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Article

The Effect of Online Guided Inquiry Laboratory toward Students' Critical Thinking Ability

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ABSTRACT

This study aims to determine the effect of online through a guided inquiry laboratory on students' critical thinking skills. The design of this study was a pre-experimental design with the type of one group pre-test post-test design. This study applied a guided inquiry learning model to two sample classes, namely class XI IPA 4 and XI IPA 5. The students' critical thinking ability test data, both pre-test and post-test, were tested using N-gain analysis which showed an average N-gain value of 0.36 in the medium category and the results of the N-gain test on each indicator of critical thinking ability. students experienced an increase, on the indicators of analyzing arguments 59%, asking and answering questions 18%, inducing and considering the results of induction by 45%, making and determining the results of considerations 24%, and determining an action 39%. Then in the paired sample t-test hypothesis test, the sig value is obtained. (2-tailed) of 0.000. This shows that there is an effect of applying the guided inquiry laboratory learning model to e-learning-based elasticity material on students' critical thinking skills as a whole and on each indicator of students' critical thinking abilities.

INTRODUCTION

The outbreak of Coronavirus Disease (Covid-19) has an impact on all sectors of life, including the education sector. All prevention efforts including prevention and control have been carried out by the government in order to break the chain of the spread of Covid-19. Based on the circular letter of the minister of education and culture number 4 of 2020 regarding the implementation of education policies in the emergency period of the spread of the Covid-19, the learning process is carried out through online learning. Current conditions cause learning in the classroom cannot be carried out so that flexible learning media is needed in time and place. One example of distance learning is through e-learning (Nugraha et al., 2020).

Through e-learning, students are required to be able to manage the entire learning process themselves, including managing their own environment, motivating, and increasing knowledge independently (Noor et al., 2017). E-learning provides access for teachers and

students to interact with each other and as a forum for students to develop their thinking ability (Bilkisda & Sudibyo, 2021). Therefore, it is necessary to integrate learning methods that are oriented towards developing students' critical thinking ability into the learning process.

Physics learning is seen as a thinking process to develop thinking ability in understanding the concepts, principles, and laws of physics, so that in the process of learning activities effective learning methods must be considered. Physics is a part of science whose mastery of the material requires critical, logical, and creative thinking ability (Setiono & Tadeus, 2018). Based on the Regulation of the Minister of National Education of the Republic of Indonesia Number 23 of 2006 in achieving the functions and objectives of learning, critical thinking ability are very important competencies to be developed because through critical thinking will train students to analyze a problem and solve problems. in physics.

Critical thinking ability are one of the ability given to students based on the 2013 Curriculum which has been adapted to the 21st century learning framework which is currently the guideline for organizing learning activities at all levels of education in Indonesia. The National Education Association has identified 21st century skills including critical thinking, creativity, communication, and collaboration. Critical thinking ability is a form of complex thinking activities that involves analyzing ideas specifically, being able to distinguish, select, be able to identify, assess, and develop into something more perfect (Usmeldi et al., 2017). Critical thinking ability need to be trained to students in order to be able to solve a problem that occurs in everyday life so as to create human resources that are able to survive and be able to compete in a global society.

In fact, the critical thinking ability of Indonesian students is still very low. This is evidenced by the results of the ranking of Indonesian students in the program for international student assessment (PISA). The questions contained in PISA have the characteristics of a high cognitive level so that they are able to measure students' critical thinking abilities. Based on the results of 2018 (PISA), Indonesia's scientific literacy score is 396 with a rank of 74 out of 79 participating countries. This shows that students' ability to answer questions that lead to critical thinking ability is still very low (Marudut et al., 2020). The learning process shows that there are problems in learning that cause students' low critical thinking ability, although many learning practices have been used, but they do not improve students' critical thinking ability and the learning process is not optimal (Saputri et al., 2019).

The statement above was strengthened through the results of an interview with one of the physics teachers of MAN 1 Central Lampung, information was obtained that the study from home policy since the Covid-19 pandemic resulted in teachers implementing e-learning for students. Learning is carried out using discussion and question and answer methods through Google Classroom and WhatsApp Group. However, in the learning process teachers tend to be more active and there are still many students who have not actively asked and developed their thinking ability, resulting in low critical thinking ability of students. The learning process is still dominated by teachers and tends to memorize rather than develop thinking skills, resulting in students being weak in conveying their own ideas, weak in analyzing, and relying on others rather than being responsible for their own choices (Patonah, 2014). From this explanation, it is necessary to practice to familiarize students with critical thinking ability, so that students are accustomed to acting and thinking critically.

The low critical thinking ability makes it difficult for students to understand elasticity and Hooke's law. Critical thinking includes the ability to read with understanding and identify the required material (Sari & Septiani, 2020). The difficulties of students in the materials of elasticity and Hooke's law were expressed by Sa'diyah et al., (2017) that students have difficulty in analyzing the concepts of elasticity and displacement, velocity, and acceleration,

describing Hooke's law, and the elastic modulus of material. Furthermore, students' difficulties were also expressed by Mustofa, (2018) that students had difficulty understanding materials related to Hooke's Law, the relationship between elastic quantities, and the composition of elastic materials.

Critical thinking ability can be improved with experimental activities. Through experiments students can learn directly by using experimental activities and media that emphasize the formation of thinking process abilities (Anggreani, 2015). with experimental activities, students are able to find and find answers to the problems they face and can be trained to think scientifically so as to improve learning outcomes. This is in linfe with the opinion expressed by Triwiyono, (2011), that guided experimental learning is more effective in improving students' critical thinking ability compared to conventional learning. Therefore, innovation is needed to improve students' critical thinking ability. One solution is to use the Guided-Inquiry Laboratory model.

Guided inquiry laboratory is a learning model that emphasizes experimental activities. According to Wenning, (2011) guided laboratory inquiry learning is an independent activity that can gradually train students to become more independent individuals in planning experiments and collecting data. Independent activities carried out by students in designing observations and making observations by changing various variables to obtain results to conducting analysis to obtain the right conclusions can optimize their thinking ability and abilities. This is supported by the results of research by Ade Febri & Sarwanto, (2020) that the application of guided inquiry laboratory is effective for improving students' critical thinking ability through an active process of thinking about things in depth, asking questions, and finding relevant information.

Students' critical thinking ability can be developed through a learning model that involves active students in learning. This is in accordance with the research results of Hamdani et al., (2019) that students' critical thinking ability can be developed through methods that involve students actively in learning. The guided inquiry laboratory learning syntax developed by Wenning consists of observation, manipulation, generalization, verification, and application. This syntax can optimize critical thinking ability, because it requires active students to be able to solve a problem independently, making it possible to implement online learning by utilizing information and communication technology in education in the form of e-learning Google Classroom. This is supported by research by Zuriah, (2020) that the use of Google Classroom in learning activities can increase students' independence and critical thinking ability.

Based on the description above, the application of the guided inquiry laboratory model in online learning is expected to improve students' critical thinking ability. Therefore, this research aimed to determine the effect of the online guided inquiry laboratory learning model on elasticity materials on students' critical thinking ability.

METHODS

Research design

This research is an experimental research conducted directly in learning activities. This study used a Pre Experimental Design with the type of One Group Pre-test Post-test Design which was carried out by giving treatment with two measurements. The first measurement was carried out before being given treatment and the second measurement was carried out after being given treatment. The treatment in this study was to apply the laboratory-guided inquiry learning model developed by Wenning, (2011) with five stages, namely observation, manipulation, generalization, verification, and application.

Participant

The population in this study were all students of class XI IPA MAN 1 Central Lampung in the 2021/2022 academic year. While the sample was selected using a purposive sampling technique, in this technique the sample was selected based on the average student learning outcomes which had almost the same distribution of scores in all classes. Thus, two classes were obtained, namely XI IPA 4 and XI IPA 5 as research samples. Both classes were applied with the guided inquiry laboratory learning model.

Data Collection and Analysis

Data collection techniques in this study used a written test technique in the form of pre-test and post-test. The instrument in this study was a critical thinking ability test question consisting of eight items developed by Zulmi & Akhlis, (2020) The instrument was developed based on Ennis' critical thinking indicators (Ennis, 1985: 68). Critical thinking indicators applied in this study were limited to 5 indicators, namely analyzing arguments, asking and answering questions, encouraging and considering the results of induction, making and determining the results of considerations, and determining an action. The instrument has been deemed valid with the correlation value of people > 0.349 and a sig. (2-tailed) < 0.05 and highly reliable with Cronbach's alpha value of 0.709.

The test instrument was analyzed using SPSS version 21.0. The effect test in this study was limited only based on the n-gain test. The n-gain test aims to determine the increase in the pre-test and post-test scores for the sample class. Then the normality test was carried out, this test was used to test whether the research sample was normally distributed, carried out using a non-parametric statistical test, namely the Kolmogorov-Smirnov. If the data from the sample is normally distributed, then the hypothesis testing is analyzed using the Paired Sample T-Test. Hypothesis testing is used to see the difference in the average results of students' critical thinking skills before being given treatment (pre-test) and after being given treatment (post-test).

RESULTS

This research was conducted by applying the guided inquiry laboratory learning model to two sample classes, namely class XI IPA 4 and XI IPA 5. Learning was carried out by applying 5 syntaxes of the guided inquiry laboratory learning model, namely observation, manipulation, generalization. , verification and complete application. online using the google classroom platform. In the initial implementation of the research, the researcher invited students to take online classes in google classroom. Then give pretest questions to the two sample classes to determine the students' initial critical thinking ability on elasticity material. After being given the pretest, the researcher continued learning by dividing the students into six study groups whose members were randomly selected.

At the observation stage, students observe a problem. After that, at the manipulation stage, students conducted a controlled qualitative experiment by changing one variable using simple tools and materials. Furthermore, at the generalization stage, students make a series of observations to provide conclusions. And representatives of each group verify by submitting the results of observations. In the last stage, namely the application, students complete the questions on the worksheet. After all the syntax is applied, the researcher gives a final explanation and concludes the learning outcomes. Then the researcher gave posttest questions to measure the final ability of students' critical thinking aspects. Posttest questions are given to compare the results of the critical thinking ability test by reviewing the increase in the pretest score. Comparison of the results of the pretest and posttest to determine whether there is an effect of the application of the guided inquiry laboratory model on students' critical thinking ability.

Quantitative data on students' critical thinking abilities based on pretest scores (before being treated) and posttest scores (after being treated) can be seen in Table 1.

Table 1. Quantitative Data of Critical Thinking Ability

	N	Min.	Max.	Mean	Std. Deviation
Pre-test	64	9	50	30.34	10,496
Post-test	64	31	84	55,80	12,324

Based on Table 1, it can be seen that the average post-test value is greater than the average pre-test value. Furthermore, the normality test of quantitative data from the results of the pre-test and post-test was carried out to test whether the research sample was normally distributed. The results of the normality test can be seen in Table 2.

Table 2. Normality Test Results

Parameter of Statistics	Asymp. Sig	Description
Pre-test	0,310	Normal
Post-test	0,508	Normal

Based on Table 2, it can be seen that the Sig. value in the pre-test and post-test > 0.05. Thus it can be concluded that the research sample used is normally distributed so that hypothesis testing can be done using the Paired Sample T-Test. The results of the t-test analysis can be seen in Table 3.

Table 3. Hypothesis Test Results with Paired Sample T-Test

n	df	t	Sig. (2.tailed)
64	63	-17.284	0.000

The results of hypothesis testing with paired sample t-test in Table 3 show the value of Sig. (2-tailed) < 0.05, meaning that H_0 is rejected and H_1 is accepted. These results indicate that there is an influence of online guided inquiry laboratory on students' critical thinking ability.

Table 4. Hypothesis Test Results with Paired Sample T-Test for Each Critical Thinking Indicator

Indicator	n	df	t	Sig. (2.tailed)
Analyzing Arguments	64	63	-10.558	0.000
Ask and answer questions	64	63	-6.177	0.000
Induction and consider induction results	64	63	-11.592	0.000
Make and determine the results of Considerations	64	63	-9.163	0.000
Define action	64	63	-11.295	0.000

Paired sample t-test on the five critical thinking indicators obtained a Sig (2-tailed) value of 0.000. Furthermore, the N-gain test was carried out to determine the increase in students' critical thinking ability before and after being given treatment. The results of the N-gain test can be seen in Table 5.

Table 5. Average N-gain Result Test

N-gain Max.	N-gain Min.	Average N-gain	Interpretation
0,78	0,09	0,36	Moderate

Table 6. N-gain Test Results for Each Critical Thinking Indicator

Indicator	N-gain	N-gain (%)	Category
Analyzing Arguments	0,58	58	Moderate
Ask and answer questions	0,18	18	Low
Induction and consider induction results	0,45	45	Moderate
Make and determine the results of Considerations	0,24	24	Low
Define action	0,38	38	Moderate

Based on the analysis that has been done, the increase in students' critical thinking ability for each indicator based on 3the pre-test, post-test and n-gain scores can be seen in Figure 1.

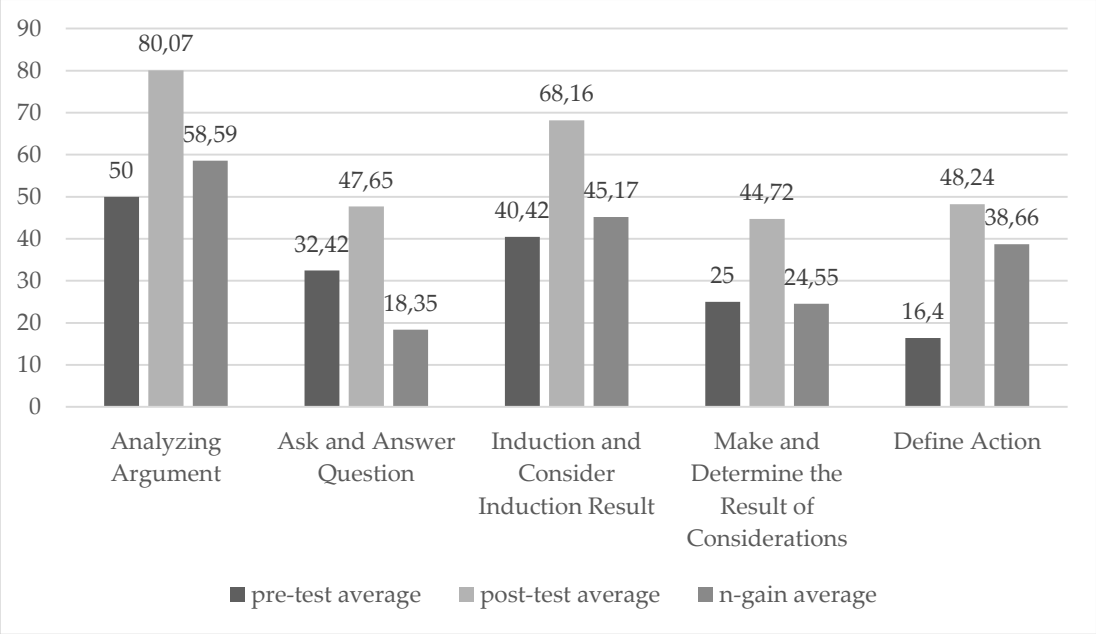

Figure 1. Student Critical Thinking Ability

DISCUSSION

The results of data analysis showed that the average value of N-gain in the two sample classes increased. This means that the application of the laboratory-guided inquiry learning model has an effect on students' critical thinking ability. This is in line with the research results of Ade Febri & Sarwanto, (2020) that the application of guided inquiry laboratory is effective for improving students' critical thinking ability. in the process students want to analyze a given problem, design experiments so that they are able to draw conclusions in solving problems and can arrange correct and systematic arguments. During the learning process, it was seen that students were able to formulate problems based on their analysis of the problems presented. In addition, after observing the results of qualitative experiments conducted, students are able to provide arguments to design experiments for the next activity. This is in line with the research of Aini et al., (2018) that students' critical thinking ability can identify learning that requires students to explore, experiment, discover, and solve problems through small group learning.

Then-gain test on each indicator of critical thinking ability also resulted in a significant increase. In the indicator analyzing the arguments, questions are asked about two arguments against a series spring circuit and a parallel spring circuit where there is only one correct argument. Students then analyze which argument is correct with an explanation of the chosen argument. Based on the data from the analysis of student answers, the average value of n-gain was 0.58 in the medium category. This shows that students are able to identify and analyze questions so that they are able to provide appropriate arguments. Isnaeni et al., (2012) suggested that students with learning patterns that focus on problems and explore knowledge will affect their analytical skills, so that when faced with analytical-type questions students are easier to solve.

The second indicator is asking and answering questions, given questions about everyday phenomena, namely loose motorcycle chains. Students are then asked to explain the cause of the slack chain. Based on the data from the analysis, the average value of n-gain is 0.18 in the low category. The low increase in this indicator is due to the large number of student answers that have little relevance to the material on elasticity and Hooke's law. Many students are unable to relate the concept of elasticity to the problems given. This is in line with the research by Sianturi et al., (2018) that the lack of student response and the tendency

to memorize rather than understand concepts lead to under-trained critical thinking ability. Further research by Luzyawati, (2017) revealed that some students still have difficulty when faced with a problem that demands to relate several concepts.

The third indicator is to induce and consider the results of induction, given two questions. The first problem is presented with an elasticity graph, then students are asked to find the value of the spring constant and the maximum spring tension. In the second question there is a question about the use of a spring on a dynamometer which is used to weigh an object that exceeds its maximum limit. Students are asked to give reasons why the dynamometer is no longer precise. Based on the results of the analysis, the average value of n-gain is 0.45 in the medium category. This shows an increase in good critical thinking ability. This is in accordance with the results of research by Kurnianto and Dwijanant, (2010) that the ability to conclude can be developed through practical activities.

The fourth indicator, namely making and determining the results of the considerations, is presented with two questions. In the first problem students are asked to determine the type of wire that produces the minimum increase that results when a load is applied to the wire. In the second problem students are asked to determine the minimum wire diameter that acts at a given voltage value. Based on the results of the analysis, the average value of n-gain on this indicator is 0.24 in the low category. The low critical thinking ability of students on this indicator is because students have not been able to use the right equation in solving problems. This is in line with the research of Tamami et al., (2017) that most students still use reason in answering questions without being based on the correct concept.

The fifth indicator is to determine an action, students are faced with two questions. The first problem has a series spring circuit and a parallel spring circuit with each circuit consisting of two identical springs. Then students are asked to determine the magnitude of the ratio of the given load in order to produce the same increase in the length of the spring. The second problem is presented with three identical springs, students are asked to determine the series of springs that produce a minimum increase in length when a load is suspended. Based on the data from the analysis, the average value of n-gain is 0.38 in the medium category. This shows an increase in good critical thinking ability. In this indicator most students are able to solve alternative solutions to a problem. This is in accordance with the results of research by Dewi and Winata, (2018) students who are able to think critically, namely students who are able to determine something accurately from what is experienced.

The improvement of students' critical thinking ability in each indicator can be indicated as a result of the training of critical thinking ability indicators at each stage of guided inquiry laboratory learning. Each stage is designed to teach or practice thinking ability in learning that will help students to become critical thinkers effectively (Windarti et al., 2017). Practicing critical thinking ability in the learning process will make students accustomed to facing challenges and solving problems. With the ability to think students are able to analyze a problem so as to obtain the right conclusion. This is reinforced by the research of Nuryanti et al., (2018) that one way to practice critical thinking ability is through the learning process.

E-learning is a solution so that learning continues to take place during the Covid-19 pandemic. The application of e-learning-based learning has a good impact on students' ability in information and communication technology (ICT). With e-learning, students can access learning media to be repeated and understood. With online media to send, support, and improve learning and assessment, the learning system will be easy (Ambarita, 2020). From another point of view, e-learning can train students' critical thinking ability. Online learning requires students to be able to solve problems independently. This is in line with research conducted by Verawati, (2020) that e-learning-based learning is effective in improving critical thinking ability.

The use of the Google Classroom type learning management system supports learning to be carried out effectively. Google Classroom has various features that support the learning process. One of the features of Google Classroom is assignment. This feature makes it easy for students to access the material provided by the teacher and can convey the conclusions of the discussion results by writing in the comments column that can be seen and responded to by other students directly. Another feature, the calendar in Google Classroom, can also improve student discipline, because the teacher can set the timeframe for collecting assignments. This is reinforced by the research of Santosa et al., (2020) which states that the learning process using Google Classroom, teachers can design the process of filling attendance and collecting assignments by providing a time span so as to improve student discipline.

Online learning makes students independent in designing and making observations. Independent activities carried out by students in making observations by changing various variables to obtain results to conducting analysis to obtain the right conclusions at the generalization stage can optimize their thinking ability. According to Triwiyono, (2011) students' critical thinking ability can be developed using one method, namely the experimental method. In experimental activities, students experiment by experiencing what they have learned for themselves. Students are given the opportunity to do it themselves, follow a process, observe an object or situation. Thus students will apply knowledge and develop their thinking skills to seek the truth and draw conclusions from the process they are doing. This is in accordance with research conducted by Sutama et al., (2014) that a learning environment that involves students actively in investigating information and applying their knowledge can improve students' critical thinking ability.

Experimental activities will help students understand the concept. By conducting experiments students will develop their understanding ability in connecting the previously studied material with the experiments carried out. Concept understanding can be known when students are able to express verbally, in writing or in application in life (Gantina, 2016). The understanding of students' concepts is shown at the verification stage, where students are able to give the right conclusions. The snippet can be seen in Figure 2 below

Figure 2. Presentation of The Conclusions of The Experimental Results at The Verification Stage

The use of virtual laboratory PhET simulation media in making observations at the generalization stage can be used as a solution to carry out experimental activities in the application of distance learning. Learning using PhET simulation media gives a positive, interesting impression, and helps explain a phenomenon more deeply, making it easier for students to understand learning material (Wicaksono et al., 2020). PhET simulation on elasticity material and Hooke's law in this study shows the value of the spring constant, the mass of the load, and the direction of the spring force are similar to the original. The visualization makes it easy for students to conduct experiments by connecting the phenomena and concepts previously studied. On the other hand, experiments with PhET simulations allow students to explore various variables independently so that they can develop their thinking ability. With these activities will raise many questions, so that various hypotheses appear until they can find concepts and are able to make the right conclusions. This is in line with the research of Zahara et al., (2015) that learning with PhET media can involve students in learning activities that require higher cognitive abilities and improve students' critical thinking skills.

Online learning makes teachers unable to guide students directly in the discussion process as a result, many students do not participate in discussion activities and the impact on increasing students' critical thinking skills is not optimal. This is in line with research conducted by Hamdani et al., (2019) that students' critical thinking ability can be developed through methods that involve students actively in learning. In the learning process, students with high initial abilities have a greater curiosity and are more active in group discussions. Meanwhile, students with lower initial abilities tend to be less active in learning and passive in discussion activities. This is in line with the results of research conducted by Diani et al., (2019) that students with high prior knowledge tend to be independent during the learning process, while students with low prior knowledge tend to accept the existing learning structure and find it. hard to be actively involved. during the learning process.

CONCLUSION

1. There is a significant influence from the application of the laboratory-guided inquiry learning model on students' critical thinking skills on the elasticity material, this can be seen from the acquisition of an average n-gain value of 0.36 in the medium category, and hypothesis testing with paired sample t-tests resulted in a sig.(2-tailed) of 0.000.
2. There is an effect of applying the guided inquiry learning model to the elasticity material based on E-Learning on each indicator of critical thinking ability. This can be seen from the average n-gain with three indicators in the medium category and two indicators in the low category.

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