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The Impact of Inquiry-Based Learning on Students' Critical Thinking Skills

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***Abstract*—Critical thinking skills are fundamental skills possessed by students to adapt to the external challenges of 21st-century. Then research on the effect of the implementation of inquiry learning models on students' critical thinking skills. This study was categorized as a quasi-experimental study with a pretest-posttest control group design. The population in this research is 224 students are divided into seven different classes. The sample selected by using cluster random sampling technique and selected 2 classes. The instrument of critical thinking consists of 6 essay questions given by an individual on material temperature and heat. Critical thinking test first through the validity test by experts. Critical thinking skills tests are given at the beginning and end of learning. Hypothesis testing is done by independent t-test. Before testing the hypothesis, the normality and homogeneity of the data are tested as a prerequisite for the parametric statistical test. This indicates that there is a difference in the critical thinking skills of students who take the inquiry learning model from students who learn to use the non-inquiry learning model. The inquiry learning model applied in the experimental class aims to train students in finding a concept related to temperature and heat.**

Keywords: inquiry-based learning, critical thinking skills

I. INTRODUCTION

Critical thinking skills are important to develop for students, given the ability to think critically influences learning outcomes and helps them understand concepts [1]. Critical thinking skills are directed and measurable assessment skills that produce interpretations, analyzes, evaluations, and conclusions, as well as an explanation of factual, conceptual, methodological, criterological, or contextual considerations on which the assessment is based. The ability to think critically has two dimensions, namely the cognitive dimension and the dimensions of affective disposition. Critical thinking statements begin with understanding critical thinking into goals and self-regulatory assessments that produce interpretations, analyzes, evaluations, and conclusions as well as an explanation of evidence, conceptual, methodology and criteria as contextual considerations [2].

Critical thinking can be used to achieve a deep understanding of a material or concept so that students' thoughts about a certain concept become true [3]. Critical thinking skills need to be trained especially in science learning. One learning model that can develop students' critical thinking skills is the inquiry learning model. Inquiry involves maximally all the ability of students to search and investigate systematically, critically, logically, analytically, so that they can formulate their own findings with confidence [4].

The application of inquiry learning models can provide facilities for students to design and find answers directly from the problems raised. Students are required to carry out scientific activities to find knowledge in order to be able to solve problems in learning science which can later help in solving problems in daily life. According to Bass et al. [5] inquiry learning is an approach in learning and understanding the natural environment through a series of activities including formulating questions, conducting investigations, observing, and explaining the results.

The inquiry learning model can also improve critical thinking skills in all aspects, namely aspects of interpretation, aspects of analysis, aspects of evaluation, aspects of inference and aspects of explanation in the medium category. Improvement in all aspects of critical thinking is indicated by the average normalized N-gain value. Azizah et al. states that the guided inquiry learning model and conventional learning can significantly improve critical thinking skills in physics material. However, increasing the ability of critical thinking with the treatment of guided inquiry learning models is significantly better than conventional learning [6].

Based on the description the researcher feels interested in conducting research on the effect of the implementation of the inquiry learning model on critical thinking skills of students on the temperature and heat material.

II. METHODS

This research was conducted in the Iibtidaiyah Madrasah Teacher Education Study Program Faculty of Tarbiyah and Teacher Training at the Mataram State Islamic University in the Secondary Science Subject. This research was categorized as a quasi-experimental study with a pretest-posttest control group design. The population in this study was 224 students who were divided into 7 different classes. The

sample in this study amounted to 60 students who were obtained through cluster random sampling techniques, namely sampling by taking into account elements of the class or group contained in the population.

Students' critical thinking skills are obtained through critical thinking tests that are given individually on the temperature and heat material. The instrument of critical thinking is in the form of 6 essay questions. Critical thinking test first through the validity test by experts. Critical thinking skills tests are given at the beginning and end of learning. Critical thinking skills data are displayed by category in each class and the increase is known by calculating the normalized gain score (N-gain) with the equation developed by Hake [7]. Hypothesis testing uses independent t test. Before testing the hypothesis, the normality and homogeneity of the data are tested as a prerequisite for the parametric statistical test.

III. RESEARCH RESULTS AND DISCUSSION

The results showed that the average critical thinking skills of students who learned to use inquiry learning models were higher than those of non-inquiry (Table 1).

Table 1. Data on Student Critical Thinking Skills

Model of Learning		**Critical Thinking Pretest**	**Critical Thinking Posttest**
Inquiry	N	31	31
	Mean	43.55	86.16
	Std. Dev	6.35	7.86
	Minimum	33.33	66.67
	Maximum	54.17	100.00
Non-Inquiry	N	29	29
	Mean	48.42	64.32
	Std. Dev	8.14	11.33
	Minimum	33.33	45.83
	Maximum	62.50	79.17

The average value of pre-test critical thinking students in the inquiry class was 43.55 categorized as very less critical and the non-intuitive class was 48.42 categorized as very less critical. The level of critical thinking skills of students in both classes is at the lowest level of thinking. This indicates that the learning process that has taken place so far has not been able to improve students' critical thinking abilities, because the cognitive aspects of students are emphasized on results rather than on aspects of processes that involve critical thinking abilities. In addition, the low value of the pre-test results was caused by students in the two sample groups not yet getting temperature and heat material that was appropriate to their level but only material recognition of temperature and heat at the high school level, and even then specifically for students who took the Natural Sciences level during high school. As it is known that students who study at PGMI Department come from different schools with various majors. The average value of the pre-test of critical thinking skills is then used as a benchmark to improve students' critical thinking skills on the post-test results.

The average value of the critical thinking skills of the experimental class and control class students after being given treatment there was a significant increase. The average post-test score of the experimental class was 86.16 and the critical category was 64.37 and the control class was less critical. The difference in the average value of critical thinking skills in the two classes indicates that students' critical thinking skills through the learning model applied to the inquiry class have a better influence than the non-inquiry class.

Figure 1 is a graph showing the improvement of students' critical thinking skills using inquiry and non-inquiry models. Based on the N-gain value, students who learn to use inquiry learning models have increased by 0.76 (high category) while students who learn to use non-inquiry models have increased by 0.3 (low category).

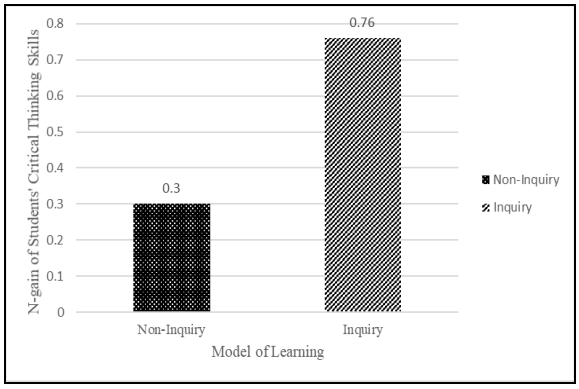

Figure 1. Graph of N-gain value of students' critical thinking skills

Students' critical thinking skills in each category differ between the experimental class (inquiry) and the control class (non-inquiry) both on the pretest and posttest grades. Students with excellent critical thinking category were found in the inquiry class which were 23 people. The complete data on critical thinking categories of students can be seen in Table 2.

Table 2. Categories of critical thinking students in each class

Number of Students		Excellent	Good	Sufficient	Low
Inquiry	Pretest	0	3	17	9
	Posttest	23	8	0	0
Non-Inquiry	Pretest	0	0	13	8
	Posttest	0	18	11	0

The results of the hypothesis test in Table 3 show that there are significant differences between students' critical thinking skills in inquiry classes and non-inquiry classes ($P < 0.05$).

Table 3. Hypothesis Testing

Variable	N	Probability	t	df	Sig. (P)
Critical Thinking Skills	60	5%	8.700	58	0.000

The inquiry learning model applied in the experimental class aims to train students in finding a concept related to temperature and heat. Familiarizing students directly involved in the learning process affects the ability to remember a concept for a long period of time, because the concept obtained is not in the form of memorization but a knowledge that is obtained directly and stored in long-term memory. According to Sadeh and Zion in guided inquiry the lecturer provides a problem and students identify with the direction of the question and determine the process and results [8].

Implementation of inquiry learning models in the experimental class and non-inquiry learning models in the control class are both using the experimental method. Students conduct experiments or experiments on the material temperature and heat. There were 5 experiments conducted by students namely the effect of heat on the temperature of substances, changes in the form of substances, expansion of liquid, the principle of Black, and heat transfer. The five experiments were carried out in groups in the learning process. After conducting the entire set of experiments that have been provided, students answer all questions that are available on the SAS (Student Activity Sheet). Next students present their experimental results in front of the class.

The guided inquiry learning model can optimally involve students in the learning process so that students actively gain their knowledge through a series of inquiry activities. Learning that requires students to be optimally involved in the learning process can improve their critical thinking skills. Students are given structured activities in the form of SAS to investigate and formulate their own concepts found. Students make the formulation of the problem, compile hypotheses that are relevant to the formulation of the problem, then students make observations, analyze data, make decisions, make conclusions, and finally communicate the results.

Aspects of critical thinking skills that must be achieved by students are more applied in the application of guided inquiry learning models, starting from observing activities, making hypotheses, processing data, analyzing data, making decisions, making conclusions, and communicating. While the non-inquiry learning model even though students do the same practicum activities as the experimental class, but in the syntax the learning model does not carry out inquiry steps. They only carry out experimental activities using cooperative learning models without being accompanied by scientific inquiry activities. The steps of the inquiry method are the basis for critical thinking and can be used as a thinking map. The process of reasoning systematically, logically and deeply accompanied by scientific arguments along with evidence in the form of data or accurate information so that conclusions that can be accounted for can be used to train critical thinking [3]

The learning process that takes place in the experimental class from the initial activity to the last activity shows that there are exercises to shape students' critical thinking skills. At the beginning of the activity before practicum activities begin, students are required to formulate hypotheses in LKM, formulating these hypotheses guided by lecturers. Formulating a hypothesis is one part of critical thinking skills. In the last activity also conducted exercises to develop critical thinking skills. In this section each group is asked to present the results of the group discussion in the form of answers to questions in the MFI. This aims to provide an explanation of what they have done and they discuss together with their group members, so that students are trained to actively express their opinions in front of the class, in this case included in the aspect of clarity (clarity). As according to Paul and Elder, the aspect of clarity is one of the supporters in improving students' critical thinking skills. Based on the learning sequence applied to the experimental class, there is a process to practice critical thinking skills because critical thinking skills will not develop if they are not trained [9]. The results of this study are in line with Amijaya et al who stated that there is a positive influence of the guided inquiry learning model on learning outcomes and students' critical thinking skills [1].

IV. CONCLUSIONS

Conclusions based on the results of the study and the discussion that has been presented are: there are differences in the critical thinking of students who follow the inquiry learning model with students who learn to use a non-inquiry learning model.

Things that need to be considered related to the results of research are science learning not only emphasizes the mastery of content (cognitive learning outcomes) but also on the aspects of higher-level thinking skills, one of them is critical thinking skills that are important to be owned by students as a provision of life in dealing with various real problems in their lives. Learning tools that have been implemented in Science 2 courses are only limited to temperature and heat material, so they need to be applied to other materials or other subjects, especially those related to science.

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REFERENCES

[1] Amijaya, L.S., Ramdani, A., dan Merta, IW. 2018. Pengaruh Model Pembelajaran Inkuiri Terbimbing terhadap Hasil Belajar dan Kemampuan Berpikir Kritis Peserta Didik. *Jurnal Pijar MIPA 13(2): 94-99.*

[2] Facione, N.C., facione, P.A. 1996. Externalizing the Critical Thinking in Knowledge Development and Critical Judgement. Diunduh dari http://www.insightassessment.com/pdf_files/.

[3] Rositawati, D.N. 2018. Kajian Berpikir Kritis pada Metode Inkuiri. Proseding Seminar Nasional Fisika dan Aplikasinya. 74-84.

[4] Gulo, W. 2008. *Strategi Belajar Mengajar*. Jakarta: Grasindo.

[5] Bass, J.E., Contant, T.L. dan Carin, A.A. 2009. *Teaching Science as Inquiry*. Boston: Pearson Inc.

[6] Azizah, H.N., Jayadinata, A.K., dan Gusrayani, D. 2016. Pengaruh Model Pembelajaran Inkuiri Terbimbing terhadap Kemampuan Berpikir Kritis Mahasiswa pada Materi Energi dan Bunyi. *Jurnal Pena Ilmiah 1 (1): 51-60.*

[7] Hake, R.R. 1999. Analizhing Change/Gain Scores. Indiana: Indiana University.

[8] Sadeh, I. dan Zion, M. 2009. The Development of Dynamic Inquiry Performances within an Open Inquiry Setting. *Journal of Research in Science Teaching 46 (10): 1137-1160*.

[9] Paul, R. and Elder, L. 2008. The Miniature Guide to Critical Thinking: Concepts and Tools. 28th Annual International Conference On Critical Thinking. California.