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The Effect of Discovery Learning Model on Student's Critical Thinking and Cognitive Ability in Junior High School

Tota Martaida[1]; Nurdin Bukit[2] ; Eva Marlina Ginting[3]
[1](Post Graduate, State University of Medan, Medan, Indonesia)
[2](Lecturer, State University of Medan, Medan, Indonesia)
[3](Lecturer, State University of Medan, Medan, Indonesia),

Abstract : *The aimed of this research is to know the effect of learning discovery model on the critical thinking and cognitive ability of SMP Negeri 5 Kisaran students. This research is a quasi experimental research with two group pretest posttest design. The population of this research is all students of class VII of SMP Negeri 5 Kisaran, first semester of academic year 2017/2018. The sample selection is done by cluster random sampling that is class VII-1 as experiment class applied discovery learning model and class VII-3 as control class applied conventional learning. The instrument used in this research is the critical thinking and cognitive thinking skills in the form of essays each of 5 questions that have been declared valid by the expert team. The results concluded that the first hypothesis test obtained* $t_{counted}$ *= 2.10 with* α *= 0.05 obtained* t_{table} *= 2.00. By comparing thitung with* t_{table} *turns* $t_{counted} > t_{table}$*, this means the critical thinking ability of students applying discovery learning model is better than students' critical thinking ability with conventional learning. the second hypothesis test obtained* t_{count} *= 2.21 with* α *= 0.05 obtained* t_{table} *= 2.00. By comparing thit with* t_{table} *turns* $t_{counted} > t_{table}$*, this means the cognitive ability of students applying discovery learning model is better than cognitive ability of students with conventional learning*

Keywords **:** *Discovery learning model, Critical Thinking, Cognitive Ability*

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I. Introduction

Education is the most basic requirement every human being must have, with human education being better able to develop the potential within him. Education can be said as a process in certain ways so that one gets the knowledge, understanding, and the appropriate behavior. According to KamusBesarBahasa Indonesia (KBBI) "education is a process of changing the attitude and behavior of a person or group in an attempt to mature man through the efforts of teaching and training; processes, ways of educating ".

Education in schools is organized by giving exemplary, build the will and develop creativity of learners in the learning process. The process of learning activities is the scope of education, one of which is learning science. Science is the knowledge gained through learning and proof. Science is a part of science that is essentially a process, a product and an attitude. **[1]** say that "Science is one of the most basic sciences of science. Natural science (IPA) is a process that leads us to general principles that describe how physical behavior ". Good education is expected by the community where it requires a professional educator in the learning process so that the learning objectives are achieved.

Based on a survey conducted by the OECD (Organization for Economic Co-operation and Development) using a broader global standard using the PISA (Program International for Student Assessment) test. The PISA test is an international study of the achievements of reading, math and science of 15-year-old schoolchildren. There are 70 countries that participated in the PISA test in 2015 Indonesia is ranked 62nd with a score of 403 while neighboring countries like Australia ranked 14th with a score of 510 and singapore in the rank 1 with a score of 556. According to an international survey of Trends in International Mathematics and Science Study (TIMSS) in 2015 shows that the average score of Indonesian students' science achievement is below the international average score. Based on the data it can be seen that Indonesia is ranked 45th out of 48 countries participating in this survey with a score of 397 while the international score is 600.

The success of learning can be improved if the learning process can take place with the availability of facilities and infrastructure that support and the ability of teachers in managing the class by using the right method, strategy or model. Based on the explanation, there needs to be renewal or innovation in achieving the learning objectives. Learning science should be more varied both models, methods and strategies to create active learning, innovative, creative, effective and fun so that students' ability can be optimized.

Based on the results of interviews conducted by teachers of science studies where the learning process is still centered on the teacher (teacher center). Teachers as the only source of learning for students. This makes

student learning outcomes low. The low learning outcomes of students is evidenced by the results of the tests conducted on 36 students in the 5th grade SMP Negeri Kisaran. Based on the results of the examinations conducted in the odd semester in the academic year 2016/2017 at the school obtained a very unsatisfactory value (0-25) as many as 24.2% of students, the value with the acquisition is not satisfactory (25-50) as many as 39.4% students , the value with the acquisition was satisfactory (51-74) of 21.2% of students and the value of satisfactory (75-90) of 15.2% of students, and value with a very satisfactory (91-100) does not exist. The percentage of students passing rate is only 15.2% with the KKM score of 78.

One of the problems that occur in education, especially in science subjects is the weakness of the learning process. Students are not encouraged to discover the knowledge themselves but students are required to remember what teachers have given them. As a result students are unable to provide solutions to problems that arise especially if the problem is related to the concept of IPA. For students themselves science lesson is an unpleasant lesson because it is full of formulas and must be memorized, resulting in many students who get low learning results or less to reach the established limit of mastery.

Based on the above, then science learning is expected to provide direct experience to understand science scientifically. Learners can achieve the expected learning results by experiencing direct learning. One way to involve students directly in understanding IPA by applying the discovery learning model. Discovery learning model one of the learning models that can answer the educational needs in accordance with the 2013 curriculum is a scientific approach. Discovery learning is a model for developing active student learning by finding out on their own, investigating on its own so that the results obtained will be long lasting in memory, not easily forgotten by students. Learning discovery, making children can learn to think analysis and try to solve their own problems encountered.

Discovery learning model is a series of learning activities that emphasize the critical thinking process and analysis to achieve and find their own answers to the problems asked. The essence of discovery learning is to give students a lesson to deal with the problems facing students facing the real world. The steps of the discovery learning model are: 1) preparatory steps, 2) implementation. The benefits of the discovery learning process are: 1) increasing the intellectual potential, 2) shifting values from extrinsic to intrinsic, 3) to improving long memories, 4) heuristic learning of the findings **[2].** The main targets of the discovery learning model are: maximum student engagement in teaching and learning activities and develop self-belief about what is found during the learning process.

In particular, science learning in school students should be directed to be able to: 1) solve problems encountered in everyday life with the concept of science that has been studied, 2) have a scientific attitude in solving problems faced. Critical thinking skills need to be improved in learning activities, because all global information comes in easily that causes information that is good or bad will continue to flow and can affect the mental nature of children. It is therefore necessary to have a clear and imaginative ability to think, to judge evidence, to play logic and to find alternatives to find solutions to give children a clear route amid the chaos of thinking in today's technological and globalization era **[3].**

Critical thinking becomes an activity that can be done better or vice versa and good critical thinking will meet a variety of intellectual standards such as clarity, relevance, adequacy, coherence. Critical thinking requires interpretation and evaluation of observation, communication and other sources of information. The most famous constituent in the development of critical thinking skills is according to **[4]** who argues that "critical thinking is reasonable, which is defined as critical thinking is rational and reflective thinking that is focused on what is believed and done. The ability to think critically in students in learning can be developed by means of teachers and students should play a role as a joint player. Teachers and students must teach each other and learn and in learning there must be mutual dialogue and horizontal communication. Material about critical thinking is material that involves analysis, synthesis and evaluation of concepts.

Several studies have demonstrated the positive impact of discovery implementation that the results of the research by **[5]** conclude that discovery is more effective in improving students' achievement followed by demonstration methods while the traditional method is the least effective. **[6]** conclude that guided discovery learning is an efficient way of reinforcing the creative thinking of students. The influence is also significant in developing the creativity, fluidity, flexibility and the development of experimental group. **[7]** concluded that Guided discovery instruction would affect the learning achievement, guided discovery instruction and influence learning learning retention.

[8] concluded that higher level of learning in higher cognitive level and the preference of the students to GDL are compared to modern learning methods. Student-centered learning methods by reinforcing the sense of the group of students to learn and learn in higher levels of cognition.

The results of research conducted by previous researchers that discovery learning model was able to improve student achievement **[9],** but still less precise work on the syntax in the learning model discovery. The same thing examined by **[10]** states that the discovery learning model can improve student learning outcomes but still many mistakes experienced by students in the learning process.

1.1 Model of discovery study

The discovery or discovery learning model is a model that is a way to develop active student learning by finding out on its own, investigating on its own, so the results will be longer remembered by students **[9].** The rationale is the opinion of Piaget which states that discovery or discovery is where in the process of teaching and learning teachers allow students to find their own information traditionally usually notified. Thus the discovery learning model is designed in such a way that it can find concepts and principles through its own mental processes. Discovery Learning has the same principles as inquiry and problem solving.

1.2 Cognitive Ability

Cognitive relates to or involves cognition. While cognition is an activity or process of acquiring knowledge (including awareness, feelings, etc.) or an attempt to recognize something through its own experience. According to Bloom cognitive is the realm that pays attention to the development of capabilities and intellectual skills. **[11]** also stated that the cognitive activity setting room is his own mental activity**. [11]** states that the hallmark of cognitive learning lies in obtaining and using representational forms that reflect the objects at hand, be they objects, objects or events. These objects are represented or represented in a person through a mental response

1.3 The Ability of Critical Thinking

[4] Critical thinking ability is a reflective and reasoned way of thinking that is focused on making decisions to solve problems. This mental process will generate the critical thinking ability of students to be able to master the science of nature in depth. According to **[12]** critical thinking is the ability to give reasons in an organized manner and evaluate the quality of a reason systematically. The idea that this regular and systematic reasoning originated from the discovery he had experienced. The ability to think critically is a person's ability to use his thought process to analyze arguments and provide interpretations based on valid perceptions through logical assumptions and interpretations **[13].** The ability to think is basic in a learning process **[14].** Critical thinking allows students to analyze their thoughts in making choices and draw conclusions intelligently. Children are given the opportunity to use higher-level thinking at each grade level, in the end they will be accustomed to distinguish between truth and lies, appearance and reality, facts and opinions, knowledge and beliefs.

Understanding the material of natural science requires thought and reasoning in order to solve the problem of natural science. At a high level of critical thinking critical thinking includes: 1) understanding the argument and believing it, b) critically evaluating the argument and believing it, and c) developing and maintaining the argument by supporting strongly and faithfully. Critical thinking is not a teaching material material but a process or activity that should be incorporated in the learning of any material at a given level of education. Solving the problem of natural science is required to think logically and procedural thinking because the problem of natural science derived from natural phenomena and complex material requires the thinking phase from basic thinking to high level thinking. Critical thinking skills are developed into indicators of critical thinking consisting of five groups according to Ennis: 1) providing elementary clarification, 2) building basic capabilities, 3) Make further explanations (anvanced clarification), and 5) implement strategies and tactics (strategies and tactics).

II. Method

2.1 Population and sample

The population in this study is all students of VII grade of junior high school 5 Kisaran, 2017/2018 academic year as many as classes, each class of 30 people then the population of 150 people. Sampling is done by cluster random sampling where each class has the same opportunity to be a research sample. This research consists of two classes, one class as an experimental class that is taught with problem based learning model and one class is taught with conventional learning.

2.2 Data collection techniques

This research includes quasi experimental research that is a research that aims to determine the presence or absence of a result of "something" imposed on the "subject" students ie students. The study involved two different sample classes treated. In experimental class with discovery learning model and control class with conventional learning. The research design is two group pretest-postest design. The following research design can be seen in Table 2.

Table 1. Research design

Class	Pretest	Treatment	Posttest
Experiment	Y_1	X_1	Y_2
Control	Y_1	X_2	Y_2

Information :
X1: Learning using discovery learning model using on pressure material.
X2: Learning by using conventional learning on pressure materials.
Y1: Pretest given prior to treatment in the experimental class and control class.
Y2: Postest given after treatment in the experimental class and control class.

Data collection techniques is the most important step in the research, because the main objective of the research is to obtain the instrument data used to obtain data in this research in the form critical thinking and cognitive ability. Both of these instruments are validated by the lecturers of Graduate State University of Medan, as panel of experts in determining the suitability of the test indicators. After the process of revision and improvement of the suggestions provided by the expert, it is concluded that the test has been able to be used to determine student learning outcomes and student confidence.

Data collection is done in two stages, the first step is collecting data about problem solving ability and second stage collecting data about critical thinking ability. Data obtained in the study were analyzed descriptively and inferentially. Inferential statistical analysis, to test the hypothesis. Before testing the hypothesis is tested the requirements of the test normality of research data with Liliefors technique, then continued with homogeneity test

III. Results

Data obtained after postest

Table 2. Summary of pretest - postest critical thinking dan cognitive ability of the control class and experimental class.

Dependent variable	Class	Mean Pretes	Mean Postes
Critical thinking	Control	17,93	71,62
	Experiment	18	75,67
The ability of critical thinking	Control	18,08	66,4
	Experiment	19,87	75

Table 4. Post-t test Postest The ability of critical thinking

Post test Equation Test	$t_{counted}$	t_{table}	Sig	Information
Test- t	2,10	2,00	0,012	Significantly different

Based on Table 4, this result indicates that $t_{counted} > t_{table}$ and significance value are smaller than 0.05. Based on these results can be concluded that there are differences in critical thinking of students in the class that taught with conventional learning and classes that taught with discovery learning model, with the results obtained critical thinking of classroom students with discovery learning model is better than the classroom with learning Conventional.

Table 5. Test-t Postest cognitive ability

Post test Equation Test	$t_{counted}$	t_{table}	Sig	Information
Test – t	2,21	2,00	0,07	Significantly different

Based on Table 5, this result indicates that $t_{counted} > t_{table}$ and significance value greater than 0.05. Based on these results can be concluded that there are differences in students' cognitive ability in classes that are taught by conventional learning and classes that taught with discovery learning model, with the results obtained class cognitive thinking with discovery learning model is better than the classroom with conventional learning .

IV. Discussion and Conclusions

4.1 Discussion

4.1.1 The critical thinking skills of students who are taught with discovery models are better than conventional learning

The critical thinking skills of students who are taught by discovery learning models show better results than are taught by conventional learning.

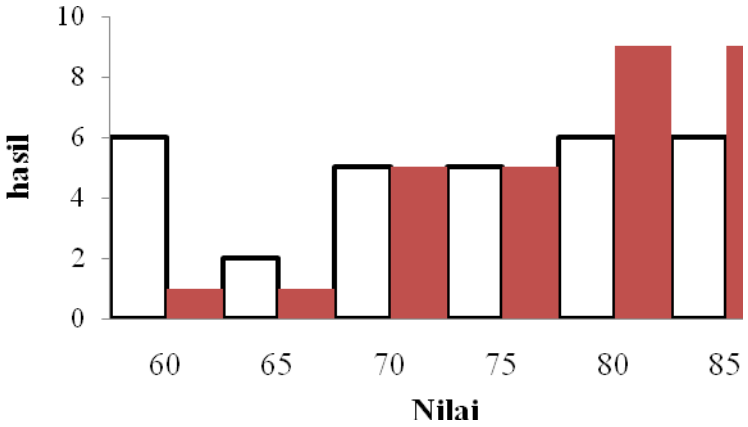

Figure1. The students' critical thinking skills are better in the experimental class than the control class.

The cause of students' critical thinking ability in the experimental class is better than the control class is because discovery learning activities can support the students in finding something from the problems given by the teacher. Problems presented, answered by students through research activities or scientific work. Scientific work can facilitate students to gain knowledge by using scientific methods ranging from mengobsevasi, formulate questions, create hypotheses, collect data and conclude. This activity will be able to improve students' critical thinking ability. Critical thinking ability of students is not obtained from the way of memorization. The same thing is conveyed by **[15]** that discovery learning provides an opportunity for students to have a real and active learning experience so that students are trained in solving problems as well as making decisions, and students can acquire concepts or materials they learn in various ways or shape to better understand the concepts or material being studied.

The second factor that causes students' critical thinking skills in the experimental class is better than the control class is because students are trained to think logically. Logical thinking can be obtained by students when providing a logical argument to determine the conclusions of scientific work. The conclusion of scientific work will be a correct and correct concept when it is conveyed through a logical argument. Logical thinking can find students' deeper critical thinking skills, as stated by **[16]** one of the abilities that is closely related to student learning outcomes is the ability to think logically, that is, the ability to find a truth based on the rules , certain patterns or logic. This capability needs to be developed in learning, as it can help students to improve conceptual understanding. The ability to think logically can bridge on improving student learning outcomes through a correct understanding of concepts.

The third factor that causes students' critical thinking skills in the experimental class is better than the control class is because the learning discovery students are trained to think systematically. Thinking systematic is the students follow the patterns of scientific methods, starting from the observation, students ask questions based on observations made. Formulation of questions posed by students will stimulate students' thinking skills in formulating problems. In formulating the problem students will optimize their initial knowledge by recalling the concepts associated with the observation activities undertaken. As stated by **[17]** early knowledge of students will have a positive impact on students, ie students will further strengthen the concepts in long-term memory.

In contrast to conventional learning in control classes, teachers tend to be more centered, meaning that in the learning process of teachers who play the most dominant role. The application of conventional learning, teachers present information step by step while students only pay attention and receive what has been delivered by the teacher. Teachers tell students what they should learn or read, thus causing the minds of students who do not develop well. Students are limited only considering the concepts of subject matter delivered by teachers but students do not understand for what the concept is learned, it can be said that critical thinking ability has not been optimal.

4.3.2. The cognitive abilities of students who are taught with discovery models are better than conventional learning

The cognitive abilities of students who are taught by discovery learning models show better results than students who are taught by conventional learning.

The cognitive abilities of students who are taught with discovery are better than students' thinking skills in the control class as in Figure 2 below.

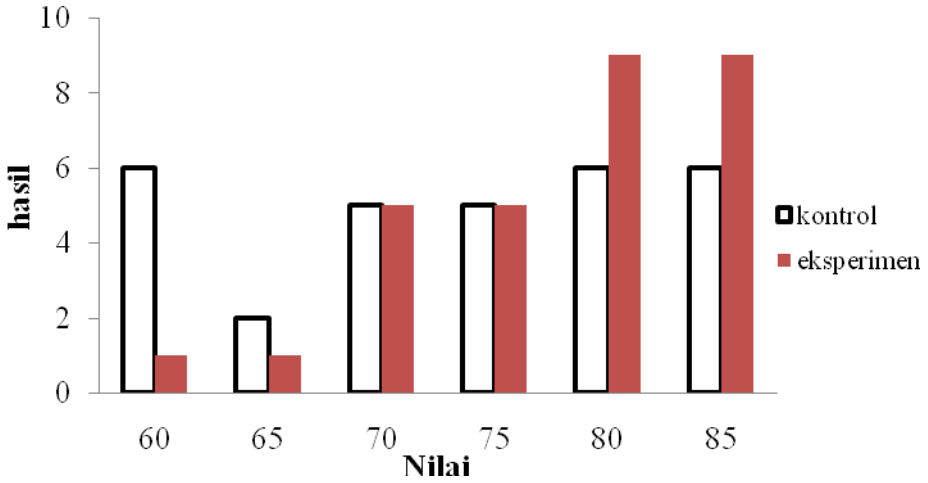

Figure 2. The students' cognitive abilities are better in the experimental class than the control class.

The cause of cognitive ability in the experimental class is better than the control class is because discovery learning can involve students actively (student center) to investigate the problems presented on the student worksheet. According to **[15]** discovery learning process provides opportunities for students to have real and active learning experience so that students are trained in solving problems as well as making decisions. Discovery learning activities can provide an opportunity for students to find something through experimentation. Facing students in a scientific activity (experiment), students are trained to be skilled in obtaining and processing information through thinking activities by following scientific procedures, such as, skilled in observing, measuring, classifying, drawing conclusions and communicating the findings. As presented by **[18]** that studying the process of scientific knowledge is a very important ability for students. This process is defined as a cognitive ability that helps students build scientific learning and helps them become active participants to study research techniques. Research techniques trained in discovery learning can explore students' cognitive abilities. According to **[19]** that cognitive ability is the ability of students to apply scientific methods in understanding, developing and discovering science. Cognitive ability is very important for every student as a provision to use scientific methods in developing science and is expected to acquire new knowledge or develop the knowledge already possessed.

The second factor that causes students' cognitive abilities in the experimental class is better than the control class is because student involvement in discovery learning provides experience and familiarizes students with scientific work to develop cognitive abilities in processing and self-discovery of such knowledge. According **[20]** states the need for involvement of a process capabilities possessed by learners in learning activities, because the ability of the process is a capability that is often used by scientists in solving problems that disturb his curiosity through laboratory activities. Learning in the experimental class with discovery learning model gives students the opportunity to work to find science and not just hear and receive information only. The mode of presentation of the lesson, in which the student experiments with experiencing something himself learned. Teaching and learning with experimental method provides an opportunity for students to experience themselves or do themselves, following a process, observing an object, state or process something. Thus, students are required to experience themselves, seek the truth, or try to find a law or proposition, and draw conclusions. These processes are research techniques that can cultivate students' cognitive abilities. As stated by **[21]** that it can be concluded that one way to improve the mastery of cognitive ability using discovery learning model.

4.2 Conclusions

Based on the results of research and discussion it can be concluded as follows:

1. The critical thinking abilities of students who are taught with discovery learning are better than students who are taught by conventional learning.
2. The cognitive abilities of students who are taught with discovery learning are better than students taught by conventional learning.

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