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Analysis of Critical Thinking Skills Through Guided Inquiry Learning Model on Reaction Rate Materials

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ABSTRACT

This study aimed to analyze students' Critical Thinking Skills on the Reaction Rate materials through the Guided Inquiry Learning Model. This study was conducted in SMAN 1 Taman using a one-group pretest-posttest design. The data obtained were analyzed using the percentage, mean, n-gain, and t-test techniques. The research result shows that (1) The average percentage implementation of Guided Inquiry Learning Model syntax executed in phases 1,2,3,4,5 and 6 in a row is 94.17%; 98.61%; 100%; 98.96%; 100%; and 100%, with excellent criteria, (2) the percentage of students' activities who are actively involved and relevant to Guided Inquiry Learning Model is 94.45% at a meeting I and 97.78% at meeting II, (3) students' Critical Thinking Skills are complete in all components tested, namely interpretation, inference, analysis, and explanation with an average gained score of 0.82; 0.84; 0.77; and 0.91, and (4) there is a significant difference in the results of Critical Thinking Skills between before and after being given a Guided Inquiry Learning Model. The results showed that the Guided Inquiry Learning Model is effective in improving students' Critical Thinking Skills.

I. Introduction

Chemistry is one of the science subjects built based on scientific products, processes, and attitudes. According to the 2013 curriculum, chemistry learning is concerned with systematically finding out about natural, so that chemistry is the mastery of a collection of knowledge in the form of facts, concepts, or principles and a process of discovery. Chemistry as a process is the skills and attitudes needed to acquire and develop knowledge (Emda, 2017). The chemistry learning process emphasizes providing direct experience to develop skills and attitudes so that students can explore and understand their natural surroundings scientifically (Mulyasa, 2011).

One of the class XI chemistry materials in the 2013 Curriculum is Reaction Rate. Based on chemistry subjects in curriculum 13 revisions in the Regulation of Ministry of Education and Culture (Permendikbud, 2016) concerning basic competencies are 3.4. explain factors that influence Reaction Rate using collision theory, and basic competencies 4.5 designing, conducting, and concluding, and presenting experimental results of factors that affect Reaction Rate and reaction order. This material requires proof so that the concepts studied can be meaningful to students. This proof can be gathered through experiments to investigate, analyze, and conclude so that students are able to construct their knowledge. The teacher can make this process easier by developing a learning atmosphere that allows students to discover, apply their ideas, become aware, and consciously use their learning strategies. Therefore, the student is required to have Critical Thinking Skills. Critical Thinking Skills are closely related to the cognitive abilities of students.

The characteristics of questions in PISA require Critical Thinking Skills because questions are quite contextual, require reasoning, argumentation, and creativity in solving it. Based on the PISA survey result in 2015, Indonesia is ranked in the ten lowest countries (64 out of 72 countries). The same result is also shown from the PISA survey in 2018 that positioned Indonesia in rank 74 from 79 countries. According to Facione et al. (1994), Critical Thinking Skills consist of several skills, namely: interpretation,

analysis, inference, evaluation, self-regulation (Filsaime, 2008). Based on the initial research conducted on October 23, 2020, in SMAN 1 Taman, 0% of students can interpret, 33% of students can provide inference, 0% of students can analyze, and 67% of students can explain based on available data.

The result indicates that students are not used to interpretation, analysis, inference, and explanation, which are the elements of critical thinking skills. It is supported by Imama's research, which has successfully increase students' critical thinking skills by a percentage of 100% with obtained high and medium N-gain categories in Reaction Rate (Imama, 2015). This result of the research is relevant to the study that giving students space to find learning experiences that better help students understand the mastery of concepts (Darling-Hammond et al., 2020).

Critical thinking is not an innate skill; thereby, students should be trained to assess the problem from various perspectives and be open-minded in developing content knowledge (Utriainen et al., 2017). Meanwhile, the short–term goal of critical thinking in the learning process is to strengthen students' conceptual understanding (Khasanah et al., 2017) to help students develop insights and concepts that will be obtained. The obtained understanding and concept are longer stored in memory because students are actively involved in learning to find concepts independently involving testing, connecting, and evaluating all aspects of a situation or problem (Filsaime, 2008).

A situation or problem is created for students to learn well and have high activity (Abdullah, 2017). The interaction of students in a classroom needs to be considered. It is because, with good interactions in the classroom, learning objectives will be easily achieved (Masitoh, 2017). Learning that makes this interaction possible is learning that is innovative. Innovative learning provides opportunities for students to explore students' abilities and solve a problem together (Cahyani & Azizah, 2019). This learning is beneficial for students because they will work together to achieve goals to provide benefits for students to increase learning motivation and improve learning outcomes (Heriyanto & Haryani, 2014).

Guided Inquiry Learning Model consists of these learning components, as it helps students develop Critical Thinking Skills to find their answers to questions by actively participating in learning activities. It is also in line with research conducted by Nasution, which reveals a significant effect of implementing inquiry learning models on students' Critical Thinking Skills (Nasution, 2018).

Students' Critical Thinking Skills could be optimized by applying an inquiry-based learning model (Zubaidah et al., 2017). Also, Qureshi's research states that implementing inquiry learning models can increase grades in chemistry subjects like Reaction Rate and increase students' confidence (Qureshi et al., 2017). It is also strengthened that students improve learning outcomes obtained by students because of the implementation of the Guided Inquiry Learning Model (Almuntasheri et al., 2016).

Students are required to be active in finding a concept and trained to develop their sense of curiosity (Farida & Muchlish, n.d.). Guided inquiry learning activities emphasize critical thinking to find answers for themselves that will help them solve the problem and build hypotheses to find the answer with data from their research (Juniati & Widiana, 2017). The Guided Inquiry Learning Model has Critical Thinking Skills that involve testing, connecting, and evaluating all aspects of a situation or problem (Larasati, 2017).

The result of this research is an implementation of all learning syntax and completion of the Critical Thinking Skills score on the indicator of interpretation, analysis, explanation, and inference. In this case, assistance is needed to deal with the above problem accurately. This research aims to analyze Critical Thinking Skills through Guided Inquiry Learning Model on Reaction Rate Material for SMAN 1 Taman students.

II. Method

This research used a quantitative method with one group pretest-posttest design that could be described as follows:

$$O_1 \; X \; O_2$$

Information:

O1: pretest score (before the implementation of Guided Inquiry Learning Model).

X: application of Guided Inquiry Learning Model

O2: posttest score (after implementation of Guided Inquiry Learning) (Sugiyono, 2013).

Data collection in this study used the method of observation and test. The observation was used in determining students' learning and activities according to the implementation of Guided Inquiry Learning Model syntax, while the test method was used to measure students' Critical Thinking Skills. The analysis is illustrated from the calculation of percentage quality implementation as follows:

$$\% \text{ Implementation} = x = \frac{\sum \text{Observation score}}{\sum Maximum\ score} \text{ x } 100\%$$

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And quantitatively based on average observation results from 3 observers. The data was then analyzed by calculating the percentage of activities carried out by students. Learning took place from beginning to end using the Guided Inquiry learning model, with the following formula (Arifin, 2011).

$$\% \text{ Act.} = \frac{\sum \text{Frequency of activity that appear}}{\sum Frequency of\ all\ activity} x100\%$$

Critical Thinking Skills were measured based on students' ability to test questions about the problem and the way to solve it. To assess Critical Thinking Skills, a critical thinking pretest method was used before being given learning treatment with the inquiry. A posttest critical thinking result was distributed at the end after being given inquiry learning treatment. The normality test was used to assess the distribution of data in pretest-posttest and see a significant difference between pretest-posttest and whether the distribution of data was normally distributed or not. Data were considered to meet assumption normality if Kolmogorov-Smirnov sig. > 0.05. Then, the Critical Thinking Skills were analyzed through the calculation of score <g> to find out the difference between the average pretest and posttest scores.

Implementation of the Guided Inquiry Learning Model was said to be excellent when it achieved. Students' activities during learning activities were analyzed descriptively (Riduwan, 2007).

$$<g> = \frac{\sum \text{Frequency of activity that appear}}{\sum Frequency of\ all\ activity}$$

Furthermore, the number obtained was converted into categories as in Table 1. Critical Thinking Skills were said to be successfully trained if they fall into a medium and high category (Pratiwi & Azizah, 2018). Students were declared to have completed learning if the learning score had reached the minimum completeness criteria set by the teaching unit, namely 66.50 (Munafaricha, 2018). Further, a t-test on a research hypotheses test was carried out with SPSS 20, where if t – count < 0.05, the Hawas accepted, but if t-count, the Ha was rejected (Kadir, 2015).

Table 1. Criteria for Gain Score

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

III. Results and Discussion

This section presents research results and a discussion of research that has been obtained during the investigation at SMAN 1 Taman. The study only investigated one class selected randomly by the chemistry subject's teacher, without a control class.

Data collection was carried out in two meetings on different days, namely on October 30 and November 7, 2020, at SMAN 1 Taman in class XI with 35 students. The purpose of observing compliance learning is to know the implementation of the Guided Inquiry Learning Model, which has been prepared in the lesson plan, and show whether the teacher has trained Critical Thinking Skills in learning.

The implementation of the learning model is observed by three observers using a sheet compliance observation. The implementation is classified as good if one attains a percentage of 61% - 80% and excellent when getting a ratio of 81% - 100% (Riduwan, 2007). All phases of the Guided Inquiry Learning Model have been appropriately completed, as presented in Fig. 1.

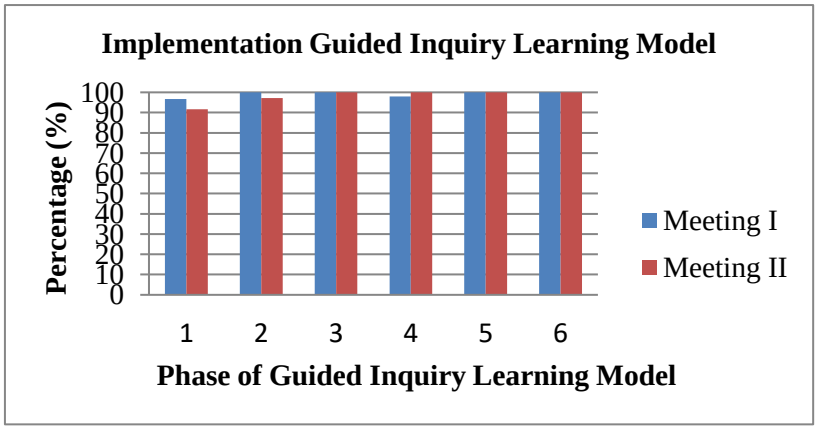

Fig. 1. Diagram of Guided Inquiry Learning Model implementation

Based on Fig. 1, the percentage of implementation Guided Inquiry Learning Model for two meetings can be described as the following. Phase 1 focuses on teachers' attention and explanation using the inquiry process that obtained 96.67% and 91.67%, categorized as excellent. Activities carried out in

phase 1 are when the teacher begins the lesson by appreciating students, linking material with students' initial knowledge of collision theory, and reminding them of the previous material. The teacher also motivates students and communicates the objectives of learning. Meanwhile, phase 2 presents an inquiry problem for phenomenon percentage obtained scores of 100% and 97.22%, classified as excellent criteria. In this phase, students are given a worksheet and time to read instructions first and then read phenomena in a worksheet.

In phase 3, students are asked to formulate a hypothesis for acquiring a problem or phenomenon, attaining 100% and 100%. Percentage meeting, I and meeting II are similarly classified as excellent. In this phase, the teacher guides students to work on worksheets. The first is to choose appropriate problem formulation based on phenomena in the worksheet with the teacher's guidance and formulate problems, including interpretation of critical thinking skills. Then, students determine appropriate hypotheses and experimental variables based on phenomena contained in a worksheet, formulate hypotheses included in inference Critical Thinking Skills.

Phase 4, collect data for proportion hypotheses test attains 97.92% and 100%. The implementation has improved from meeting I to meeting II with excellent criteria. In this phase, students are guided to take tools and materials and conduct experiments to collect data. Beforehand, students read and learn work procedures in solving problems that exist in a worksheet. During the experiment, students collect and organize data obtained during the experiment and compile experimental data. Then students analyzed experimental data.

Phase 5, formulate an explanation or conclusion obtains a percentage of 100% and 100%. The percentage of meeting I and meeting II are the same with excellent criteria. In this phase, students make conclusions based on the experiments.

Phase 6, reflect on the problem situation and thought process obtain a percentage of 100% and 100% with excellent criteria. In this phase, students work on application questions to remember how to solve problems that have been given and provide another example in everyday life. Students display their work in class after experiment results are presented. Students are guided to make conclusions from the gathered knowledge and find a concept. According to information processing theory, the teacher reviews lessons that have been obtained so that students understand better and enter long-term memory.

Based on the description above, the most dominant phase that helps students improve Critical Thinking Skills is phase 4. Because students test activities hypotheses by collecting data. During the collection of student data through direct experiments, learners can test problem formulations, hypotheses, variables, and experimental steps made. Participants can analyze and conclude results in experimenting with relevant research in phase 4, including the dominant phase.

According to Fig. 1, the average percentage 2 meetings in phases 1, 2, 3, 4, 5, and 6 are 94.17%, 98.61%, respectively, 100%, 98.96%, 100%, and 100%. The average percentage of Guided Inquiry Learning Model's phases at the first meeting to a second meeting signifies that each phase of the Guided Inquiry Learning Model has been accomplished and classified as an excellent category, proven by the percentage of each phase reaches that generates student activities.

Observation of student activities aims to discover all students' activities during the learning process using Guided Inquiry. Three observers carried out the observation on student activities. The result from observations of students' activities at meetings I and II is illustrated in Fig 2.

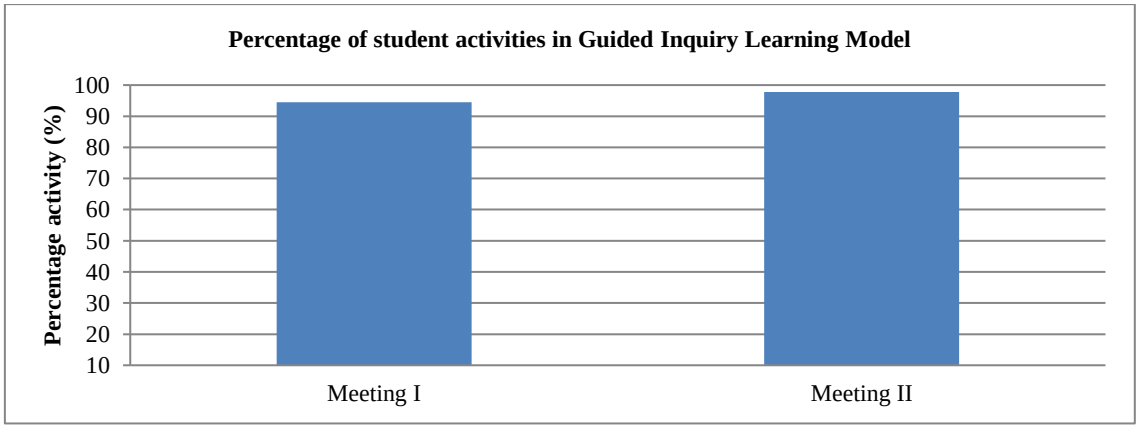

Fig. 2. Percentage of student activities in Guided Inquiry Learning Model

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Fig. 2 shows that the percentage of relevant activities at the meeting I is 94.45% and at meeting II is 97.78%. It means that student activities have been carried out properly both by teacher and students, so students' Critical Thinking Skills can improve.

Students' Critical Thinking Skills are measured through tests that refer to a critical thinking component. The test was conducted in pretest and posttest, where pretest was carried out before learning using Guided Inquiry Learning Model, and posttest was carried out after the students have attended the Guided Inquiry Learning Model. The problem used for knowing the increase in students' Critical Thinking Skills is in the form of descriptive questions. These questions include four out of six components of Critical Thinking Skills trained (N. C. Facione et al., 1994; Filsaime, 2008).

Components of Critical Thinking Skills trained and presented in pretest and posttest questions are interpretation, inference, analysis, and explanation. The following present data from analysis of result pretest to posttest Critical Thinking Skills in terms of their completeness. Students can be said successful if their results of Critical Thinking Skills ≥ 66,50 according to what is set in 2013 revised curriculum with predicate B where score also matches minimum completeness criteria in SMAN 1 Taman. The following show result of pretest and posttest Critical Thinking Skills in each component:

A. Interpretation Component

In this component, Critical Thinking Skills are trained in the interpretation component as measured by seven descriptive questions where questions discuss formulating a problem, formulating hypotheses, and determining variables according to given phenomena. The meaning of interpretation, according to (Facione, 2011), is the ability to change the information presented from one form to another. In the interpretation component, written pretest answers are still inaccurate, so that interpretation component is still insufficient (Imama, 2015).

The phenomenon used in a worksheet is the phenomenon of factors that affect the Reaction Rate in everyday life. This activity trains students' Critical Thinking Skills of the interpretation component, namely the ability to change the information presented from one form to another (Filsaime, 2008).

In a second meeting, a dominant activity that occurred has increased due to the arranged worksheet format so that students had to be able to interpret based on worksheet assistance that they obtained at the meeting I. In solving the problem given, students need to recall or review their work at the previous meeting.

In the posttest, an increase in students' average scores was observed. If the average pretest score of students obtained is 49.08 and 100% of students did not complete, then in the posttest, 91.43% of students completed the test with an average score of 90.72. It can be said that the Guided Inquiry Learning Model is able to train the interpretation component. In the interpretation component, students' general answers are correct. They have been able to identify control, manipulation, and response variables and make a problem formulation that connects two variables.

B. Analysis Component

The definition of analysis, Facione et al. (1994), is identifying the intended and actual inferential relationship between the statement, question, concept, description, or form of expressing belief, judgment, experience, reason, information, or opinion. Critical Thinking Skills in the analysis, the component is measured by six descriptive questions where questions discuss the analysis of how practicum occurred (Imama, 2015).

During the learning, students are taught and trained to answer questions about the analysis component through a worksheet, and finally, when answering posttest questions, students show excellent result improvement. Thirty-three students completed the posttest. In this component, many students get the incomplete score, namely two students, because subjects' answers are not accurate and do not meet predetermined indicators, so the score obtained for the posttest is low. The limited-time constraint during learning causes the analysis component is not maximally conveyed. In this activity, the teacher guides students to answer analyses about practicum that have been carried out previously to obtain additional information through the practicum in the table or graph.

Second meeting guidance is reduced, so students are independently trained to make tables or graphs and enter data correctly. Students' practicum results are still assisted by the teacher to obtain additional information that can support their findings during the learning. This activity is in accordance with Critical Thinking Skills that are trained, namely analysis in identifying the intended and actual inferential relationship between the statement, question, concept, description, or form of expressing belief, judgment, experience, reason, information, or opinion. Critical Thinking Skills are a training activity component of this analysis practice students with the teacher's help and guidance to obtain additional information to conclude (Filsaime, 2008).

In the posttest, there is an increase in students' average scores. If the average pretest score of students obtained is 35.86 and 100% failed to complete, then

in the posttest, 94.29% of students complete the test with an average of 84.29. It can be said that the Guided Inquiry Learning Model can train the analysis component.

C. Inference Component

Critical Thinking Skills in the inference component are measured by five questions on drawing a conclusion based on phenomena that have been given. Students' answers are incorrect in the inference component, so it is still said that Critical Thinking Skills in this component are still low. The definition of inference, according to Facione et al. (1994), is identifying and obtaining elements necessary to make reasonable conclusions; make assumptions or hypotheses; consider relevant information and deduce consequences from data, situation, question, or another form of representation (Imama, 2015).

At pretest score, almost all students got a score below minimum completeness criteria. Students have not been able to link response variables with manipulation variables, so the answers obtained do not match the assessment indicator. There are still many confused students, so many of them choose not to answer.

When learning takes place, students are then taught and trained to answer Critical Thinking Skills questions on the inference component by working on questions contained in a worksheet as an exercise. After learning, students find it easier to work on posttest questions, which can be seen in posttest results. The posttest score was excellent, and all 35 students scored above minimum completeness criteria, namely ≥ 66.50. In its delivery, this component is trained in making results in the form of a conclusion from what they have done and got. The result of student activities shows that dominant activity that occurs in activity makes a decreasing conclusion that previously got more numbers then becomes less. It shows that students understand how to relate what they have obtained with what they have done outside of the limited time used during learning.

Activities carried out by the teacher guide students to conclude practicum data after obtaining information on phenomena in the worksheet, understanding information obtained. At the first meeting, guidance needs to be given. However, students are still asked to read and understand information obtained to choose the right conclusion given to the worksheet. The second meeting guidance process was reduced by instructing students independently to conclude based on the given phenomena.

The above activities are in accordance with Critical Thinking Skills are trained, namely inference. According to Facione et al. (1994), identifying and obtaining elements needed to conclude makes sense; make assumptions or hypotheses; consider relevant information and deduce consequences from data, situations, questions, or other forms of representation. In this activity, students collect all information obtained from the beginning of learning to draw the result of this learning in the form of a conclusion (Imama, 2015).

In this activity, the dominant time needed is reduced at the second meeting. Students have been trained to draw a conclusion based on hypotheses they have made and based on their practicum results.

In the posttest, there was an increase in students' average scores. If the average pretest score of students obtained was 31.43 and 100% did not complete, then in the posttest, 94.29% of students completed with an average of 89.57. It can be said using the Guided Inquiry Learning Model is able to train the inference component.

D. Explanation Component

In pretest and posttest questions of Critical Thinking Skills, the explanation component is one question in the description that contains the influence of factors that affect Reaction Rate with the theory that students have previously obtained. Critical Thinking Skills in the explanation component are measured through descriptive questions. Questions discuss the conclusion that students have obtained with theories obtained by students.

The meaning of explanation, according to Facione (2011), is being able to state the result of a person's thoughts, justifying that thought from the side of evidential, conceptual, methodological, and contextual considerations where one's result is based, and presenting one's reasoning in the form of arguments strong argument (Imama, 2015).

At the pretest score, almost all students scored below minimum completeness criteria (66.50) because students are still unable to connect theories they have obtained before with ideas they have just obtained. This is proven by many students who answer not according to predetermined indicators. On the other hand, there are not many students who do not answer because of confusion to answer.

Students can easily solve questions presented at the posttest using an explanation component. It is evidenced by the result of an excellent posttest score. As many as 33 students attained scores above minimum completeness criteria (66.50), while two students got scores below minimum completeness criteria. In this activity, the teacher plays a guiding role who acts as a moderator between students who display results and do not display results. If there is something wrong or different from the teacher's material, they will immediately rectify it.

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In addition, the meaning of explanation, according to Facione (2011), is being able to state the result of a person's reasoning justifying this reasoning from the side of evidential, conceptual, methodological, and contextual considerations where one's result is based, and presenting one's reasoning in the form of strong arguments (Imama, 2015).

In the posttest, there is an increase in students' average scores. If the average pretest score of students obtained is 42.50 and 100% of students do not complete, then in the posttest, 94.29% of students completed with an average of 93.57. It can be said that the Guided Inquiry Learning Model can train the explanation component. The average scores of Critical Thinking Skills from two meetings are presented in Fig 3, the result of normality in Table 2, an average gain score of Critical Thinking Skills in Fig. 4, and a t-test in Table 3.

Table 2. The result of the normality test

	Kolmogorov - Sminorva			Shapiro – Wilk		
	Statistic	Df	Sig.	Statistic	Df	Sig.
Posttest	0.274	35	0.30	0.823	35	0.067
Pretest	0.186	35	0.200	0.986	35	0.930

Table 3. The result of the t-test

	Mean	Std. Deviation	Std. Error Mean	T	Df	Sig. (2-tailed)
Pair 1 Pretest -	-49.82029	14.14549	2.39102	-20.836	34	.000

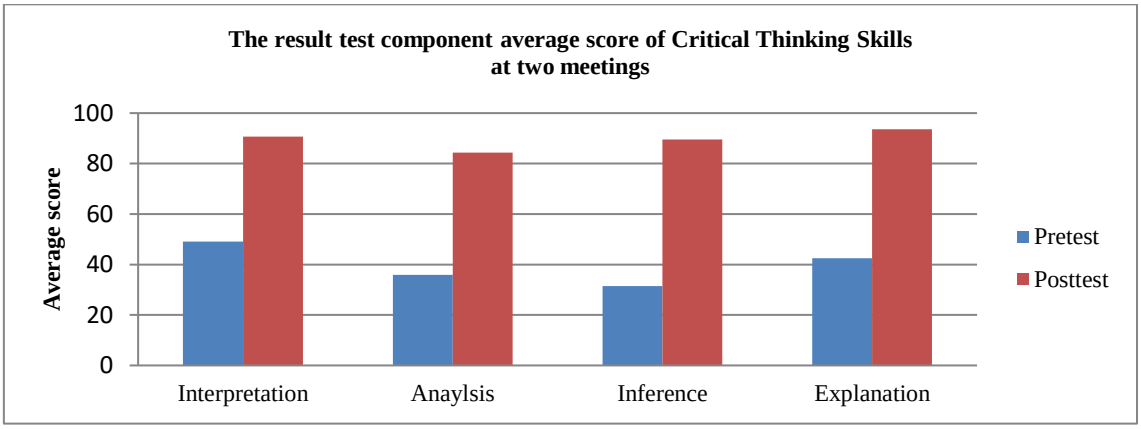

Fig. 3. The resulting test component average score of Critical Thinking Skills at two meetings

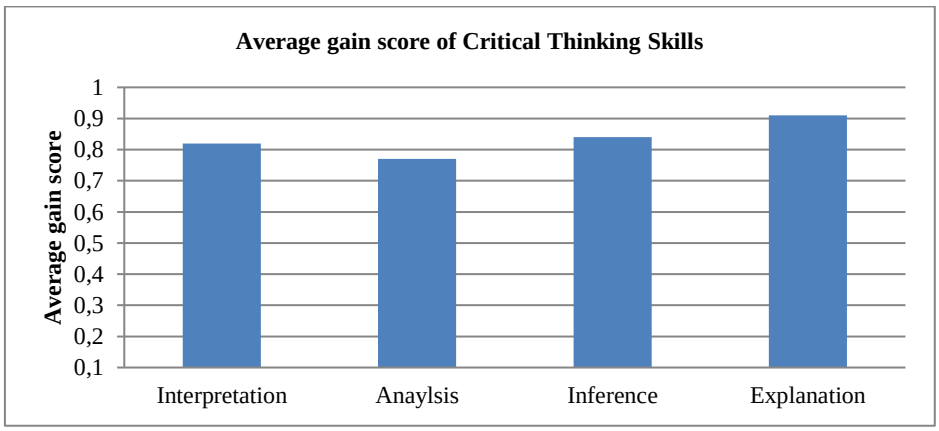

Fig. 4. The average gain score of Critical Thinking Skills

Fig. 3 explains that the fourth component of Critical Thinking Skills has increased from pretest score to posttest score. Besides, after implementing the Guided Inquiry Learning Model for each component, the average pretest-posttest score has gone above minimum score completeness criteria ≥ 66.50 with the excellent category. It can be said that the Critical Thinking Skills of students are said to be thorough and trained.

In addition, the normality test with Kolmogorov – Smirnov attains a significant level of 0.05. This nor-

mality test assesses data distribution in pretest and posttest and investigates the considerable difference between pretest-posttest and whether the distribution of data is normally distributed. The output of SPSS 22.0 is presented in Table 2. Normality test result indicated that pretest score data has a significance level 0.093, it means that data score obtained are normally distributed. Posttest score data has a significant level of 0.067, which means that the data obtained is normally distributed to get the gain score.

The gain score is calculated on average to find out improvement students' Critical Thinking Skills. The average gain score is presented in Fig. 4. Fig. 4, from pretest and posttest scores, shows average gain scores from interpretation, analysis, inference, and explanation are 0.82, 0.77, 0.84, and 0.91, respectively. Students' Critical Thinking Skills in effective interpretation components are trained and increased with a high category score.

In Table 3, after the test t-test, a significant value is obtained by 0.000 < 0.05. It shows that proposed hypotheses prove H0 is rejected, and Ha is accepted, signifying an increase in Critical Thinking Skills through Guided Inquiry Learning Model. It corresponds to Duran's research, which states that implementing IBL (Inquiry-Based Learning) learning significantly increases students' Critical Thinking Skills (Duran & Dökme, 2016).

IV. Conclusion

This study indicates that students trained Critical Thinking Skills (interpretation components) on Reaction Rate for two meetings is 91.43%, obtaining a complete score with an average gain score of 0.82. In addition, students who carry out relevant activities on Reaction Rate during Guided Inquiry Learning Model get a percentage of 94.45% at meeting 1 and 97.78% at meeting 2. It can be concluded that student activities are carried out well and support Guided Inquiry Learning Model's effectiveness in improving Critical Thinking Skills. The average percentage implementation of Guided Inquiry Learning Model syntax executed in phases 1, 2, 3, 4, 5, and 6 in a row is 94.17%; 98.61%; 100%; 98.96%; 100%; and 100% with excellent criteria because each phase obtains a percentage ≥ of 61%.

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