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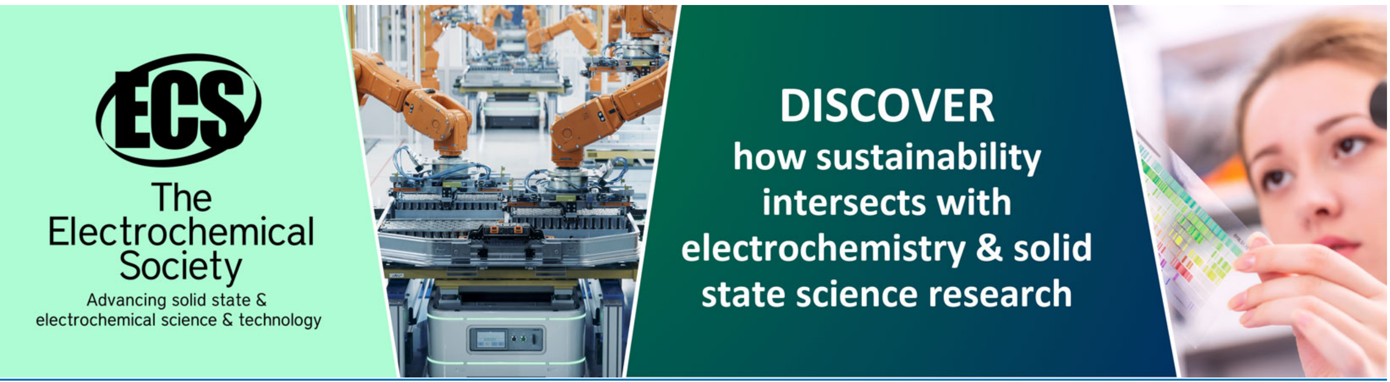

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Scientific Learning and Its Contributions to Increase the Student's Self Confidence and Learning Outcomes

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Abstract. This study aims to determine the contribution of scientific learning in terms of Problem Based Learning (PBL), Contextual Teaching and Learning (CTL), and Guide Discovery Learning (GDL) to student's self-confidence and learning outcomes (critical thinking ability and mathematical representation). The population in this research is students of eight-class from State Junior High School in Bandar Lampung City which is distributed in 31 schools. The samples of the study were students from three selected schools representing high-rank schools, middle-rank schools and low-rank schools. The sample was chosen by purposive random sampling technique. The research design is Pre-test Post-test Control Group Design. The results showed that (1) student's self-confidence in CTL and student's self-confidence in PBL were higher than student's self-confidence in conventional learning, (2) student's self-confidence in GDL did not differ from student's self-confidence in conventional learning; (3) student's mathematical critical thinking skills in CTL and student's mathematical critical thinking skills in PBL are higher than student's mathematical critical thinking skills in conventional learning; (4) student's mathematical representation in GDL is higher than student's mathematical representation in conventional learning. Related to the completeness of the student's learning outcomes, it is known that: (1) the percentage of students who have critical thinking skills are good- categorized in the CTL class and in the PBL class is more than 60% of the total number of students; (2) the percentage of students who have mathematical representation are good-categorized in the GDL class is not more than 60% of the total number of students. Thus it can be concluded that in general, scientific learning contributes to the development of self-confidence and student's learning outcomes.

1. Introduction

Based on curriculum standard currently used in Indonesia [1], minimum competence in the realm of knowledge that must be achieved by junior high school students in mathematics is (1) understanding and applying knowledge (factual, conceptual, and procedural) based on curiosity about science, technology, art, culture related to phenomena and visible events; (2) processing, presenting, and reasoning in the concrete domain (using, decomposing, assembling, modifying, and making) and the abstract realm (writing, reading, counting, drawing, and composing) according to what is learned in schools and other similar sources in a theoretical perspective. With this mastery of competence, students are expected to develop high-level math skills.

These high-level mathematical abilities include the ability to understand mathematical concepts, the ability to use reasoning in patterns and traits, problem-solving skills that include the ability to understand problems, and the ability to communicate ideas with symbols, tables, diagrams, or other media to clarify problems. This ability needs to get special attention regarding its central role in solving problems.

In general, mathematical abilities of junior high school students (eight-grade) in Indonesia are still low. This is reflected in the low percentage of students' correct answers in the international study Trends in the International Mathematics and Science Study (TIMSS) and the Program for International Students Assessment (PISA). Based on the results of the TIMSS study in 2011 [2], students are weak in solving non-routine questions related to verification, mathematical reasoning, finding generalizations or conjectures, and finding the relationship between data or facts provided. While in the PISA study, students of eight-grade were weak in using mathematical concepts to solve real life problems [3]. The low TIMSS and PISA study results were caused by many factors, including Indonesian students generally lacking in training in solving problems whose contextual content, demanding reasoning, argumentation and creativity in completing it [4].

The emerging consensus among mathematics and science educators throughout the world is that the acquisition of high-level cognitive skills (HOCS) students must be the main instructional goals in education [5]. HOCS includes, among others: the ability to ask questions, solve problems, make decisions, and engage in critical thinking ([6]; [7]; [8]). Ideally, students gradually build their critical thinking skills as long as they go to school; not only asked to think critically at certain times. National curriculum initiatives around the world (Japan, China, Australia, Israel, Singapore, including Indonesia, for example), advocate increasing thinking skills that are structured, high-level, heuristic, Meta cognitive, imaginative, critical, and creative. On that basis, the learning outcomes to be developed in this study are critical thinking skills and mathematical representation abilities.

Critical thinking abilities include things like: applying available information to new situations, analysing causes or motives for situations, and evaluating opinions on subjects. Some definitions of critical thinking skills are conveyed by the following experts. [9], defines the ability to think critically as "reasonable reflective thinking that focuses on deciding what to believe or do. Furthermore [10], claims that critical thinking is" a thought that allows judgment, based on criteria, corrects itself, and sensitive to context ".

On the other hand, the ability to think critically also requires other thinking skills including mathematical representations, because someone does not only have to be critical in thinking, but is required to be able to deliver his ideas. The ability to convey this idea is part of a mathematical representation. As one of the process standards, [11] establishes the standard of representation expected to be mastered by students during school learning, namely: (1) making and using representations to recognize, record, and communicate mathematical ideas; (2) choosing, applying, and translating between mathematical representations to solve problems; (3) using representations to model and interpret physical, social, and mathematical phenomena.

Representation is an expression of mathematical ideas displayed by students as a model or substitute form of a problem that is used to find solutions of a problem its faces as a result of the interpretation of its mind [12]. According to [13], representation is a configuration (form or arrangement) that can describe, represent, or symbolize something in a way. According to [14] mathematical representation ability is a useful tool for understanding geometrical concepts, completing tasks and for explaining to others.

Bandar Lampung city is one of the cities in Lampung Province which has several junior high schools both state and private. Based on the results of interviews with 20 teachers from several junior high schools in Bandar Lampung City, information was obtained that students often experienced difficulties when working on math problems in the form of story problems or questions that were slightly different from the examples given by the teacher. Students find it difficult to understand and analyze questions; as a result in planning a solution, implementing a solution, and making conclusions, they get less satisfying learning outcomes. This shows that students' mathematical abilities are still underdeveloped. The results of an analysis of mathematics learning in several state junior high schools in Bandar Lampung in the last 3 years shows that mathematics learning is partly still going on traditionally and oriented towards developing the ability of Low order thinking (LOT). After applying the new curriculum in several schools it was also known that there were some difficulties experienced by the mathematics teacher. In this study, learning is applied with a scientific approach which is expected to improve students' mathematics learning outcomes and self-confidence

According to [15], self-confidence is a positive attitude that makes him develop positive judgments about himself and the environment or situation he faces. In this study, self confidence is intended as a person's confidence in his ability to solve mathematical problems faced. Self confidence is very important to be developed for several reasons. [16], states that with confidence, students will be more motivated and prefer to learn mathematics. [17], states that global competition makes students required not only to be smart in terms of science, but also to have the confidence and courage to face every global challenge. [18], state that "Confidence will lead to improved performance and more successful life in general". Meanwhile, [19] said that self confidence as simply believing in oneself. Related to mathematics education, Margono in [20] revealed that students' self-confidence in learning mathematics can be divided into three aspects, namely 1) Trust in understanding and self-awareness of mathematical abilities, 2) Ability to determine realistically the goals to be achieved and compile action plan as an effort to reach the target, 3) Trust in mathematics itself.

Self-confidence needs to be owned by students in learning mathematics, but the facts show that students' self confidence in learning mathematics is generally still low. The results of the TIMSS study in 2012 [2], show that on an international scale only 14% of students have high self-confidence related to their mathematical abilities; 45% of students are in the medium category; and 41% are in the low category. Especially for students in Indonesia, only 3% of students have high self-confidence in mathematics, 52% are in the medium category and 45% are in the low category.

Learning with the scientific approach adopts the steps of scientists in building knowledge through scientific methods. There are many learning models that use scientific approaches including problem based learning (PBL), Guided discovery learning (GDL), and Contextual Teaching and Learning (CTL). According to [21], PBL is a learning method that facilitates students learning through solving problems that are the core of learning. Problems raised in PBL are complex and do not only have one answer (open-ended). Students work in collaborative groups to identify what they need to solve problems, involve students in learning independence, apply the knowledge they have to the problem, reflect on what they are learning and how effective the strategy is used.

U.S. Department of Education [22], states that CTL is an educational philosophy that believes that student learning outcomes can be enhanced by connecting material to the context of student life and can involves students in activities linking lessons to the real-life context they face.

2. Method

This research was an experimental study to determine the contribution of the application of scientific learning to the improvement of self-confidence and student learning outcomes. This is seen from the difference in the increase in self-confidence and student learning outcomes in scientific learning when compared to conventional learning. The experimental design used was pretest-posttest control group design. The population in this study was all eighth grade students of State Junior High Schools in Bandar Lampung City which were distributed in 31 schools. The research sample was students from three schools selected as samples, each representing high, medium and low ranking schools with purposive sampling technique. Sampling was done by randomly choosing one school for each rank. Then at each selected school, two classes are taken randomly. One class follows scientific learning and one class follows conventional learning. To obtain data, two instruments were used, namely the mathematics learning outcomes test and the self-confidence scale. The teaching materials used in this study are Student Worksheets (SW), which consider the tasks, participation, and motivation of students designed for scientific learning. To analyze the research data, it was tested the Normality and Homogeneity of Variants and the Test of Two Average Differences.

The dimension of self-confidence is adapted from [23], namely: 1) Confidence in his ability, 2) Optimistic, 3) Objective, 4) Responsible, and 5) Rational and realistic. Meanwhile, to assess critical thinking skills, indicators are adapted from [24], namely: 1) Interpretation, 2) Analysis, 3) Evaluation, and 4) Inference. To measure mathematical representation capabilities, the indicators used are adapted from [11], namely: (1) making and using representations to recognize, record and communicate mathematical ideas; (2) using representations to model and interpret physical, social, and mathematical phenomena, (2) choosing, applying, and translating between mathematical representations to solve problems.

3. Result and Discussion

After processing the self-confidence questionnaire of students in the experimental group and the control group obtained data as presented in Table 1.

Table 1 Data of Students *Self Confidence*

Max Score	Experiment					Control				
	N	x_{min}	x_{max}	$\bar{x}$	*S*	*N*	x_{min}	x_{max}	$\bar{x}$	*S*
High-rank School – CTL										
96	*32*	*54*	*94*	*80,63*	*10,63*	*32*	*50*	*92*	*72,56*	*10,95*
Middle-rank School – GDL										
80	*36*	*42*	*70*	*53,03*	*5,45*	*38*	*41*	*61*	*52,66*	*5,22*
Low-rank School – PBL										
64	*22*	*40*	*54*	*45,86*	*1,99*	*21*	*34*	*56*	*42,81*	*2,62*

CTL=Contextual Teaching and Learning; GDL= Guided discovery Learning; PBL=Problem-Based Learning

Based on the data in Table1, the highest score of the self-confidence scale of high and middle rank-school students in the experimental group was higher than the students in the control group. However, the highest score of the self-confidence scale of low-rank school students in the experimental group was lower than the students in the control group. From the data that has been described in Table 1, then several hypotheses are tested related to the improvement of students' self-confidence. 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 post test data for each research data showed that the data of students' self-confidence in the experimental class and the control class for high-ranking schools came from the population not normally distributed. While the data of students' self-confidence in the experimental class and the control class for medium and low grade schools came from the population with 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' self-confidence is presented in Table 2.

Table 2. T - test and Mann Whitney U- test to score of student self-confidence

High-rank School					
Class	**Mean**		Z_{count}	Z_{table}	**Decision**
Experiment	*80,63*		*-3,93*	*1,96*	*H_0 accepted*
Control	*72,56*				
Middle-rank School					
Class	**Mean**	**DP**	t_{count}	t_{table}	**Decision**
Experiment	*53.03*	*72*	*0,14*	*1,68*	*H_0 accepted*
Control	*52,66*				
Low-rank School					
Class	**Mean**	**DP**	t_{count}	t_{table}	**Decision**
Experiment	*45,86*	*41*	*1,78*	*1,68*	*H_0 rejected*
Control	*42,81*				

Based on the results presented in Table 2, there is no difference of the average of self confidence from the students in GDL and students that study conventionally at middle-ranking school. The average of students' self-confidence in PBL and conventional learning at lower-rank school are different. For data from the high-ranking schools, the results of analysis with non-parametric (Mann-Whitney U test) for the data of self-confidence, shows that the average of students' self-confidence in CTL is higher than students in conventional learning.

Based on the data in Table 3, the highest scores of high-rank and low-rank school students in the experimental group for mathematical critical thinking skills were higher than those in the control group.. The highest score of students in the experimental group for the mathematical representation ability was higher than the students in the control group. 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 mathematical abilities were tested for each school rank.

Table 3. Data of Students Learning Outcomes of Mathematics

High-rank School – CTL											
Abilities	**Max Score**	**Experiment**					**Control**				
		n	x_{min}	x_{max}	$\bar{x}$	S	n	x_{min}	x_{max}	$\bar{x}$	s
Critical Thinking	*64*	*32*	*12*	*40*	*25,41*	*7,85*	*32*	*4*	*33*	*18,03*	*8,88*
Middle-rank School – GDL											
Mathematical Representation	*100*	*36*	*36*	*95*	*71,61*	*13,89*	*38*	*33*	*86*	*59,97*	*11,97*
Low-rank School – PBL											
Critical Thinking	*24*	*22*	*10*	*18*	*13.77*	*2,10*	*21*	*10*	*21*	*12.69*	*2,52*

From the data that has been described in Table 3, then normality test and variance homogeneity test are first carried out. The test results show that the data on students' critical thinking skills in the experimental class and control class for high-rank and low-rank schools are from the population not normally distributed. While the data of mathematical representation ability of students 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' mathematical abilities have homogeneous variances.

Table 4. t - test and Mann Whitney U- test to score of Learning Outcomes of Mathematics

High-rank School – Critical Thinking					
Class	**Mean**	**DP**	**t_{count}**	**t_{table}**	**Decision**
Experiment	25,41	62	4,29	1,67	H_0 rejected
Control	18,03				
Middle-rank School – Mathematical Representation					
Class	**Mean**	**DP**	**t_{count}**	**t_{table}**	**Decision**
Experiment	71.61	72	1,87	1,68	H_0 rejected
Control	59,97				
Low-rank School – Critical Thinking					
Class	**Mean**		**Z_{count}**	**Z_{table}**	**Decision**
Experiment	13,77		2,10	1,96	H_0 rejected
Control	12,69				

Based on the results presented in Table 4, the average of critical thinking skills of students in CTL are different from students in conventional learning. In the same way it can be concluded that the average of mathematical representation ability of students in GDL is different students in conventional learning. The results of the analysis using non-parametric test (Mann-Whitney U test) for the data of critical thinking ability of students in PBL, it is known that there is a difference between the averages of mathematical critical thinking abilities of students in PBL with the average of students' critical thinking abilities student in conventional learning.

Based on the results of data analysis and hypothesis testing it can be seen that student learning outcomes (critical thinking ability and mathematical representation ability) with scientific learning (CTL, GDL, and PBL) is higher than student learning outcomes with conventional learning. Therefore, it can be concluded that scientific learning has contributed to improving student learning outcomes. This is consistent with several research related to critical thinking skills and PBL, including the research of [25], [26],[27], [28].

For the GDL model, the results also show that the GDL model influences student learning outcomes. There are six steps in GDL that provide opportunities for students to develop mathematical representation abilities. Through stimulation step, students are motivated to be confident in their abilities and active in learning activities. Through identify the problem; students will be familiar with understanding and formulating the problem given in the form of a hypothesis. In data collection step, students are used to collecting relevant information to prove whether or not the hypothesis has been formulated. In data processing step, students are accustomed to interpreting, processing, classifying, calculating or applying in certain ways the data and information that has been obtained. Then students conduct a careful examination to prove whether or not the hypothesis has been determined by the findings associated with the results of data processing. The last step, students conclude the results obtained with the guidance of the teacher. The results of this study are consistent with study of [29], that discuss of the GDL role in improving critical thinking skills and critical thinking dispositions. The contribution of CTL to the improvement of learning outcomes is consistent with several researches. The results study of [30] show that the improvement of students 'critical thinking skills in CTL is higher than students in conventional learning. In his research [31] concluded that conditions that fostered the implementation of CTL strategies were a collaborative interaction with students, a high level of activity in the lesson, a connection to real-world contexts, and an integration of science content with other content and skill areas. Furthermore, the results study of [26] shows that students' mathematical critical thinking skills can be increased through PBL. In conventional learning, students are not trained in solving non-routine problems. [32], 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 was indicates that students are not active in learning.

Regarding students' self-confidence, the results showed that not all made meaningful contributions. In high-rank schools with CTL models and low-rank schools with PBL models, the results of the study showed that there was a contribution from the learning model to students' self-confidence. While in the middle-rank school, self-confidence of students in GDL model is lower than students in conventional learning. This is because the GDL model is a new learning model for students and its implementation is relatively short. Student self-confidence cannot be increased in a short time, because self-confidence is formed from the processes that occur in the environment. This is in line with Saransonin [33] which suggests that self-confidence is formed and develops through individual and social learning. In this study, not all of students participate in learning activities well. Self-confidence begins with a determination of you to do everything you want and need in life. In accordance with the opinion of [34] which revealed that growing a sense of proportional self-confidence, individuals must start within themselves. The students self-confidence should have been started since childhood, so that in the learning process students can develop their self-confidence. This means that in developing students' self confidence it takes a long time. Based on the above discussion, it can be concluded that scientific learning has a contribution to the increase of self-confidence and student learning outcomes.

4. Conclution

Based on the results of data analysis, it can be concluded that scientific learning has a contribution in improving student learning outcomes. This is seen from: (1) Critical Thinking ability and self-confidence of students in CTL is higher than students in conventional learning; (2) The mathematical representation ability of students in GDL is higher than students in conventional learning but the self-confidence of students in GDL is not higher than students in conventional learning; (3) Critical Thinking ability and self-confidence of students in PBL, is higher than students in conventional learning. Based on the research, it is suggested that: (1) Considering that students' self-confidence in GDL is not optimal, it is necessary to conduct further studies on the application of GDL learning to students by paying attention to several weaknesses in this study; (2) It should be explored about the contribution of other scientific learning models to improving student learning outcomes.

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