The guided discovery model that was developed effectively to improve students' reflective thinking ability and student's self-learning both in high-rank school and middle-rank school.

1. Introduction

The development of science and technology requires humans to continue to improve their quality to face competition in the era of globalization. Education is an important aspect of improving the quality of human resources. To create quality human resources, a learning process is needed. Learning provided in schools consists of various disciplines delivered through subjects. One of the subjects given at school is learning mathematics.

Mathematics learning is very important learning given in school, which aims to equip students with the ability to think logically, analytically, systematically, critically, creatively, problem-solving, and generalizing. In learning mathematics, a person needs to think so that he is able to understand the mathematical concepts learned and use these concepts appropriately when looking for solutions to mathematical problems.

In the process of finding solutions to mathematical problems, higher-order thinking skills are needed. One part of higher-order thinking skills is reflective thinking ability. This is like the statement of Biongan [1], "Reflective thinking can be equated to higher thinking levels of Bloom's Taxonomy of

which teachers need to align into their lessons such as analysis, synthesis, and evaluation". [2] also states that reflective thinking is a process that requires skills that mentally provide experience in solving problems identify what is already known, modify understanding in order to solve problems, and apply the results obtained in other situations.

The development of reflective thinking skills in mathematics learning is very important. This ability is needed in solving problems that require the process of analyzing, synthesizing, clarifying and concluding. The importance of mathematical reflective thinking ability has not yet been supported by the achievement of mathematical reflective thinking ability itself. In fact, there are many problems in mathematics learning that have caused the achievement of high-level mathematical thinking skills, especially reflective thinking skills. Results of the Program for International Student Assessment (PISA) [3], Indonesia ranks 62th out of 70 countries surveyed with a score of 386 for mathematical abilities. This is relatively low compared to the international average score of 490 for the world math average. [4], stated that one of the factors causing the low PISA results was that Indonesian students were generally less trained in solving contextual problems, demanding reasoning, argumentation, and creativity in solving them. The results of the PISA show that Indonesian students generally have difficulty in solving problems that demand reasoning, argumentation, and creativity. These abilities are needed in the reflective thinking process. Therefore, increasing the reflective thinking ability of students needs to be done.

Mathematical learning according to constructivism is based on the assumption that understanding arises through interactions with the environment. This theory considers that the learning process of knowledge acquisition begins with the occurrence of cognitive conflict [5]. This cognitive conflict can only be overcome through self-control. At the end of the learning process, knowledge will be built by the child through his experience from the results of interactions with the environment. Self-control is a form of self-regulated learning. Thus, self-learning is an important component as a determinant of student success in learning.

Self-regulated learning refers to the use of active processes and ongoing knowledge, behavior, and attitudes in achieving goals [6]. The characteristics contained in self-regulated learning are awareness of thinking, the use of strategies, and ongoing motivation [7]. In this study, Self-regulated learning is intended as self-learning. Self-learning not only thinks about thinking, but helps individuals use their thinking processes in developing learning plans, choosing learning strategies, and interpreting their appearance, so that individuals can effectively solve their problems. Thus someone who has good self-learning will have a greater chance of successfully achieving his goals.

Students at Junior high schools in Bandar Lampung City have generally low on reflective thinking ability and self-learning. Based on interviews with teachers and observations of learning, it is known that most students have difficulty when dealing with contextual issues related to higher-order thinking skills. Students have difficulty in analyzing and linking a given problem with a problem they have previously faced. Based on interviews with several students, they said that they did not understand the problem and forgot how to solve the problem. In addition, the learning model used tends to be teacher-cantered, and students only passively receive information from the teacher.

Efforts to improve reflective thinking ability and student self-learning can be through the learning process by providing contextual problems that arouse curiosity, know what is known and what is needed from the problem, and provide opportunities for students to work, and draw conclusions from the problem. This is supported by [8] which states that the ability of reflective thinking in mathematics will be raised and developed when students are in an intense process of problem-solving. Several learning models provide opportunities for students to engage in learning activities, one of them is the guided discovery learning model. [9] states the guided discovery learning model is a component of educational practice which includes teaching methods that prioritize active learning, process oriented, self-directed and reflective.

2. Method

This research is a developmental research that follows the rare steps as presented in the research flowchart in Figure 1.

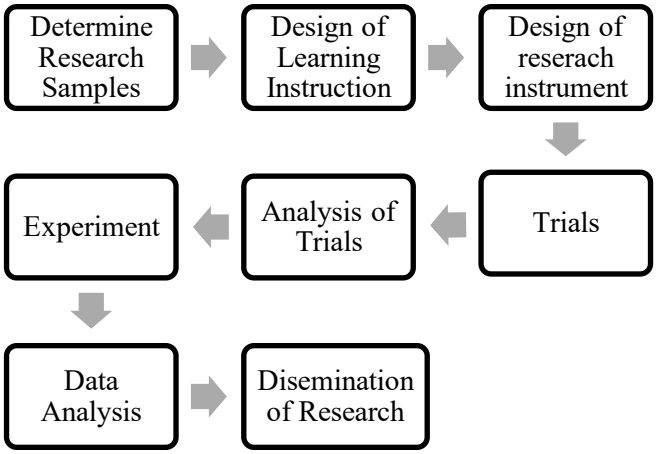

Figure1. Research Flow Chart

This research and development begin with (1) determination of research samples. The sample is determined based on school ranking (high and middle). Then (2) development of model, (3) development of research instruments, validation of models and research instruments, (4) trialling research instruments, (5) analyzing the results of trials, (6) experiment to applying the developed learning models, (7) analyzing the results of the application of the models, and (8) disseminating research results. The population in this study were all eighth-grade students of State Junior High School in Bandar Lampung City, which were distributed in 31 schools. The sample of this study were students from two schools selected as samples each representing high and medium ranking schools. Selected SMPN 20 Bandar Lampung (middle-rank school) and SMPN 5 Bandar Lampung (high-rank school).

Students in Class VIII of SMPN 5 Bandar Lampung are distributed in eight classes, namely classes VIII A to VIII H. Through the draw, class VIII E was chosen as an experimental class with 30 students and class VIII H as a control class with 30 students. Students in Class VIII of SMPN 20 Bandar Lampung are distributed in eight classes, namely classes VIII A to VIII H. Through the drawing of class VIIIA as a control class with 29 students and class VIIIC as an experimental class with 28 students. According to [10], Experiments carried out to apply the developed model, using the pretest-posttest control group design.

Data collection techniques in this study were test and non-test techniques. The test technique is used to collect data about students 'mathematical reflective thinking abilities, while the non-test technique in the form of a questionnaire is used to collect students' self-learning data. The test used was a description test while the questionnaire used was a self-learning scale.

To analyze the research data, steps are performed: 1) test of the normality of the data using the chi-square test, 2) test the homogeneity of variance using the F test. 3) test of the difference between the two averages using the t-test (if the data are not normally distributed use the test non parametric test using Mann Whitney U test).

3. Result and Discussion

The results of this study are grouped into two things, namely: 1) the results of the development of the model, and 2) the results of the experiments or the results of the application of the model. The results of the development of the model: The results of the analysis of the validation test by the experts showed that 89% of the instruments met the requirements of the face and content validity. Furthermore, the results of the validity uniformity test show that the experts have given a uniform assessment. Thus it can be concluded that the developed model is used in the experimental class. The results of the experiments: After processing the reflective thinking ability test of students in the experimental group and the control group obtained data as presented in Table 1.

Table 1 Data of Students Reflective Thinking Ability

High-rank School										
		Experiment					Control			
Max Score	N	x_{min}	x_{max}	$\bar{x}$	s	n	x_{min}	x_{max}	$\bar{x}$	s
32	*30*	*11*	*31*	*21.87*	*5.89*	*30*	*9*	*28*	*18.13*	*5.96*
Middle-rank School										
		Experiment					Control			
Max Score	N	x_{min}	x_{maks}	$\bar{x}$	s	n	x_{min}	x_{max}	$\bar{x}$	S
32	*28*	*12*	*32*	*22.46*	*6.84*	*29*	*8*	*32*	*18.39*	*6.03*

Based on the data in Table1, the highest score of the reflective thinking ability of high and middle school students in the experimental group was higher than the students in the control group. The average score of the experimental group at the high-rank school was also better, namely 21.87 with a standard deviation of 5.89 compared to 18.13 in the control group with a standard deviation of 5.96. The average score of the experimental group at middle-rank school was 22.46 with a standard deviation of 6.48 compared to 18.39 in the control group with a standard deviation of 6.03.

From the data that has been described in Table 1, several hypotheses are tested related to the improvement of students' reflective thinking ability. For this purpose, the normality test is performed using the chi-square test against both groups of data. The results of the calculation of the normality test of the posttest data for each research data showed that the data of students' reflective thinking ability in the experimental class and the control class for high-rank schools and middle-rank schools came from the population with a normal distribution. Test the homogeneity of variance on the data in the experimental class and control class using the F-test. Based on the results of the homogeneity test it is known that both data groups have homogeneous variances.

Furthermore, a summary of the results of the average difference test for research data on students' reflective thinking ability is presented in Table 2.

Table 2. t - test to score of nf student reflective thinking ability

High-rank School					
Class	**Mean**	**DP**	t_{-count}	t_{-table}	**Decision**
Experiment	*21.87*	*58*	*0.33*	*1.67*	*H_0 rejected*
Control	*18.13*				
Middle-rank School					
Class	**Mean**	**DP**	t_{-count}	t_{-table}	**Decision**
Experiment	*22.46*	*55*	*0.22*	*1.67*	*H_0 rejected*
Control	*18.39*				

Based on the results presented in Table 2, the results of the test analysis with the α level = 0.05; the average difference test between the experimental class and the control class by testing two parties at the ranking school is showing that t_{-count} is in the Ho rejection area. Thus Ho is rejected. This means students' reflective thinking ability in Guided Discovery Learning is different from students' reflective thinking ability in conventional learning.

After processing the posttest result data for some students' self-learning in the experimental group and the control group, obtained data as presented in Table 3.

Table 3. Data of Students sealf-learning

High-rank School										
		Experiment					**Control**			
Max Score	N	x_{min}	x_{max}	$\bar{x}$	s	n	x_{min}	x_{max}	$\bar{x}$	s
32	*30*	*113*	*157*	*139.97*	*9.60*	*30*	*102*	*153*	*130.63*	*14.56*
Middle-rank School										
		Experiment					**Control**			
Max Score	N	x_{min}	x_{maks}	$\bar{x}$	s	n	x_{min}	x_{max}	$\bar{x}$	s
32	*28*	*100*	*149*	*126.36*	*13.59*	*29*	*115*	*154*	*134.90*	*6.03*

Based on the data in Table 3, the highest scores of self-learning scale from high-rank school students in the experimental group were higher than those in the control group. The average score of the experimental group score was also better, namely 139.97 with a standard deviation of 9.60 compared to 130.63 in the control group with a standard deviation of 14.56. The highest score of of self-learning scale from student in the experimental were higher than the students in the control group. In contrarry, the average score of the experimental group in the middle-rank school is 126.36 with standard deviation 13.59 compared to 134.90 in the control group with standard deviation 6.03. Furthermore, to find out whether or not there is a difference in the average of the two sample groups based on the school rankings, the average differences in self-learning scale were tested for each school rank.

From the data that has been described in Table 3, then several hypotheses are tested related to improving student self-learning. For this purpose, the normality test and variance homogeneity test are first carried out. The test results show that the data on students' self-learning in the experimental class and control class for high-rank and middle-rank schools are from the population that is normally distributed. Same with the data of student self-learning in the experimental class and control class for middle-rank schools come from the population that is normally distributed. The variance homogeneity test is known that both groups of students' self-learning have homogeneous variances.

Based on the results presented in Table 4, the results of the t-test analysis with the level = 0.05 at high-rank school, the results obtained t count = 2.93 dan 1.67, so H0 is rejected. This means that the average of student's self-learning in guided discovery is higher than the average of student's self-learning in conventional learning. Then, with the level = 0.05 at middle-rank school, the result of -9.24 and 2.05, so H0 is rejected. This means that the average of student's self-learning in guided discovery is higher than the average of student's self-learning in conventional learning.

Table 4. t - test and t'- test to score of student self-Learning

High-rank School					
Class	**Mean**	**DP**	**t_{-count}**	**t_{-table}**	**Decision**
Experiment	139.97	58	2.93	1.67	H_0 rejected
Control	130.63				
Middle-rank School					
Class	**Mean**	**DP**	**t'_{-count}**	**t_{-table}**	**Decision**
Experiment	126.36	55	-9.24	2.05	H_0 rejected
Control	134.90				

Based on the results of data analysis and hypothesis testing it can be seen that: (1) students reflective thinking ability (in high-rank schools and middle-rank school) with Guided Discovery Learning are higher than students reflective thinking ability in conventional learning; (2) students self-

learning (in high-rank schools and middle-rank school) with Guided Discovery Learning are higher than students student's self-learning in conventional learning.

Based on the results of hypothesis testing that has been done, it is known that the students 'mathematical reflective thinking ability in guided discovery learning is higher than the students' mathematical reflective thinking ability in conventional learning. These results are reinforced by the data from the pretest and posttest results. The posttest results showed that the average score of students' mathematical reflective thinking ability in guided discovery learning increased significantly compared to students in conventional learning.

Judging from the achievement indicators of reflective thinking ability there are also significant differences. Before treatment, the achievement indicator of reacting students who took guided discovery learning was lower than students in conventional learning. It turns out that after treatment, reacting indicators achieved by students are higher than students in conventional learning. Likewise, the indicators compare and contemplating. So that in general the percentage of achievement indicators of students' mathematical reflective thinking ability in guided discovery learning is higher than students in conventional learning.

his means that the application of guided discovery learning can improve students' ability to respond to given problems, carry out the process of elaborating, informing, and analyzing the truth of answers, and conducting analysis and clarification of information to evaluate what they believe.

In the application of guided discovery learning, the stage of providing stimulus in the form of questions about previous material relating to the problem to be learned helps students recall the knowledge they had. [11] states that the stimulus will not reach short-term memory if the stimulus provided is not a concern. If we relate that information to things that students already know when we provide new information, students will recall or recall information in long-term memory. According to [12] the stimulus is in the form of asking a problem or question so that students can explore the information they want to solve the problem.

the opportunity to identify problems that are relevant to the learning resources they have, by writing down what is known and what is asked, so that they can formulate a hypothesis that is a statement as a temporary answer. From the stimulus given, students can recall the knowledge they have and have the desire to investigate the given problem. After the recall process is done, students will find it easier to identify problems by writing down what is known and what is asked. Thus, at this stage, the reacting indicator can be improved.

At the information gathering stage, students are given the opportunity to gather a variety of relevant information by searching for literature, conducting trials to prove the truth of a hypothesis that has been formulated. Furthermore, at the data processing stage, information that has been obtained by students is then interpreted, processed, classified, calculated or applied in a certain way. This data processing functions to connect the knowledge that students have with the new information they have so as to form general principles that can help students to check the truth of hypotheses and determine the resolution of the given problem. At this stage, students analyze information that has been obtained, then collect data or information from various learning sources to be able to formulate a relationship between the problem being faced with the knowledge they have. Next, make a decision regarding the method of solving the problem. Thus, this stage of the comparing indicator can be improved.

At the verification stage, students are given the opportunity to examine carefully in order to prove the truth of the results of problem-solving. At the stage of drawing conclusions, students describe, inform, consider any data or information obtained to determine the best method of solving the problem. This activity is in accordance with Bruner's theory which states that the active search for knowledge by humans themselves will provide the best results. [13] also states that discovery learning makes students actively construct new knowledge, consider with information in memory, take meaning and unify the information based on previous experience. This statement supports that learning with guided discovery will further strengthen students' understanding of new concepts. Thus, at this stage can improve contemplating indicators. From the description above, we can say that guided discovery learning can improve students' mathematical abilities. This is in line with several studies such as [14], [15],[16] and [17].

Different things happen in conventional learning. In conventional learning, the teacher begins by explaining the material, followed by the teacher giving examples of problems and their solutions. Next, the teacher invited students to ask questions related to unclear material, but many students did not ask. Then the teacher gives some questions to the student. In doing the problem exercises, students tend to follow the settlement method that is exemplified by the teacher, while for the slightly different questions students find it difficult to solve them. Therefore, students are not trained in solving non-routine problems. [18], states that during this time in the process of learning mathematics in class, students generally learn mathematics only given by the teacher and not through exploration activities. It all indicates that students are not active in learning. Through this learning process, students' mathematical abilities cannot be increased.

4. Conclusion

The results of the expert analysis show that the discovery learning model developed has fulfilled valid and practical criteria for use in learning. The experimental results show that the discovery learning model is effective in terms of students' mathematical reflective thinking abilities and student self-learning.

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