

GUIDED INQUIRY LEARNING MODEL IMPLEMENTATION TO IMPROVE SENIOR HIGH SCHOOL STUDENTS' CRITICAL THINKING SKILLS ON EQUILIBRIUM MATERIAL

Artika Giovani* and Dian Novita

Chemistry Education Study Program, Faculty Mathematics and Natural Science, State University of Surabaya, Indonesia

*Email: artikagiovani02@gmail.com

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Abstract: The study aims to improve student students' activities, critical thinking abilities, and responses toward implementing the guided inquiry learning model. The one-group pretest-posttest design was employed in the research. The research sample was 36 students from Al-Islam High School Krian Sidoarjo, West Java, Indonesia. The instruments in this research were the syllabus, lesson plans, and student worksheets. The research instruments used were the observation sheet on the implementation of the learning model, the student activity observation sheet, the pretest and posttest sheets, and the student response sheet. The research findings were: (1) The implementation of the learning model received a score of 91.11%, 94.99%, and 99.29% at meeting 1, meeting 2, meeting 3, respectively, with very good criteria. (2) The activity of students in the first meeting was 96.23%, the second meeting was 97.40%, the third meeting was 99.11%. (3) The normality test results showed a significance value of $0.083 > 0.05$, which shows that the data was normally distributed. The analysis results using the Paired Sample T-test got a significance value of $0.000 < 0.05$, Sig. (2-tailed) < 0.05 . It indicates a significant difference between the results of the pretest and posttest. (4) The results of student responses obtained positive reactions with an average percentage of answers of 99.44%. The negative reactions with the average percentage of answers are 0.62%.

Keywords: *guided inquiry, critical thinking skills, equilibrium*

INTRODUCTION

Based on the preamble of the 1945 Constitution, it is stated that one of the goals of the Republic of Indonesia is to train the existence of the state. Achieving the goals of the Republic of Indonesia requires efforts from various directions, mainly the efforts of teachers. Teachers have an essential position to train the state's existence.

The curriculum currently used is the revised 2013 curriculum as stated in Permendikbud No. 69 of 2013, which explains that the 2013 curriculum aims to prepare the Indonesian human resources. They should have the potential to stay as folks that are devoted, efficient, creative, effective, and innovative and might contribute to the lives of the entire state. Indonesia is a society, state, nation, and civilization inside the international. Implementing the 2013 curriculum is also one of the government's steps to face challenges in the 21st era [1].

The learning process is very important for the continuity of teaching and learning activities carried out in schools. Teaching and learning activity is the interaction process that occurs between teachers and students and learning resources in a learning environment.

Teachers are student facilitators. In this case, it is hoped that there will be a balanced relationship between the roles of teachers and students. The formation of interaction between teachers and students occurs when a teaching and learning activity takes place in a pleasant atmosphere [2]. Undoubtedly, students will become more active in class if teaching and learning activities are conducted

in a pleasant atmosphere. Innovation in learning is needed in this 21st era. The teacher must have a high sense of sensitivity and concern to improve the quality of learning to support educational competition in this 21st era because education is important for national progress to produce quality human resources [3].

In this 21st era, a change in learning patterns at school is needed. If the first pattern at school was the teacher-centered pattern, then this pattern must be changed to student-centered. Student-centered is a learning pattern that puts students at the center of the teaching and learning process. These students centered learning patterns improve the quality of students' knowledge, make students more responsible for their learning process, make students more active, creative, and innovative, and make students have the ability to solve problems by thinking critically and logically [4].

The ability to suppose deeply with logically with a purpose to clear up a problem and shape an idea is knowing critical thinking ability. That is supported utilizing Ennis (1985) that critical thinking is a reflective and reasoning manner of thinking geared toward making choices in a problem. Critical thinking skills consist of six key components, including components of analysis, interpretation, evaluation, explanation, self-regulation, and inference [5].

According to previous research, critical thinking skills are still not handled properly, especially in high school. College students' capability in critical thinking skills is still low, so assistance is

needed to accurately and adequately overcome the problems [6].

Based on the outcomes of an interview with one of the chemistry teachers at Al-Islam High School Krian Sidoarjo, the learning of critical thinking skills has not yet been fully implemented. The outcomes of the pre-study questionnaire showed that 87% of the students had difficulty in chemistry subjects. It happened because the chemical material itself has many theories that must be studied, memorized, and calculated [7]. One of the chemicals that is considered difficult is chemical equilibrium. Chemical equilibrium is one of the chemical materials for class XI in the 2013 curriculum [8]. Teachers on chemical equilibrium only provide learning that is conditioned to discuss with their peers. As a result, many students have difficulty understanding the chemical equilibrium material in the presence of phenomena or events in life. That is supported by the outcomes of student pre-research performed at Al-Islam high school Krian, Sidoarjo. 28 of 36 students said they had problems with chemical equilibrium substances. A total of 36 students showed that many students still did not understand the 5 main components of critical thinking skills, namely interpretation, inference, analysis, explanation, and evaluation.

Based on the explanation above, to overcome these problems, it is necessary to treat them in an appropriate and accurate learning model. One of the learning models that may be applied to enhance critical thinking abilities is the guided inquiry getting to know the model. The guided inquiry learning model is more student-centered so that the teacher only acts as a facilitator when learning activities take place [9]. The guided inquiry learning model is expected to allow students to be more energetic during the learning process. The guided inquiry learning model aims to encourage students to solve problems and find concepts independently through critical and analytical thinking [10]. So, with the practice of guided inquiry, learning models can grow the ability of students to develop the potential of the mind to the fullest through a critical thinking process based on the problems that occur [11].

Based on previous research, it is shown that the learning outcomes carried out using the model of guided inquiry learning proved to be effective. According to the research, students' critical thinking skills have improved after the practice using the model of guided inquiry learning [12]. According to previous research, the guided inquiry learning model is very effective and can improve critical thinking skills [13]. The previous research also stated that the implementation of learning using guided inquiry could increase students' average cognitive learning outcomes from 51.71 to 89.71 [14]. Reinforced by previous research, outcomes from students' learning have increased since the guided inquiry learning model was applied [15].

RESEARCH METHODS

The type of research used was quasi-experimental research. This research was only conducted in one class without any comparison at Al-Islam High School Krian Sidoarjo for 2021/2022 with 36 students. This study used the One Group Pretest Posttest Design research design, with the following research pattern:

O ₁	X	O ₂
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Description:

O₁ = Initial test (test before treatment)

X = Treatment

O₂ = Final test (test after treatment)

The tools applied in this study were syllabus, studies plans, and students' paper sheets. The research instruments applied were the observation sheets for the implementation of the learning model, the sheets of student activity observation, the pretest and posttest sheets for both cognitive and critical thinking skills, and student response sheets.

The research method used was the observation, which aimed to observe the implementation of learning directly and determine critical thinking skills reviewed through pretest and posttest.

The learning implementation observation sheet was used to decide the suitability of the learning model that the teacher had finished with the existing learning model syntax based on the theory. The learning model that had been applied in this study was a model of guided inquiry learning. Student activity observation sheets were used to observe student activities when learning activities took place. The pretest and posttest sheets of critical thinking skills were tests used to specify the critical thinking skills of each student. The implementation rate of guided inquiry learning was calculated using the following formula:

$$\% \text{ syntax executable} = \frac{\text{Total score}}{\text{maximum score}} \times 100\%$$

Critical thinking skills were investigated using the normality test and continued with the Paired Sample T (T-test) test. If the value is obtained in sig. (2-Tailed) < 0.05, it can be summarized that the pretest and posttest results that have been given are different. The data obtained is then converted into a score as depicted in Table 1.

Table 1. Criteria for implementing the learning model

Percentage	Criteria
0% - 20%	Very less
21% - 40%	Not enough
41% - 60%	Enough
61% - 80%	Good
81% - 100%	Very good

In this study, the critical thinking components tested were 5 out of 6: interpretation, inference, analysis, explanation, and evaluation. Then for each component is calculated using the following formula:

$$\text{Critical thinking value} = \frac{\text{Score earned}}{\text{Maximal score}} \times 100$$

Then calculate the <g> value to find out how much the students' scores increased from the pretest and posttest. To calculate the value of <g> use the following formula:

$$\langle g \rangle = \frac{\text{Posttest score} - \text{Pretest score}}{\text{maximum score} - \text{Pretest score}}$$

The N-gain value that has been obtained is then adjusted to the criteria in the following table.

Table 2. N-gain criteria

< g > Score	Criteria
<g> ≥ 0.7	High
0.7 > <g> ≥ 0.3	Currently
<g> < 0.3	Low

Analysis of learning outcomes in the cognitive domain was carried out by analyzing the pretest and posttest scores. Learning outcomes in the cognitive domain of students are said to be complete if the pretest and posttest scores have met the completeness value set by Al-Islam High School Krian Sidoarjo, namely 80. Students are said to be complete if they get a score of more than 80. The value is obtained from:

$$\% \text{ Value of learning outcome} = \frac{\sum \text{score earned}}{\sum \text{maximal score}} \times 100$$

The response of students, in this case, is a research method that aims to find out the responses of students about the learning model that the teacher has applied. The response questionnaire sheet was prepared to refer to the Guttman scale, which was started in questions. Response questionnaire sheets can be calculated based on the following criteria:

Table 3: Guttman Scale Criteria

Answer	Score / Score
Yes	1
No	0

Giving a score for the assessment of student response observations can be analyzed using the following formula:

$$\% \text{ Student response} = \frac{\sum \text{Answer "Yes"}}{\sum \text{maximum answer "Yes"}} \times 100\%$$

After obtaining the percentage of student responses, it must be adjusted to the following value criteria:

Table 4: Criteria for student response scores

Percentage	Criteria
0% - 20%	Very less
21% - 40%	Not enough
41% - 60%	Enough
61% - 80%	Good
81% - 100%	Very good

The percentage of student responses is said to give a positive response if the score is obtained ≥ 61%, then the learning model can be said to be good.

RESULT AND DISCUSSION

The results of the research and discussion obtained from the research on the application of the guided inquiry learning model at Al-Islam High School Krian, Sidoarjo, will be described as follows:

Implementation of the Learning Model

The learning model used in this research is a guided inquiry learning model. This guided inquiry learning model was implemented by three observers from students in the Department of Chemistry at the State University of Surabaya. The learning implementation observation sheet is the instrument used in this case. The observations were made 3 times, namely at meeting 1, 2, and 3. The implementation of the guided inquiry learning model can be said well if the results of the percentage of observations are in the range of 61% - 80%. It is said to be very good if the results of the percentage of observations are in the range of 61% - 80% in the range of 81% - 100%.

The result of the implementation learning model can be seen in Figure 1.

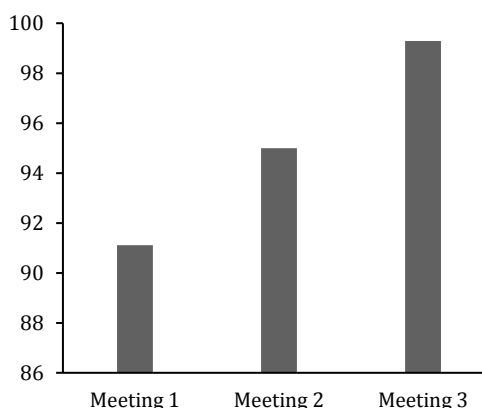


Figure 1. Average Implementation of Learning Model

Figure 1 shows the average result implementation of the guided inquiry learning model. The average for meeting 1 gets 91.11% with very good criteria, meeting 2 gets a score of 94.99% with very good criteria, and meeting 3 gets a score of 99.29% with very good criteria. Details results of the

implementation guided inquiry learning model can be seen in Figure 2.

Figure 2 shows the details of each phase of the implementation guided inquiry learning model. The implementation of the learning model got a very good score from phase 1 to phase 7. Through the results obtained, it can be concluded that the guided inquiry learning model has been applied coherently according to the syntax.

Student Activities

All activities that students do during the learning process are called student activities. This student activity will affect the implementation of the guided inquiry learning model. Observations on student activities were carried out by 3 observers from students majoring in Chemistry at Unesa. Observations were made 3 times, according to the number of meetings conducted in this study. The student activities that occur during this research can be seen in Figure 3.



Figure 3. Student Activities

Student activities can be well implemented and support an increase in the skills in critical

thinking if the percentage of related student activities is bigger than the irrelevant student activities. The results of the analysis of the percentage of student activity are shown in the figure 4.

Based on the figure 4, the percentage of students doing irrelevant activities at meeting 1 is 3.77%, at meeting 2 it is 2.60%, at meeting 3 it is 0.89%. So that the percentage of students is following the overall student activity at each meeting, where for relevant activities at meeting 1 it is 96.23%, for relevant activities at meeting 2, it is 97.40%, for relevant activities at meeting 3, it is 99.11%. Based on these results, it can be said that students have been trained to think critically with the guided inquiry learning model.

Critical Thinking Skills

Critical thinking skills are thinking skills that can bring up ideas, questions, and arguments based on the phenomena or problems presented. There are 6 components of critical thinking, namely inference, interpretation, explanation, analysis, self-regulation, and evaluation [5]. In this study, only 5 components of the 6 components of critical thinking were used, namely interpretation, inference, analysis, explanation, and evaluation.

Improvement of critical thinking skills can be measured through pretest and posttest. The pretest was given to decide students' capability before the guided inquiry learning model was applied. The posttest was given to determine the ability of students after the guided inquiry learning model was applied. The increase in critical thinking skills was analyzed using the normality test (Kolmogorov-Smirnov), followed by data analysis using the Paired Sample T (T-test) test on SPSS. The following are the results of the data analysis obtained (table 5).

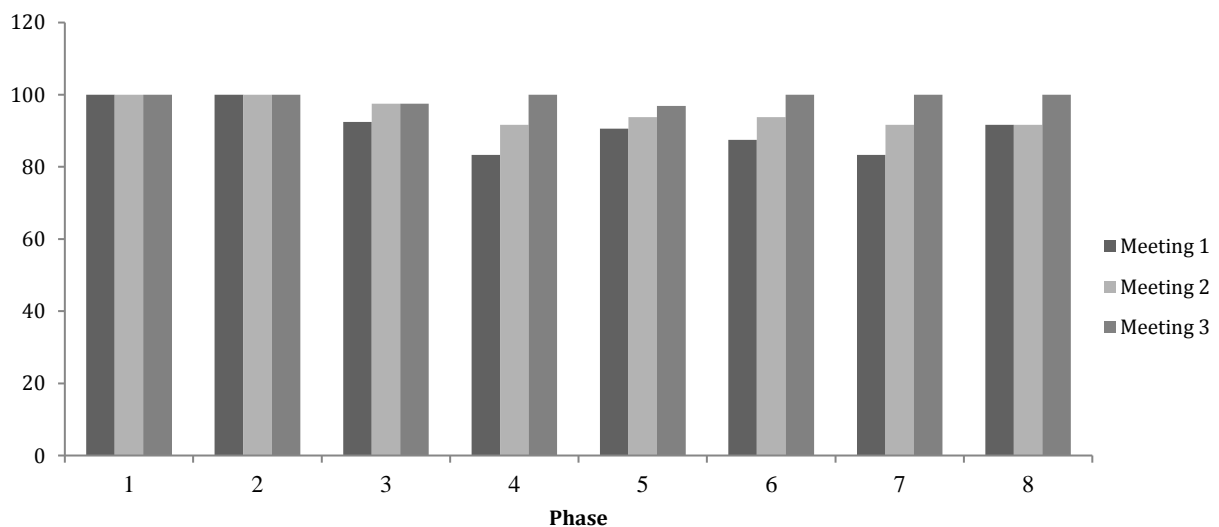


Figure 2. Implementation of the Learning Model in Each Phase

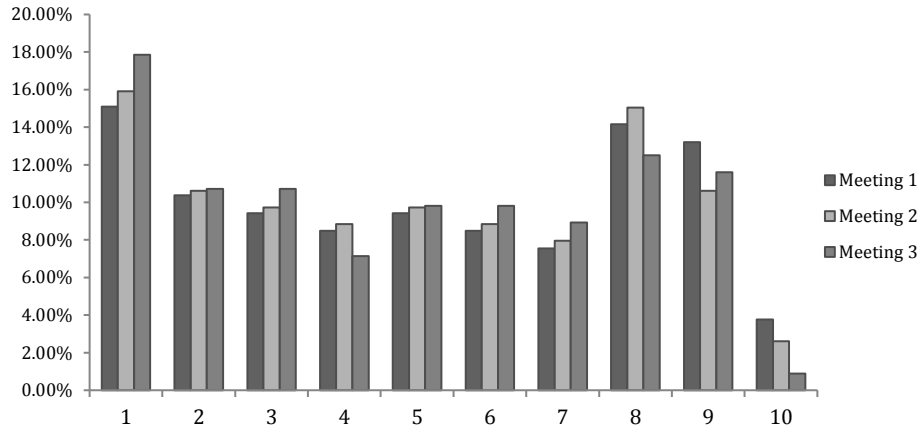


Figure 4. The Result of Student Activities

Table 5. Normality Test
 Tests of Normality

	Kolmogorov-Smirnova		
	Statistics	df	Sig.
Pretest	0.138	36	0.083
Posttest	0.131	36	0.124

Based on the table of the results of the pretest and posttest normality tests, the significance value is $0.083 > 0.05$. It can be concluded that the data is normally distributed. Furthermore, the Paired Sample T (T-test) test was carried out.

Table 6. Paired Sample T-Test
 Paired Samples Test

		Paired Differences		
		T	df	Sig. (2 tailed)
Pair 1	Pretest – Posttest	-51.372	35	0.000

Based on the Paired Sample T-test table with a significance value of $0.000 < 0.05$, the averages between the outcomes of the Pretest and Post-test are different. Then which one for each component is tested using N-gain analysis. The following is the average result of the data analysis of every part of critical thinking skills.

Based on the table 7, with the application of the guided inquiry learning model, the N-gain value for the interpretation component is 0.97; for the inference component that is 0.87; for component analysis that is 0.87; for the explanatory component, namely 0.74; and for the evaluation component that is 0.82 with the N-gain criteria for each high component. This proves that the model of guided inquiry learning helps students improve their critical thinking skills. The following is a picture of the average component of critical thinking skills.

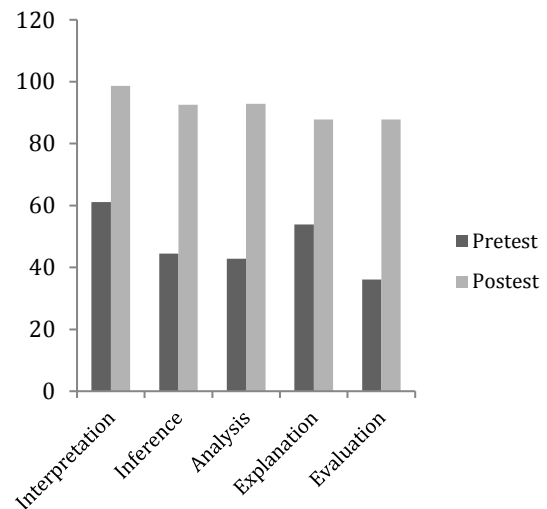


Figure 5. Average Components of Critical Thinking Skills

Table 7. Components of Critical Thinking Skills

Components of Critical Thinking Skills	Pretest	Posttest	N-gain	Criteria
Interpretation	61,12	98.62	0.97	Tall
Inference	44.45	92.50	0.87	Tall
Analysis	42.78	92.87	0.87	Tall
Explanation	53.88	87.78	0.74	Tall
Evaluation	36.12	87.78	0.82	Tall

Interpretation is the ability to understand and express the meaning of a situation or data [16]. In the interpretation component, students carry out activities, namely determining the problem formulation and writing experimental tools and materials based on the phenomena given and experimental videos. The following is one of the students' answers regarding the interpretation component.

bagaimana pengaruh tekanan dan volume terhadap arah pergeseran kesetimbangan kimia?

Translation :

How do pressure and volume affect the direction of the shift in chemical equilibrium ?

Alat	Bahan
tabung reaksi	gas NO_2
rak tabung reaksi	H_2O
	air panas
	air dingin

Translation :	
Tools	Materials
Test Tube	NO_2 (g)
Test Tube Rack	H_2O
	Hot Water
	Cold Water

Figure 6. Answers Regarding The Interpretation Component

The inference is the ability to identify rational conclusions by considering relevant issues [17]. In the inference component, students carry out activities, namely determining hypotheses and making conclusions based on the phenomena that have been given and based on experimental videos. The following is one of the students' answers regarding the inference component.

pemanasan yang dilakukan pada gas NO_2 menyebabkan pergeseran bergeser ke arah reaktan, sebaliknya jika gas NO_2 didinginkan maka reaksi bergeser ke arah produk.

Translation :

The heating carried out on the NO_2 (g) causes a shift in the equilibrium towards the reactants. On the other hand, if NO_2 (g) is cooled, the reaction will shift to products

tekanan dan volume bisa mempengaruhi arah pergeseran kesetimbangan kimia. jika tekanan di perbesar maka volume di perkecil. jika tekanan di perkecil maka volume di perbesar

Translation :

Pressure and volume can affect the direction of the shift in chemical equilibrium. If the reactants are increased, the volume is decreased. If the pressure is decreased, the volume will be increased.

Figure 7. Answers Regarding The Inference Component

The analysis is the ability to clarify conclusions according to the problems associated with the concept of available material [18]. In the analysis component, students carry out activities, namely determining experimental variables and observations based on the phenomena given and experimental videos. The following is one of the students' answers regarding the analysis component.

variabel manipulasi = Perubahan suhu
 variabel kontrol = volume gas NO_2
 variabel respon = pergeseran arah kesetimbangan yang dipindai dengan Cat kerdas yang perubahan warna

Translation :

Manipulation Variable : Changes in temperature
 Control Variable : NO_2 (g)
 Response Variable : A shift in the direction of the equilibrium marked by a change in colour

Figure 8. Answers Regarding The Analysis Component

The explanation can provide reasons for problems according to evidence in the form of material or data presented [19]. In the explanation component, students carry out activities, namely determining conclusions that are associated with the material that has been given. The following is one of the students' answers regarding the explanatory component.

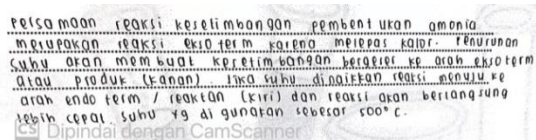
perubahan tekanan dan volume dapat menggeser arah kesetimbangan kimia. apabila tekanan di perbesar volume di perkecil dan reaksi bergeser ke arah yang memiliki jumlah koefisien kecil. jika tekanan di perkecil maka volume di perbesar maka reaksi akan bergeser ke arah yang memiliki jumlah koefisien besar.

Translation :

Changes in pressure and volume can shift the chemical equilibrium. If the pressure is increased the volume is reduced and the reaction will shift in the direction that has a small number of coefficients. If the pressure is decreased and the volume is increased, the reaction will shift in the direction that has a greater number of coefficients.

Figure 9. Answers Regarding The Explanation Component

The capability to rate credibility based on a report or judge a conclusion is called evaluation [20]. In the evaluation component, students carry out activities to answer questions about applying equilibrium material that occurs in everyday life. The following is one of the students' answers regarding the evaluation component.



Translation :

The equilibrium reaction equation for the formation of ammonia is an exothermic reaction because it releases heat. A decrease in temperature will make the equilibrium shift towards the exothermic or product (right). If the temperature is increased the reaction will proceed faster. The temperature used is 500°C.

Figure 10. Answers Regarding The Evaluation Component

Critical thinking skills in the explanation and evaluation components receive the lowest values compared to other critical thinking components. Ramadhani and Novita's research states that the lowest average N-gain score for critical thinking skills is an analysis component [13]. The test of students' cognitive learning outcomes is a test given to students to know the understanding and ability of students to the material that has been given. The test is given 2 times, namely pretest and posttest in the form of 10 multiple choice questions that refer to the realm of C4 or analyze. Students' cognitive learning outcomes are said to be complete if students get scores above 80.

The average value of students during the pretest is 25. All students are said to be still incomplete. This is because students still do not have knowledge about the material factors that affect equilibrium. In contrast, the average value of students during the posttest, which is 85, proves that all students have completed the learning outcomes because students already have knowledge of the material presented.

Student Response

Student responses are student responses to learning that has been carried out using a guided inquiry learning model. The responses of these students were obtained by giving a questionnaire in the form of questions via a google form. Questionnaires were distributed to 36 students of Al-Islam High School Krian Sidoarjo. This questionnaire contains statements that include the implementation from the guided inquiry learning model used to improve critical thinking skills. Percentage of student responses when giving a positive response $\geq 61\%$, then the model of guided inquiry learning that has been applied is said to be good. The students' responses got a positive reaction with an average percentage of answers of 99.44%. Then the results of student responses get a negative response with an average percentage of answers of 0.62%. It proves that applied learning can make

students more active and involved in learning chemistry to understand better [21].

CONCLUSION

From the data research and discussions above, it can be summarized the application of the guided inquiry learning model to improve critical thinking skills gets an average result of the first meeting of 91.11% with very good criteria; meeting 2 gets a score of 94.99% with very good criteria. Meeting 3 gets a score of 99.29% with very good criteria. Relevant student activities during learning activities that are applied with guided inquiry learning models to train students' critical thinking skills are 96.23%. In contrast, 3.77% is for irrelevant student activities. The students' thinking skills have increased. It can be seen in the results of data analysis using the Paired Sample T (T-test) and N-gain test. The normality test results get a significance value of $0.083 > 0.05$, so it can be concluded that the data is normally distributed. The results of the analysis using the Paired Sample T-test get a significance value of $0.000 < 0.05$, so it can be concluded that there is an average difference between the results of the Pretest and Posttest. The student responses get a positive response with an average percentage of answers of 99.44% with very good criteria. Then the results of student responses get a negative response with an average percentage of answers of 0.62%. From the explanation above, it can be concluded that the guided inquiry learning model that has been applied is very good.

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