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Increasing Critical Thinking Skills Through Natural Science Learning Based on the Integration of Guided Inquiry with Numbered Heads Together

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ABSTRACT

Process of science learning stresses on giving students direct experience to develop their competence. Therefore, teachers are required to be creative and innovative to improve students' critical thinking. Accordingly, there is a need for a research on "The science learning based on guided inquiry integration with Numbered Heads Together (NHT) toward critical thinking skill". This research aim to figure out of influence of the science learning based on guided inquiry integration with NHT. This research is a quasi-experimental study, with design "non-equivalent group control design". This research was conducted at September-December 2018 with samples of the experimental class (n = 40) and the control class (n = 40) at class VIII SMP N 21 Pekanbaru. The research instrument consisted of questions to test students' critical thinking skills. This shows the research instrument at a good and quality stage. The results of this study note that there are significant differences in the average value of the Post test students' critical thinking skills between the experimental class amounted to 75.00 with the control class 67.00 after the intervention ($P < 0.05$). So that the use of Integration of guided inquiry with NHT in the learning process can improve students' critical thinking skills.

1. Introduction

Natural Science or known as IPA in Indonesia is one part of science that continues to experience rapid development. The science learning process emphasizes on

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providing direct experience to develop students' competencies in order to understand the natural environment scientifically which helps students gain a deeper understanding of the natural environment and fosters the ability to think, work, and act scientifically and communicate it through developing the ability of scientific processes and attitudes by using a scientific approach (I Made., et al, 2009).

Science education is essentially a process or effort to teach students to understand the nature of science; products and processes and develop scientific attitudes that are aware of the values that exist in society in the form of the application of positive IPA attitudes and actions (I Made., et al., 2009; Siti., et al., 2015). Therefore, science education is also directed to the process of inquiry and doing so that it can help students to gain a deeper understanding of the natural surroundings (Trianto, 2013).

Science learning emphasizes the ability to understand concepts in achieving success. This shows that the science lesson is not rote learning but rather demands understanding of the concept and even the application of the concept. Science is needed in daily life to meet human needs through solving identifiable problems (Darmaeni., Et al, 2018).

Various obstacles cause the low level of natural science education in Indonesia. Various groups consider that the cause of the low achievement of students is due to the low quality of science education in schools. It is referred to the Education and Culture Human Resources Development Report and the Education Quality Assurance report in 2013 reporting that in the Human Development Index, Indonesia ranks 102 out of 105 countries, the results of the International Student Assessment Program (PISA) report found that out of 6 (six) levels cognitive abilities formulated in the PISA study, all Indonesian students were only able to master the lessons up to level 3 (three) only, while many other countries involved in this study reached levels 4, 5, and 6. From the results of these studies, it can be concluded that learning system is different from the demands of the times. It is caused by many factors including models and strategies in learning that tend to be more on the memory aspect only (Winarno., Et al, 2015).

Based on observations of the science learning process in Pekanbaru and surrounding high schools, especially in SMP 21 Pekanbaru, it was found that the low achievement and learning outcomes of science can be seen from the low mastery of science due to conventional science learning delivered by the lecture method which is very contrary to the nature and characteristics of science learning. In addition, students still experience difficulties in linking the material learned with phenomena that occur in everyday life, especially for the material of the motion system and digestive system. Students are less skilled at connecting digestive mechanisms with the enzymes involved. In addition, students are less skilled at analyzing problems in the motion system and digestive system.

These problems must be addressed immediately to improve the quality of learning and optimize the effectiveness of the learning process, especially in increasing

students' critical thinking skills. One alternative is the selection of the right learning model that fits the problem above, namely, the integration of guided inquiry with the NHT model.

Learning with the inquiry model is a learning in which students are likened to a scientist who is solving a problem and trying to find answers about the problems raised by the teacher in class. Inquiry learning is designed to invite students directly into the scientific process in a relatively short time (Trianto, 2013). In addition, the steps in the guided inquiry learning model guide students to think critically. According to Siti., Et al (2015) students' critical thinking skills will not develop properly if it is done intentionally. Therefore, to encourage the potential of students' critical thinking, the implementation of learning and evaluation must be managed in a planned manner to empower students' thinking skills through guided inquiry models. Critical thinking can be developed in science learning through problem solving, conducting experiments, asking and answering questions, observing, recording the results and making conclusions which are guided inquiry syntax (Prasojo, 2016).

The NHT model is one model of cooperative learning that gives students the opportunity to share ideas with one another and weigh the most appropriate answers and increase the spirit of student cooperation (Septiya, et al., 2017). Based on the results of the needs analysis, a guided inquiry integration learning model with the NHT model is needed because it can increase students' critical thinking skills. Indeed, it is also able to link the material being studied with phenomena that occur in everyday life. In addition, an effective and efficient learning model and strategy is needed to attract the interest and activeness of students, so that the learning process in teacher centered can be changed into student centered in accordance with the demands of the 2013 Curriculum.

Referring to the problems that have been raised, the researchers conducted a research on "Natural Science Learning Based on the Integration of Guided Inquiry with Numbered Heads Together (NHT) on Students' Critical Thinking Skills".

2. Methodology

This research is a quasi experiment. The experimental research design used was quasi-experimental with a "non-equivalent control group design" with independent variables modification of guided inquiry with NHT and conventional learning models. While the dependent variable is the ability to think critically. The study was conducted in September to December in 2018-2019 Academic Year at SMP N 21 Pekanbaru. Critical thinking skills in this study consist of: analyzing, synthesizing, problems solving, concluding, and assessing. Before the research was done, the instrument was validated with valid results. Then, the pre test of control and experiment classes were determined. The implementation of learning in the experimental class is by giving treatment with the integration of guided inquiry models with NHT, while in the control class it uses a conventional learning model

(no treatment was given). Finally, a post test was given to test students' critical thinking skills.

3. Results and Discussion

Based on the data obtained through the final test (Post test) in the form of 10 items multiple choice statements questions and 5 items in the form of essays were given to students in the experimental and the control class, then, the data comparison were obtained as in the following Figure.

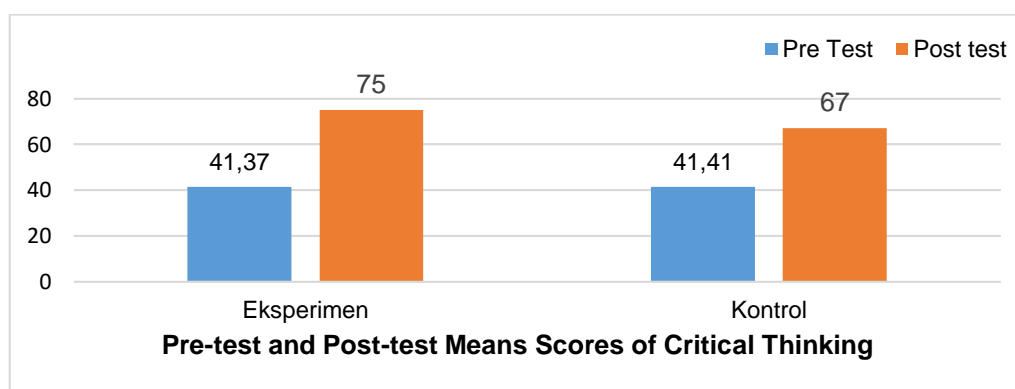


Figure 1. Pre-test and Post-test Means Scores of Critical Thinking Skills with IT Integration and NHT

Figure 1 above shows that the means score of critical thinking skills at the pre-test for the experimental class is 41.37 with a very low category while in the control class the mean score is 41.41 with very low category. This shows that the ability of the two classes before intervention (treatment) is not different (homogeneous). As for the results of the post test for critical thinking skills, it is known that the average score of the experimental class is 75.00 with the C category with medium category which is greater than the control class getting a score of 67.00 with the C category in the medium category. This means that after the intervention, it is known that the students' critical thinking skills achieves a better increase in the experimental class when it is compared to control class. In other words, the experimental class has an average difference of 8.00 from the control class.

When post test and pre test results compared, there is a high increase in the experimental class. There are differences in the mean scores of students' critical thinking skills in the experimental and control class. This means that after the learning process or intervention using the guided inquiry integration with NHT there is an increase in both of mean scores and indicators of students' critical thinking skills to be better.

Learning with the guided inquiry integration with NHT in the experimental class can guide students in increasing critical thinking skills when it is compared to conventional model learning in the control class. The syntax of the guided inquiry integration model with NHT can lead students to think critically and begin to be

trained in connecting facts with concepts in science learning (Siti and Aminuddin, 2015).

Furthermore, to see the results of critical thinking skills in detail, the following table is provided (Table 1).

Table 1. The Comparison of Critical Thinking Skills Scores in Guided Inquiry and NHT Integration

No	Critical Thinking Skills Indicators	Control Class		Experimental Class	
		Pre test	Pos test	Pre test	Pos test
1	Analyzing	44.03 (E)	64.00 (C)	43.68 (E)	73.00 (C)
2	Synthesizing	42.40 (E)	66.00 (C)	42.72 (E)	73.00 (C)
3	Problem Solving	41.87 (E)	72.00 (C)	41.70 (E)	90.00 (A)
4	Concluding	38.40 (E)	66.00 (C)	37.25 (E)	72.00 (C)
5	Assessing	40.37 (E)	65.00 (C)	41.52 (E)	68.00 (C)
	Means	41.41 (E)	67.00 (C)	41.37 (E)	75.00 (C)

Information:

A: Very High B: High C: Medium D: Low E: Very Low

Table 1 shows that the indicator of critical thinking skills with the highest mean score in the pre-test between experimental class (43.68) and control class (44.03) is an indicator of analyzing. The ability to analyze is the lowest critical thinking skill in the indicator of critical thinking skills both in the experimental class and the control class. It is clear that the fundamental skill of critical thinking is analyzing as an indicator that students can increase before they were given a treatment.

The lowest critical thinking ability indicator in pre test results is the indicator of concluding with a mean score of 37.35 in experimental class and 38.40 in control class. It is found that the skill of concluding in critical thinking indicators needs increase, so that students are trained in contributing to inferring a problem based on the source of information found.

Still in table 4.1, the Indicators of critical thinking aspects of analyzing in terms of the its mean score shows that the mean score in the experimental class is higher (mean = 73.00, sd = 1,416) when it is compared to mean score in the control class (mean = 64.00 sd = 1,416). Overall, students' answers in experimental class for analyzing skill has higher mean score than the control class. This means that the experimental class using Guided Inquiry Integration with NHT has better analytical skills than the control class.

Students in the experimental class have been able to collect data or information appropriately related to the problems given to the material of the motion system and the digestive system in LKPD. Most students have been able to analyze information that has been collected from various sources obtained, so, the

indicators to analyze it have been seen to be developing. Students in the experimental class were given questions directly by the teacher in both of the LKPD, so, students looked for answers with the group. The syntax of the integration of guided inquiry with NHT, especially in the phases of asking questions, formulating hypotheses, collecting and analyzing data was proven to help students increasing critical thinking skills (analyzing) until they were trained to solve further questions. While in the control class, students have less skilled to analyze the information obtained from various sources, so it appears there are obstacles in the process of discussion in groups to analyze the data that has been obtained.

The results of Irham's research, et al (2016) states that learning with guided inquiry influences the thinking ability of students because students are guided to be more active in finding their own concepts with a direct inquiry process. In line with Kunandar (2011), he also states that learning with guided inquiry can increase critical thinking skills because students must analyze and handle information in learning.

Indicators of critical thinking synthesize students in terms of average scores indicate that the average ability of the synthesizing aspects in the experimental class is higher (mean = 73.00, sd = 1,354) when compared to the average value in the control class (average = 66.00, sd = 1,354). Overall from the students' answers to synthesizing ability, it can be concluded that the experimental class had higher average synthesizing ability compared to the control class. This means that the experimental class using Guided Inquiry Integration with NHT has the ability to synthesize better than the control class.

Learning with guided inquiry integration is able to help students increase their synthesizing skill. This could be seen from the teacher when he gives students the opportunity to discuss to solve synthesizing questions; the students seem to be able to solve problems with the group. The skill to synthesize can be trained with the stages of guided inquiry learning that is applied by the teacher in the phases of asking questions, formulating hypotheses, collecting and analyzing data. These habits help students to connect the information obtained and process the information into a new idea in the group. While in the control class, students were difficult to solve problems with the indicators like synthesizing; this is because it is not supported by learning resources such as LKPD that guide students to think critically. Thus, the skill to synthesize in the control class is lower than the experimental class.

In accordance with the results of research by Hani, et al (2016) stating that the learning process with the guided inquiry model carried out is able to increase students' thinking skills, especially critical thinking skills because students critical thinking requires a variety of reasons and clear information to be synthesized and it is then synthesized till that information is perfectly acceptable. Trianto (2013) also states that the series of learning activities in the inquiry learning model maximally involves all learners' abilities to search and investigate systematically,

critically, logically, analytically, so that they can formulate their own findings with confidence.

Indicators of critical thinking solve students' problems in terms of mean scores indicating that the mean skill of problem solving aspects in the experimental class is higher (average = 90.00, sd = 1,256) when it is compared to the mean score in the control class (average average = 72.00, sd = 1,256). Overall, the students' answers to the problem-solving skills can be concluded into the experimental class has higher mean skill to solve problems than the control class. This means that the experimental class using Guided Inquiry Integration with NHT has the ability to solve problems better than the control class.

Learning with guided inquiry integration with NHT helps students to think critically in the experimental class. When the teacher presents several problems in learning, students begin to be trained to find solutions to these problems with fellow groups. Students were seen sharing ideas and information to solve problems. Phases of Inquiry syntax are integrated with NHT, especially in the phase of collecting and analyzing data, and thinking together, can help students' critical thinking skills, so that the skill to solve problems starts honed with the habituation acquired during learning. While in the control class, some students seem to have difficulty solving problems with indicators of problem solving, this is because it is not supported by learning resources such as LKPD that guide students to think critically. Thus, the ability to solve problems in the control class is lower than the experimental class.

Based on the overall Indicators of critical thinking, the indicator of problem solving is an indicator with the highest achievement among the other Indicators. Hani, et al (2016) mentioned that the learning process using the guided inquiry learning model provides learning stages carried out individually and in groups, so that the process of exchanging information to solve the problems raised by the teacher. This causes students to think broadly and learn from experience and learn from friends about the concepts being studied. Thus, the learning process by using the guided inquiry learning model in accordance with Piaget's theory, "Knowledge will be meaningful when students seek and find it themselves".

The above is in line with a research reported by Yono., Et al (2015) stating that guided inquiry learning that begins with a problem and the answer must be found itself becomes a good means for the occurrence of physical interactions between students and the science objects they learn. Hosnan (2014) also supported the idea that inquiry learning is a series of learning activities that emphasize the process of critical and analytical thinking to find and find answers themselves to a question in question.

Indicators of critical thinking aspects of concluding in terms of mean scores indicate that the average ability to conclude in the experimental class is higher (mean = 72.00, sd = 1,607) when it is compared with the mean score in the control class (mean = 66.00, sd = 1,607). From the students' answers to the skill of concluding, it can be concluded that the experimental class is higher in its mean

skill to infer than the control class. This means that the experimental class using Guided Inquiry Integration with NHT has a better concluding ability than the control class.

Guided inquiry integration learning with NHT has a positive influence on students in the experimental class. In the concluding indicator, most students seemed to be able to solve problems related to the concluding indicator in the motion system and digestive system. The habituation by giving questions related to the indicator on the LKPD and group discussions can help students to increase critical thinking skills on the concluding indicator. Most students are able to provide arguments from the questions given during learning and provide a conclusion when being asked to answer the question. The skill to conclude begins to be trained with guided inquiry integration learning with NHT. While in the control class, students were difficult to solve problems with concluding indicator, this is because it is not supported by learning resources such as LKPD and other learning resources that guide students to think critically. Thus, the skill to conclude in the control class is lower than the experimental class.

The finding above is in line with a research from Patchouli, et al (2016) which states that in the concluding stage, students will involve various aspects of critical thinking skills, namely logical thinking, inductive processes, deductive, evaluative, giving logical arguments in decision making. All aspects will be accommodated in interactive discussions. Hence, the statement of Hani., Et al (2016) also supports the finding above stating that students' confidence in the concepts that are obtained clearly after carrying out learning with guided inquiry syntax is caused by students who think critically need clear and reasonable facts to make conclusions as Alee (2007) revealed that critical thinking is reasonable and reflective thinking that focuses on deciding and concluding what must be believed or done.

Indicators of critical thinking aspects of assessing in terms of mean scores indicate that the average skill to assess in the experimental class is higher (mean = 68.00, sd = 1,218) when it is compared to the mean score in the control class (mean = 66.00, sd = 1,218) respectively. Overall, from the students' answers to the skill of assessing is concluded into the experimental class has higher mean skill in assessing than the control class. This means that the experimental class using Guided Inquiry Integration with NHT has a better skill in assessing than than the control class.

The integration of guided inquiry with NHT is able to guide students to think critically on assessing indicator in the experimental class. Students seem to be able to solve questions in the scoring category. This can be seen that most students are able to provide a new formulation of the information obtained while learning. So that the skill in assessing began to be trained and developed. The guided inquiry syntax with NHT especially in the phases of formulating hypotheses and analyzing data helps assessing indicator to increase and be trained in learning. The habituation made by the teacher during the learning process by presenting the questions of assessing categories is able to shape the mindset of

students so that the skill to think critically on assessing indicator starts to develop. While in the control class, students were difficult to solve problems with assessing indicator, because this indicator requires a high level of ability to process and convey the information received into a judgment. This is also because it is not supported by learning resources such as LKPD that guide students to think critically. Thus, the ability to assess in the control class is lower than the experimental class.

In accordance with the statement of Muhammad, et al (2015), critical thinking is based on the thinking process of each student to analyze and bring up students' insights on each meaning of the problem, because critical thinking is a systematic process that allows students to formulate, evaluating students' own beliefs and opinions. The statement is also in line with the statement of Lia., Et al (2018) stating that students are accustomed to learning with reasoning that is integrated with thought because guided inquiry learning is emphasized to think, discuss in problem solving, and thinking habits that encourage students to explore so as to find concepts meaningfully.

The assessing indicator in critical thinking is the lowest indicator among the other critical thinking indicators in the experimental class. This is because students still did not actively search for information or knowledge by themselves using various sources. It causes difficulties in mastering concepts and developing critical thinking skills so that the score of students is categorized as low.

T-test analysis results are run to determine the difference between students' critical thinking skills from the treatment in the experimental class and the control class. The results of the T-test analysis are shown in Table 2 below.

Table 2. T-Test Results for Critical Thinking Skills

Critical Thinking Skills	N	Mean	Std. error	T value	Sig.
Experimental Class	40	75.00	5.665	7.669	0.000
Control Class	40	67.00	5.475		

Table 4.2 shows that the mean score in post test scores of students' critical thinking skills after studying in experimental and control classes have a difference in the mean scores of about 8.00 for the experimental class (75.00) which is at the medium category, and the control class is 67.00 at the medium category. Furthermore, the T-test inference analysis showed that there is a significant influence on the post test of students' critical thinking skills between the experimental class and the control class with the t value of 7.669 and sig. = 0.000 ($p < 0.05$).

These results, reject the null hypothesis (H_0 1) that there is no significant effect of natural science learning based on the integration of guided inquiry with NHT on students' critical thinking skills between the experimental class and the control class. It can be formulated that students' critical thinking skills between the

experimental class and the control class are different after the intervention (treatment) is implemented.

The results of the mean score of students' critical thinking skills indicators can be seen with specifically through MANOVA analysis. Furthermore, the inference analysis was carried out using MANOVA to find out the differences in each indicator of students' critical thinking skills based on class. The results of the MANOVA analysis is to see the mean critical thinking skills scores in the experimental class and the control class. The results of the MANOVA analysis can be seen in the following Table 3.

Table 3. MANOVA Results for Critical Thinking Indicators for the Integration of IT and NHT

Critical Thinking Skills Indicators	Class (Group)	Sig.	Ho.1
Analyzing	Experiment	0.000	Rejected
	Control		
Synthesizing	Experiment	0.000	Rejected
	Control		
Problem Solving	Experiment	0.000	Rejected
Concluding	Experiment	0.004	Rejected
	Control		
Assessing	Experiment	0.099	Accepted
	Control		

From the results of MANOVA analysis, it is known that there are significant differences in the ability to think critically on the indicators of analyzing, synthesizing, problems solving, and concluding, but there is no significant effect on the indicators assessing.

4. Conclusion

Based on the description aforementioned, it can be concluded that natural science learning based on the integration of guided inquiry with NHT affects the skill to think critically on the indicators of analyzing, synthesizing, problems solving and concluding, but there is no significant effect on the assessing indicator.

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