



The Effect of Guided Inquiry Models and Open Inquiry of Wave and Sound Vibration Materials on Critical Thinking Ability in terms of Science Process Skills

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Abstract: This type of research is Quasi-Experimental research used to determine the influence of guided inquiry learning and open inquiry of vibration, wave, and sturdy materials on critical thinking ability (CTA) in science process skills (SPS) of class VIII students. The study population was students of state junior high schools in Mojokerto City class VIII, and samples were used in two schools in each sub-district with four classes of 32 students each. The research technique used is random cluster sampling with CTA and SPS test instruments. The study found there is an influence of critical thinking ability on guided and open inquiry learning models. The second result there is an influence of critical thinking ability on science process skills (SPS) high and low. The last result there is no interaction of the influence of critical thinking ability between inquiry learning models guided, open inquiry and SPS.

Keywords: Critical Thinking Ability; Guided Inquiry Model; Open Inquiry Model; Science Process Skills

Introduction

Natural science (known with IPA) is the knowledge of natural symptoms arranged in sequence. IPA includes a product, process, and attitude (Tyas et al., 2020). IPA as a process means IPA as a step in solving problems. IPA as a product, namely in natural science, there are facts, principles, laws, and theories that have been tested for truth. IPA is an attitude that contains values and morals such as high curiosity, criticalness, creativity, and an open view (Narut & Supradi, 2019). Science learning encourages students to study the surrounding nature to solve problems that arise in everyday life (Nirwana & Wilujeng, 2021).

Based on the 2013 curriculum implemented with 21st-century learning, learning activities are made to think critically, solve problems, be creative, and be innovative (Makhrus, 2018). Indonesia's involvement in PISA education programs in developing countries such

as Indonesia in 2018, Indonesia was ranked 71st out of 79 countries. The data obtained by students in Indonesia in solving analytical, evaluation, creation, logic, and reasoning problems are still lacking (Sutrisna, 2021). The need in education today is that students can reason and analyze a problem. It shows that the ability to think critically is needed (Anugraheni, 2020). According to (Lusidawaty et al., 2020), Science learning increasingly has a harmful impact, resulting in students being less interested in the learning process and bored. Supported to the reality that exists in schools in science learning is the lack of application learning models that teach students to develop critical thinking skills (Taib et al., 2020).

According to Ennis (1993), critical thinking is a well-founded and reasonable thought process that can be accounted. Critical thinking is a systematic process of formulating and evaluating a problem that is happening according to one's beliefs (Firdaus et al., 2019). The

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ability to think critically occurs when there is a willingness and ability to consider alternative views on a problem (Liang & Fung, 2020). Indicators of critical thinking are providing basic explanations, building basic skills, concluding, making further explanations, and strategies and tactics (Ennis, 1993). The support of science process skills can increase the ability to think critically. According to (Lestari et al., 2018), increased critical thinking skills is due to increased science process skills. High science process skills will have a high critical thinking ability, also proven by students who can consistently solve problems from their concepts (Nugraha et al., 2017).

Science process skills are the ability to apply, understand, develop, and discover science. SPS is divided into two parts, namely basic science process skills and integrated science process skills (Saleh et al., 2020). SPS indicators are observation, interpreting, predicting, hypothesizing, applying concepts, and communicating (Sriyati et al., 2021). According to the results of observations, learning at the State Junior High School in the city of Mojokerto in the class VIII science subject showed that critical thinking skills were relatively low with evidence during the learning process, students were less active in learning homework and tended to receive passively only material provided by the teacher. During the covid 19 pandemic, students took part in online learning using zoom meeting, but over time students became lazy to attend zoom meeting and rarely submitted assignments given by the teacher. This causes a decrease in students' thinking ability, including low students' critical thinking ability. With a low level of critical thinking, according to (Priyadi et al., 2018), students have difficulty answering problems given by teachers and problems that exist around them in identifying and connecting a problem faced. The existence of difficulties, the lack of concepts that are understood and concepts that are cut off not into a single whole are signs of students' low critical thinking ability (Priyadi et al., 2018).

Based on the observation results obtained, there is a need for a solution to improve critical thinking. Controlling these problems needs to provide learning different from the usual received by students, namely by providing learning models that provide opportunities for students to learn directly to improve critical thinking skills. The learning model that dominates students to be active in the science learning process so that they can think and develop student abilities namely the Inquiry learning model (Ramdani et al., 2020). The inquiry learning model is divided into three, namely structured inquiry, guided inquiry, and open inquiry (Ramdani et al., 2020). The inquiry learning model used and determined in this study is a guided inquiry learning model and an open inquiry model because, at the learning stage, it provides opportunities for students to

make observations, submit hypotheses, and conduct experiments to conclude (Ramdani et al., 2020).

The guided inquiry learning model is learning to find, investigate, and answer problems so that students can confidently communicate their findings (Mufidatul Hasanah, 2021). This model can lead students to solve problems using experiments with their critical thinking skills (Jundu et al., 2020). According to (Taib et al., 2020), guided inquiry can empower students' science process skills, thinking ability, and understanding. The syntax of the guided inquiry model adopted from Sanjaya is orientation, formulating problems, formulating hypotheses, collecting data, testing hypotheses, and formulating conclusions (Indawati et al., 2021).

The open inquiry model is a model with an emphasis on freedom of thinking critically and analytically (Ramdani et al., 2020). In the open inquiry, students formulate their problems, making experimental steps that will be carried out to solve the problem. This model aims to develop the ability to answer questions critically and have objective evidence (Prasetyo & Rosy, 2021). The syntax of the open inquiry model is the formulation of problems, making hypotheses, experimenting, evaluating hypotheses, and making conclusions (Martuti, 2013).

Based on the explanation above, a study was made entitled the influence of guided inquiry models and open inquiry of wave and sound vibration material on critical thinking skills in terms of science process skills of class VIII students.

Method

This research is a type of quasi-experimental research with a *pretest-posttest group design research design*. The population and sample of this study are all class VIII students in the city of Mojokerto in the 2021/2022 academic year. The schools taken are different from district to sub-district. The sample consisted of four classes with two classes in each school. The first experimental class uses a guided inquiry model, and the second experimental class uses an open inquiry model. The technique for sampling uses random cluster sampling. The design of factorial research is presented in Table 1.

Tabel 1. Factorial Research Design CTA 2x2

SPS	Guided Inquiry (X ₁)	Open Inquiry(X ₂)
Height (Y ₁)	X ₁ Y ₁	X ₂ Y ₁
Low (Y ₂)	X ₁ Y ₂	X ₂ Y ₂

Information:

X₁ Y₁: CTA students use a guided inquiry learning model on high SPS

X₁ Y₂: Student CTA using guided inquiry learning model on low SPS

X₂Y₁: CTA students use an open inquiry learning model on high SPS

X₂Y₂: Student CTA using open inquiry learning model on low SPS

The instrument uses lesson plan, worksheet, CTA tests, SPS tests and content and constructs validation tests have been carried out. Data analysis used the normality of Kolmogorov Smirnov, with homogeneity of anava, and similarity test using independent t-test pretest, while hypothesis test used anava.

Results and Discussion

Data on students' critical thinking skills at JHS Mojokerto were obtained from post-test questions as essay questions. The results obtained by the CTA post-test data are in Table 2.

Table 2. Data on Critical Thinking Ability Posttest SMPN Mojokerto City

Learning Model	Amount of Data	Average
Guided Inquiry	64.00	71.03
Open Inquiry	64.00	66.83

Table 2 shows that it can be seen that the post-test critical thinking ability of two sub-districts in Mojokerto City shows that with the guided inquiry learning model, the average score is higher than using the open inquiry learning model. In the post-test data, SPS is categorized into high and low SPS. SPS categorization is high when the two models' total value is \geq the average SPS value. Likewise, for SPS categorization, it is low if the total value of $<$ the average value. Description of the CTA data in Table 3.

Table 3. SPS data against CTA

SPS	Amount of Data	Average
Low	60.00	66.366
Tall	68.00	71.36

Based on SPS data on CTA in Table 3, it can be concluded that students who have higher SPS than low SPS and high SPS scores have high CTA as well when compared to those who get low SPS get low CTA.

Table 4. Decrypt Student Posttest SPS Data with Learning Model

Model Group	Amount of Data	Average
Guided Inquiry	64.00	79.05
Open Inquiry	64.00	78.80

In Table 4, SPS use a higher guided inquiry model on average when compared to SPS using an open inquiry model. Analysis with prerequisite tests to determine whether or not samples are normally distributed at pretest and post-test is presented in Tables 5 and 6.

Table 5. Pretest Data Normality Test Results

Information	Type	Sig.	Conclusion
CTA	Guided Inquiry	0.20	Usual
	Open Inquiry	0.11	Usual
SPS	Guided Inquiry	0.20	Usual
	Open Inquiry	0.07	Usual

Table 6. Posttest Data Normality Test Results

Information	Type	Sig.	Conclusion
CTA	Guided Inquiry	0.06	Usual
	Open Inquiry	0.20	Usual
SPS	Guided Inquiry	0.20	Usual
	Open Inquiry	0.06	Usual

In Tables 5 and 6, the normality test showed that all data had significance values greater than $\alpha = 0.05$, so it can be concluded that all data are normally distributed. The next prerequisite is a homogeneity test to determine whether or not a homogeneous sample is in the pretest and post-test presented in Tables 7 and 8.

Table 7. Data Homogeneity Test Results Pretest

Information	Sig.	Conclusion
CTA	0.60	Homogeneous
SPS	0.30	Homogeneous

Table 8. Data Homogeneity Test Results Posttest

Information	Sig.	Conclusion
CTA	0.91	Homogeneous
SPS	0.06	Homogeneous

In Table 7 and Table 8, the homogeneity test showed that all data had significance values greater than $\alpha = 0.05$, so it can be concluded that all data are homogeneous. Next is the test for the initial state with an average similarity test using an independent t-test. The results obtained are presented in Table 9.

Table 9. Preliminary State Test Results

Description	Sig.	Information
CTA	0.604	No difference
SPS	0.304	No difference

The results of the student's initial state test obtained a significance value of more than 0.05, concluding that there is no difference in students' initial ability. Furthermore, the test is used to determine whether there is a difference in the influence of students' CTA and SPS on applied learning. The Two Way anava test is used. The results of the hypothesis test can be seen in Table 10.

Table 10. Two-Lane Anava Test Results

Source	Mean	F	Sig
Corrected Model	538.70	3.90	0.01
Intercept	602190.96	4364.14	0.00
Learning Model	597,66	4.33	0.04
SPS	791.03	5.73	0.02
Learning Model* SPS	252.64	1.83	0.18

The results of the anava test as a basis for taking the rejection of research hypotheses with the following conclusions. The first hypothesis is that the ability to think critically with a learning model has a significance value of 0.039 which means less than the significance level of 0.050. Therefore, it can be concluded that there is a significant difference in critical thinking ability using guided inquiry learning models and open inquiry. The second hypothesis of the ability to think critically with SPS has a significant value. 018, which means less than the significance level of 0.050. it can be concluded that there is a significant difference in critical thinking ability to students' science process skills. The third hypothesis of CTA, the learning model with SPS has a significant value. 178, which means greater than the significance level of 0.050. It can be concluded that there is no significant interaction of critical thinking ability and learning model to students' science process skills.

Differences in Critical Thinking Ability of Students Learning Using Guided and Open Inquiry Learning Models

Based on the results of hypothesis tests that have been carried out on the learning model used for CTA, it has a significance of 0.039. There is a significant difference in influence because the $\alpha < 0.05$. The difference in the influence of CTA apart from the homogeneity test can be seen in the average CTA of each model. The average CTA using the guided inquiry model is 71.03, and CTA using the open inquiry model has an average of 66.83.

Based on the statement above, there are differences in the influence of higher guided inquiry learning, and students own the CTA because in the learning process, students who use the guided inquiry model get guidance to carry out the learning process starting from being given demonstrations, formulating problems guided by teachers to students formulating conclusions. With guided inquiry in the learning process, students are guided to develop their thinking skills so that they can have the potential to have critical thinking skills. In line with (Indawati et al., 2021) this guided inquiry learning model affects critical thinking skills can be seen from each syntax in this model, which can improve CTA. CTA will improve the cognitive structure to obtain bright ideas and concepts and compile the knowledge possessed to sharpen the thinking ability of students (Maryam et al., 2020).

The open inquiry also influences students' CTA as seen from the open inquiry syntax. Open inquiry teaches students to make it like a scientist, from formulating problems to making conclusions, which students do. According to Ramdani et al (2020), open inquiry spurs students to learn independently and actively in the learning process. The purpose of the open inquiry model is to formulate the problems that will be made and researched by yourself, can develop creativity to answer

questions with evidence and critical thinking skills (Anugraheni, 2020). However, there are differences in the influence of the two models on critical thinking ability because grade VIII junior high school students can still not carry out their learning process in the open inquiry syntax. (Sari et al., 2021) mentioned that junior high school students still depend on teachers who direct students to carry out the learning process.

Differences in CTA of Students who have High and Low SPS

Based on the results of hypothesis tests that have been carried out on CTA used against high and low SPS have a significance of 0.018. There is a significant difference in influence because the $\alpha < 0.05$. The difference in the effect of CTA on SPS is high, having a total of 68 data with an average of 71,358. Low SPS has 60 data with an average value of 66,366.

The difference between CTA, which has a high SPS can be seen from the CTA indicator, which is in line with the SPS indicator, namely in providing a basic explanation by observing. High SPS students are linked to several concepts and can solve the problems they are facing. In line with (Nugraha et al., 2017), high SPS will have a good CTA showing that students are consistent in solving problems from several concepts that have been learned into one whole. On the other hand, low SPS will lead to low CTA because students are less able to imply various concepts to become a single entity. Although according to (Nugraha et al., 2017), low SPS has low CTA, it is also explained that students have limited insights into logical thinking and are not precise in determining conclusions.

Interaction of The Influence between Learning Models and SPS on CTA

The hypothesis test results obtained a significance of 0.178, meaning it is greater than 0.05. There is no interaction between the guided and open inquiry learning model and SPS towards CTA because students are not used to using guided inquiry learning models and open inquiry. Students concentrate more on the experiments they are undergoing. When the inquiry learning model is implemented, students include their ability both knowledge and skills to investigate systematically, logically and think critically so that students can formulate their discoveries that have been obtained with full confidence and can maintain these discoveries by integrating the concepts they have and can explain the conclusions that have been obtained. In addition, the inquiry is also related to science process skills on indicators of conducting student experiments in line with observations on science process skills by seeking information from the literature and experiments.

According to (Royani et al., 2018), there is a factor in the absence of interaction between SPS and CTA,

namely the lack of a quantified concept. Students are still dependent on teachers, and the time available is severely lacking due to reduced learning hours.

Conclusion

The conclusions of this study are the guided and open inquiry has different influences on the ability to think critically. The use of guided inquiry has a high SPS compared to the open inquiry learning model. The second conclusion high SPS and low SPS influence CTA. High SPS will support CTA, and vice versa. If SPS is low, students have low CTA as well. The last conclusion the absence of interaction influences guided inquiry models, open inquiry, SPS on CTA. The absence of interaction is due to the reduction in class hours, the lack of concepts that are possessed before the learning process, and students prioritizing experimentation.

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