

## CRITICAL THINKING SKILLS ENHANCEMENT OF STUDENTS THROUGH INQUIRY LEARNING MODEL LABORATORY BASED ON REFLECTION OF THE LIGHT

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**Abstract.** *This study aims to determine the use of inquiry-based learning model laboratory to increase critical thinking skills of students of SMP Negeri 6 Banda Aceh on light reflection material. The method used is a quasi-experimental control group design with pre-test and post-test design. The population in this study is in the eighth grade students of SMP Negeri 6 Banda Aceh. The sampling technique used purposive sampling technique. As for the samples in the study were students VIII2 as an experimental class, and the class as a class VIII5 control the number of students in each class of 30 people. Experimental class taught by laboratory-based inquiry learning model, and the control class was taught by conventional learning models. Data collected through the research instrument is test critical thinking skills in essay form. Conclusions are drawn based on the results of data analysis and processing using Microsoft Word Exel, 2013. The results of data analysis showed an average score of critical thinking skills and experimental control group was 27.90% (low) and 42.02% (moderate). This result was also confirmed by the t-test, the average difference in the improvement of critical thinking skills ( $\alpha = 0.05$ ) obtained  $t(6.10) > t$  table (2.39). These results indicate a laboratory-based inquiry learning model can significantly improve the students' critical thinking skills compared with conventional learning models in light reflection material.*

**Keywords:** *Model inquiry, and critical thinking skills*

### INTRODUCTION

Science is the study of the environment, in this case relating to how to find out about a systematic nature, so that the IPA is not just mastery of the form of a collection of facts, concepts, or principles, but also a process of discovery. According to Cain and Evan in (MONE, 2008: 21) says that the IPA contains four things: content or products, processes or methods, attitudes, and technology. Content or products means that in science there are facts, laws, principles, and theories that have been accepted as true. Research conducted by Kirno (2010: 192-193), the reality in the field shows that in learning science students tend to be less active and creative in learning, because of the technique that the teacher is to memorize the note from the teacher's explanation and from books and learning resources are less involved real. Sadia (2008) revealed teachers still have the assumption that knowledge can be transferred intact from that of the teacher to the student's mind, so that teachers focus on the effort of pouring knowledge into the heads of students. In addition the strategy used by teachers in teaching is still conventional; teacher centered which tend to be authoritarian and does not stimulate student learning activities optimally.

One material that is difficult to understand science students is the material the reflectance of light, because the explanation requires tools and experimental materials to help students understand the material. Based on the results of questionnaires conducted by Nirmala (2015) obtained results, 84.62% junior high school students said that the light reflectance material is difficult to understand. 55.81% of students giving the reason that the abstract reflection of light materials so they are difficult to understand. 36.05% found them difficult to understand this material because the teachers do not use the right media in the learning process. 8.14% the rest said that teachers only give the formulas when the light reflection material. To be able to achieve the expected competencies should have knowledge of a good start to follow learning. Inquiry-based learning is deemed appropriate, because in these learning students are given the freedom to seek and

find his own knowledge. Learning science (physics) is an inquiry-based learning to engage students in activities that will develop their knowledge and understanding of the concepts of science as scientists study the natural world.

According Gulo (2002:43), inquiry means a series of learning activities that involve maximally overall students' skills in searching and investigating in a systematic, critical, logical, analytical, so that they can formulate their own findings with aplomb. Furthermore Hamelo, et al. (2006) states, inquiry as an activity which also includes many activities such as observation, making the questions, read the source books and other sources of information to see what is already known, planned investigation, reviewing what is already known to obtain evidence- evidence in experiments with using the tools, analysis and interpretation of data, find answers, explanations, and predictions and discuss the results. With the inquiry learning model, the subject matter gained students will be more durable, easy to remember, is more easily applied to different conditions, can bring motivation to learn, can train thinking skills openly, can improve their understanding of concepts, develop a scientific attitude, can develop in-depth understanding of students about the concept of science and can also develop critical thinking skills. In accordance with the results of previous studies conducted by Deur, et al. (2005), Setiawan (2005), Neat (2008), and Hermawati, (2012), which states that the inquiry learning strategies have different impacts significantly to the understanding of the concept and student learning outcomes. Learning by applying inquiry learning provides better value at the level of students' cognitive and affective (Balim, 2009).

One alternative to overcome the above results is the availability of an experimental learning model. In learning activities that use the experimental method, students are given the opportunity to experience for themselves or make their own, following the process, observe objects, analyze, demonstrate and draw conclusions about an issue related to the material provided. According to Sari (2014) through the experiment, the students did minds on and hands on. Student participation in experimental activities encourage students to ask a question, hypothesize, make a prediction, building an argument, communicate findings / Experiment, and use reasoning strategies that involve critical thinking skills. Understanding the student will be stronger and deeper if the student is given the opportunity to experience directly in a process, analysis and conclusions on an issue. This is supported by research conducted by Hamalik (2008) also indicate that the experimental method can improve critical thinking skills when applied in inquiry learning model.

Inquiry learning using the experimental method possible and in the context of collaborative learning (group) can improve critical thinking skills. The magnitude of the role and influence of experimental methods in the learning process as described above, into consideration researchers to combine inquiry learning model with the experimental method, moreover, from the study of the above information was obtained that the experimental method can support the inquiry learning in facilitating students to improve their understanding of concepts and also can of training critical thinking skills.

## **METHOD**

The method used quantitative methods and the types of research used a quasi-experimental (quasi experiment). The study design used in this research is the randomized control group pretest-posttest design (Fraenkel and Wallen, 1990). In this design, the sample will be divided into two classes, the experimental and control classes. Experimental class is a sample that will get treatment in the form of laboratory-based inquiry learning, while the control class is a sample that will get treatment in the form of conventional learning. Schematic design of the study randomized control group pretest-posttest design can be seen in Table 1.

**Table 1.** Skema *Randomized Control Group Pretest-Posttest Design*

<b>Class</b>	<b>Pretest</b>	<b>Treatment</b>	<b>Posttest</b>
Experiment	T <sub>1</sub>	X <sub>a</sub>	T <sub>2</sub>
Control	T <sub>1</sub>	X <sub>b</sub>	T <sub>2</sub>

*Information:*

*T1: Initial tests (pretest) before being given treatment.*

*T2: Tests end (posttest) after being given treatment.*

*Xa: The treatments were based inquiry learning lab*

*Xb: The treatments were conventional learning*

The sampling technique in this study was randomly selected to receive the experimental class and control class. Randomization results obtained VIII2 class as an experimental class and control class VIII5 as each student numbered 30 people. The data collection is done by giving the matter essay on experiment classes and control classes in accordance with indicators of students' critical thinking skills. Data processing pretest and posttest experimental class and control class by using N-gain normalized and t test average values.

## RESULTS AND DISCUSSION

### Description of Critical Thinking Skills

This analysis was conducted to determine the initial state of the critical thinking skills of students of both classes of samples (experimental and control), whether there are differences in students' critical thinking skills significant or not. This analysis is done by testing normality, homogeneity and then proceeds with tests of significance difference of the average of the value pretest both classes. The results of normality and homogeneity test at level of 95% (significance  $\alpha = 0.05$ ) on the distribution of pretest scores of both classes can be seen in Table 2.

**Table 2.** Test Results Normality and Homogeneity against Pretest Scores Second Class

<b>Pretest</b>	<b>Rerata Skor</b>	<b>Normalitas</b>			<b>Homogenitas</b>		
		<b><math>\chi^2</math></b>	<b><math>\chi^2_{Tabel}</math></b>	<b>Distribusi</b>	<b>F<sub>hitung</sub></b>	<b>F<sub>Tabel</sub></b>	<b>Interpretasi</b>
Ekperimen	56,32	3,89	5,99	Normal	1,00	2,41	Homogen
Kontrol	50,49	4,85	5,99	Normal			

Based on Table 2 above, it appears that both the class pretest score data were normally distributed and homogeneous; with an average score of control class is smaller than the experimental class. Thus, hypothesis testing the significance of differences in critical thinking skills are the start (pretest) second class can be done with parametric tests using the t test. T test performed at the level of 95% (significance  $\alpha = 0.05$ ), while the results of testing by t-test can be seen in Table 3.

**Table 3.** Test Scores pretest Experiment Class and Class Controls

<b>Jenis Pengujian</b>	<b>Nilai t hasil Perhitungan</b>	<b>Nilai t dari Referensi Tabel</b>	<b>Kesimpulan</b>
Uji t	2,21	2,39	Tidak Signifikan

Based on Table 3 shows that the value of the  $t(2,21)$  is smaller than the  $t$  table (2.39). These results indicate that the initial skills (pretest) critical thinking class students experiment did not differ significantly. It can be concluded early critical thinking skills students experiment class and control class is the same, or not significantly different.

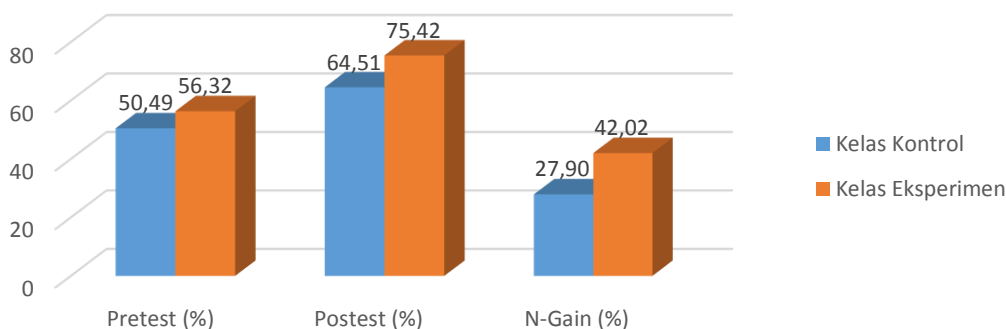
**Description of Critical Thinking Skills**

This analysis was conducted to determine whether the treatment is given, the inquiry learning model laboratory experiments in the classroom can improve students' critical thinking skills significantly, compared with the conventional learning models on controls. In general, the difference in average test scores of critical thinking skills acquired experimental class and control class can be seen in Table 4.

**Table 4.** Score Critical Thinking Skills Class and Class Experiment Control

Kelas Sampel	Pretest		Posttest		N-Gain	
	Rata-rata	%	Rata-rata	%	Skor	Kategori Peningkatan
Eksperimen	27,03	56,32	36,20	75,42	0,42	Sedang
Kontrol	24,23	50,49	30,97	64,51	0,28	Rendah

Based on Table 4, it appears that the critical thinking skills to the experimental class and control class has increased, but the big increase is different. To be clear, the differences increase critical thinking skills both classes can be seen in Figure 1.



**Figure 1.** Comparison of the average score pretest, posttest and N-gain Critical Thinking Skills Students between Grades and Grade Control Experiment

Differences in average scores posttest experimental class with a grade control significantly different at  $\alpha = 0.05$ . From an average score of N-gain between the experimental class and control class also seen that, the experimental class increased by 42.02% compared to the control class is 27.90. It can be concluded, the students' critical thinking skills have been improved after following a good lesson in the experimental class and control class. To determine whether the difference is significant or not, then tested the significance of the average difference (hypothesis testing). The analysis is done by testing normality, homogeneity of the distribution of N-gain critical thinking skills upgrading two classes and then proceeds to the significance test the average difference. The results of normality and homogeneity test at level of 95% (significantly  $\alpha = 0.05$ ) on the distribution of N-gain both classes can be seen in Table 5.

**Table 5.** Test Results Normality and Homogeneity Against N-gain critical thinking skills Second Class

Pretest	Rerarta Skor (%)	Normalitas		Distribusi	Homogenitas		
		$\chi^2$ hitung	$\chi^2_{Tab}$		F <sub>hitung</sub>	F <sub>Tabel</sub>	Interpretasi
Kelas Ekperimen	42,02	3,00	5,99	Normal	1,14	2,41	Homogen
Kelaas Kontrol	27,90	3,71	5,99	Normal			

Based on Table 5, N-gain data is distributed both normal and homogeneous class. So, the hypothesis test the significance of differences in students' critical thinking skills improvement class can be done with both parametric test using the t test. T test performed at 95% confidence level (0.05), the test results with the t test are shown in Table 6.

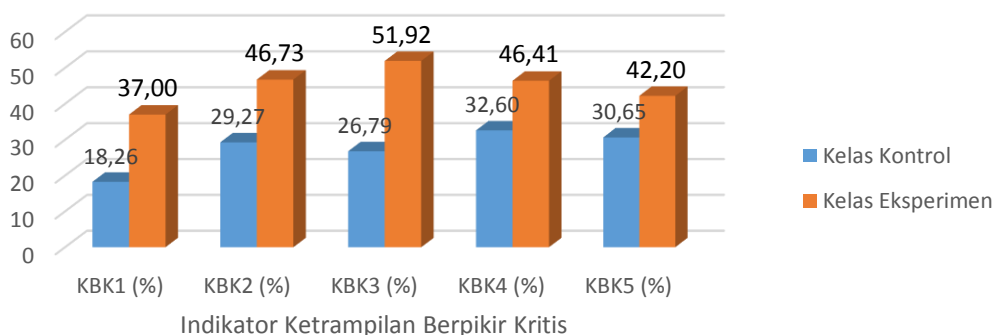
**Table 6.** Test Results hypothesis with t test

Jenis Pengujian	Nilai t hasil Perhitungan	Nilai t dari Referensi Tabel	Kesimpulan
Uji t	2,52	2,39	Signifikan

Hypothesis test results shown in Table 6 shows that the value of the t (6,10) is greater than t table (2.39). These results indicate that there are significant differences between the critical thinking skills and the experimental class control class. Experimental class experienced a larger increase (as seen from the N-gain). In other words, it can be said that at the 95% confidence level (0.05), laboratory inquiry learning model can significantly improve the critical thinking skills of students (experimental group) compared the use of conventional learning models (control group). Thus, it can be concluded that the inquiry learning model laboratory is very effective to improve students' critical thinking skills in light reflection material.

**Description of Critical Thinking Skills Improvement on each indicator**

Critical thinking skills are examined included indicators of the ability to ask and answer questions, consider whether the source is reliable or not, create and determine the outcome of the consideration, deduce and consider the results of deduction, and inducing and considering the results of induction. To determine the magnitude of increase in critical thinking skills to each indicator, please see Figure 2.



**Figure 2.** Score average N-gain indicators Critical Thinking Skills

Information:

- KBK1 = The ability to ask and answer questions;
- KBK2 = Consider whether the source is reliable or not;
- KBK3 = Creating and determining consideration;
- KBK4 = deducing and consider the results of the deduction;
- KBK5 = Induces and consider the results of induction

Based on the figure above shows that, the acquisition of N-gain the experimental class is highest in the indicator to make and determine the results of consideration of (51.92%) with category and the lowest occurred in indicators of asking and answering questions (37.00%) with medium category. While the N-gain control class is highest in deducing indicators and consider the results of the deduction of (32.60%) with category and the lowest occurred in indicators of asking and answering questions (18.26%) with a low category. In general, we can see both classes of both the experimental class and the control class are equally increased students' critical thinking skills. However, an increase in students' thinking skills better in the experimental class with category compared to the control class to a lower category.

The analysis showed that the use of inquiry learning model in teaching reflection can improve students' critical thinking skills compared with conventional learning. Results of research of course influenced by the advantages of the method applied learning. According to Setiawan (2013) some of the advantages of the method of inquiry is as follows, (1) the students actively in learning activities, because he thinks and uses the ability to find the final result, (2) the students fully understand the lesson material, because experience the process to find, something obtained in this way for longer remember, (3) find themselves give rise to a sense of satisfaction, inner satisfaction encourages want to inquire again until the interest in learning increases, (4) students who obtain knowledge of the method of inquiry will be able to transfer his knowledge to different contexts, (5) this method trains students for independent study.

If we observe the percentage of N-highest gain in the indicator to make and determine the results of consideration, while the control class highest deduce indicators and consider the results of deduction. While the highest percentage of N-gain low category in the experimental class and control class contained in the indicator of the ability to ask and answer questions. Indicators asking for clarification is an easy thing to do but ask for an explanation students are things to think about as mindless answers to be delivered does not match the expected response. In this indicator when it gives a simple explanation students should be aware that some explanation was necessary in truth test to obtain evidence. This is in line with the opinion of Matindas (2010) critical thinking is a mental activity that is carried out to evaluate the truth of a statement. Students should also be able to provide explanations either so students are required to understand the basic concepts of material to be covered beforehand, so students have to understand a little more in advance of the material to be studied. Arnyana (2005: 648) describes essentially critical thinking skills are not given ability, but the ability to be trained and must be learned in school. Besides that practical activities commonly performed less of thinking can develop skills critical for learning activities more emphasis on the achievement of a material to be studied and the expected response to the student worksheet (LKS) can also be obtained by students through the student handbook without doing practical work. It is also in line with the opinion of Liliyasi (2005) that no matter how good someone thinking relies on his efforts in finding a meaning or a material that can be seen from her willingness to try and processes that he passed, because the ability to think cannot be given by a teacher to the student.

In this study proves that learning through inquiry labs can be used as one method to improve students' critical thinking skills and subject matter can also help students to discover concepts or theories through experiments independently. This research is consistent with the results of research conducted previously by Sochibin, et al., (2009), and Aggareni (2013) revealed that the inquiry learning model can improve the understanding of the concept and develop the critical thinking skills of students in materials science.

Whereas in conventional learning is teacher centered learning, which means that in the learning process the teacher who plays the most dominant. In the application of conventional learning, the teacher presents information stage by stage while students just observe and accept what has been delivered by the teacher. Teachers tell students about what they need to learn or read, resulting in students' minds are not well developed. The results of student learning thereby resulting in only limited considering the concepts of the subject matter presented by the teacher, but the students did not understand as to what these concepts learned. Apart from that, conventional learning strategies emphasize the

concepts and principles of information, exercises, and tests. Conventional learning involves a lot of one-way communication, making it difficult for teachers to get feedback on student understanding.

### CONCLUSION

Based on the research that has been done can be concluded that the use of laboratory-based inquiry learning model can significantly improve students' critical thinking skills compared with conventional methods on the material light reflection. This is demonstrated by the average N-gain experiment classes that implement inquiry-based learning model laboratory of 42.02% with a medium category, while the average N-gain control for a class that implements conventional learning models amounted to 22.16% by category low.

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