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IMPROVING CRITICAL THINKING SKILLS OF HIGH SCHOOL STUDENTS THROUGH GUIDED INQUIRY IMPLEMENTATION FOR LEARNING REACTION RATE CONCEPT IN CHEMISTRY

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Abstract: This research was conducted to know (1) the implementation of the guided inquiry learning model; (2) student activities; (3) critical thinking skills; and (4) student responses. The type of research was used pre-experimental with one group pretest-posttest design. The population in this research was all students of class XI MIPA SMAN 1 Gedangan Sidoarjo in the 2021/2022 academic year, with 11th grade MIPA 6 as the sample. The research results show that the learning model is implemented in the very good category with the percentage of implementation at first is 96.09% and the second meetings are 98.83%. The activity of students is very good and supports the effectiveness of the learning model, with the percentage at the first and second meetings being 97.9% and 98.7%, respectively. (3) There was an increase in critical thinking skills from acquiring the N-Gain score, 87.10% of students in the high category and 12.90% of students in the medium category, and the classical student learning outcomes are 87.10%. (4) Student response to the learning model that has been applied is very good, with a percentage of 90.37%. Based on this, it indicated that the guided inquiry model could improve the critical thinking skills of 11th grade students on the reaction rate material.

Keywords: *Guided Inquiry, Critical Thinking Skills, Reaction Rate*

INTRODUCTION

The rapid development of science and technology in this era of industrial revolution 4.0 demands quality human resources. Quality human resources are born from quality education. Implementing the 2013 curriculum is one of the government's efforts to produce quality human resources. In the 2013 curriculum, learning is student-centered (*student center)*, where students are expected to play an active role in the learning process. Forming a creative, innovative, and productive generation to contribute in various fields of life is the goal of implementing the 2013 curriculum [1].

Chemistry is one of the subjects taught in senior high school, which can form logical, critical, creative, and innovative thinking skills in the learning process [2]. One of the chemistry materials is the rate of reaction, which has the basic competence to explain the factors that affect the reaction rate. Based on the pre-research questionnaire results that who were given to 11th grade MIPA 6 at SMA Negeri 1 Gedangan, 96% of students considered chemistry to be a complex subject, and 63% chose reaction rate material as complex.

Based on this, it is necessary to have a thinking skill that can explain the material to students. Thinking ability is a fundamental ability in the learning process [3]. The ability to solve science and everyday problems is a form of critical thinking skills. According to Permendikbud Number 22 of 2016 concerning Competency Standards for Elementary and Secondary Education Graduates, one of the dimensions of skills that primary and secondary education students must possess is critical thinking skills [4].

Critical thinking is one of the abilities that students must possess to make the right decisions in solving problems, especially in chemistry learning [5]. Fischer explained that critical thinking is one type of evaluative thinking, both critical and creative thinking, especially on ideas put forward to support something [6]. Facione suggests that there are six main components in critical thinking. Interpretation, inference, analysis, explanation, evaluation, and self-regulation [7]. However, only four indicators are used in this study, namely interpretation, analysis, inference, and explanation.

The results of the pre-study with 31 students showed that students' ability to think critically was still relatively low, with a critical thinking score of students on the interpretation indicator by 23%, the analysis indicator by 19%, the inference indicator obtained by 21%, and the explanation indicator that is equal to 31 %. These results indicate that students' ability in critical thinking is still low, so a learning model is needed that can train these skills. Critical thinking can be trained in learning to improve [8].

Critical thinking skills are very relevant if they are trained using an inquiry-based learning model (investigation) so that the suitable learning model is a guided inquiry learning model [9]. The inquiry process can help find new knowledge for students [10]. The purpose of the inquiry model is to encourage students to find their solution to a problem through a critical and analytical thinking process [11]. The guided inquiry model consists of 6 syntaxes, namely 1) focusing students' attention and explaining an inquiry process, 2) presenting an inquiry problem or phenomenon, 3) encouraging students to formulate hypotheses to explain problems or phenomena, 4) encouraging students to collect data to test hypotheses, 5) formulate explanations and

conclusions, 6) reflect on problem situations and thought processes [12].

Thinking skills can be developed by placing students as learners who can find concepts and solutions to problems through the investigation process to develop the mind's potential to the fullest [13]. Students who like to conduct experiments in the laboratory with the guided inquiry model stated that this could encourage them to search and think [14]. Students with this learning model get much higher scores than students in learning conditions continuously directed by the teacher [15]. Relevant research proves that the guided inquiry model can improve critical thinking skills on the scores *of posttest* students for each component [16]. Similar studies showed that the inquiry model was successfully applied with maximum final results [17]. Based on these indications, research was conducted with the title "Guided Inquiry Implementation in The Reaction Rate Materials to Improve Students' Critical Thinking Skills Of Class XI."

RESEARCH METHODS

This study used a pre-experimental method with the *One Group Pretest Posttest Design*, carried out without a control class. The population was all students of class XI MIPA SMA Negeri 1 Gedangan Sidoarjo for the academic year 2021/2022, while the sample was students of class XI MIPA 6. The research design of *One Group Pretest Posttest Design* is as follows:

$$O_1 \ X \ O_2$$

Description:
O_1: initial test scores before applying the learning model
X : treatment was the application of the guided inquiry model
O_2: final test scores after using the learning model

The learning devices used in this study were the syllabus, lesson plan, and Student Worksheet, which refers to guided inquiry learning. While the research instruments used were 1) learning implementation sheets of observation is to determine the suitability of the syntax made by the teacher when applying the learning model, 2) student activity sheets used to determine student activities during learning activities, 3) *pretest* and *posttest* critical thinking sheet to determine the improvement of students' critical thinking skills before and after being given treatment, and 4) student response questionnaire sheets used to determine student responses to the learning model used. Expert lecturers validated research tools and instruments before being used to collect data.

The data analysis technique used is data analysis of guided inquiry syntax, student activities, and student response. Then critical thinking skills tests were tested through *N-Gain*. Two observers observed the implementation of the learning model according to predetermined criteria. The results obtained from the observer's assessment are processed using the formula:

$$\%\text{implementation} = \frac{\Sigma\text{score obtain}}{\Sigma\text{maximum score}} \text{x}100\%$$

The results obtained are then converted using a Likert Scale, as shown in Table 1. Learning is said to be implemented well if the percentage of implementation reaches 61%.

Table 1. Criteria for implementation of the learning model

Percentage	Criteria
0% - 20%	Very less
21% - 40%	Less
41% - 60%	Enough
61% - 80%	Good
81% - 100%	Very good

[18]

Learning is said to be implemented well if the percentage of implementation reaches 61%.
Student activities were carried out using the observation method by two observers for two meetings. Calculated using the formula:

$$\%\text{Activity} = \frac{\Sigma\text{student activity}}{\Sigma\text{overall activity}} \text{x}100\%$$

Student activity is said to support the application of the learning model if it has a relevant percentage of student activity reaching 61%.
The increase in students' critical thinking from *pretest* to *posttest* is calculated using the *N-Gain score* with the following equation:

$$< \text{g} >= \frac{\text{posttest score} - \text{pretest score}}{\text{maximum score} - \text{pretest}}$$

The results obtained are then converted to the criteria in Table 2.

Table 2. Criteria N-Gain score

<g> score	Criteria
<g> 0.7	High
0.7 > <g> 0.3	Medium
<g> 0.3	Low

[19]

Critical thinking skills have increased if 61% of students have achieved *an N-Gain score* in the medium or high criteria.

Students are said to be complete in learning if the *posttest* score reaches the minimum completeness criteri ≥78. The percentage of classical completeness can be calculated using the formula:

$$\%\text{classical} = \frac{\Sigma\text{complate respondent}}{\Sigma\text{respondent}} \text{x}100\%$$

Learning is effective and classically complete if 75% of students score ≥78. Students' responses to education are carried out by providing questionnaire questions analyzed using the Guttman scale. Each category was analyzed with the following formula:

$$\%response = \frac{\Sigma \text{respondent answered}}{\Sigma \text{respondent}} \text{x}100\%$$

Student responses get positive results on the learning model used if the percentage obtained is 61%.

RESULTS AND DISCUSSION

Research data on critical thinking skills were obtained from the test results. Before being used, the learning tools and research instruments were reviewed and validated by two expert lecturers. The aim is to test the feasibility of the learning model that will be applied. Validation results are in Table 3.

Table 3. Validation Results

No.	Aspect	Kriteria
1.	Syllabus	97.5% (very valid)
2.	Lesson plan	94.6% (very valid)
3.	Student worksheet	94.6% (very valid)
4.	Grid *Pretest* & *Posttest*	96.9% (very valid)
5.	Observations of the Learning Model	97.9% (very valid)

Implementation of The Learning Model

Observations on the implementation of the learning model were carried out by two observers using the implementation observation sheet for two meetings. This observation aims to know the implementation of the syntax of the applied learning model. Implementation, in this case, is the quality of teachers when using the learning model is good or not. It can be seen from the lesson plan validation assessment where the lesson plan has met the guided inquiry syntax with a validation result of 94.6% (very valid).

Based on the results of the analysis that has been carried out, it shows that the activities of teachers and students were carried out well. The percentage of implementation of the learning process at the first and second meetings is shown in Figure 1.

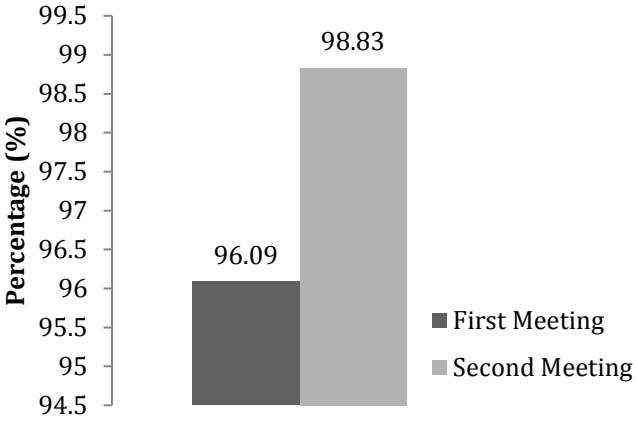

Figure 1. Implementation of The Learning Model

From the pictures above, the average implementation of the guided inquiry model has increased. At the first meeting, the average implementation was 96.09% and raised at the second meeting with 98.83%. Details of the implementation of learning in each activity and phase are shown in Figure 2.

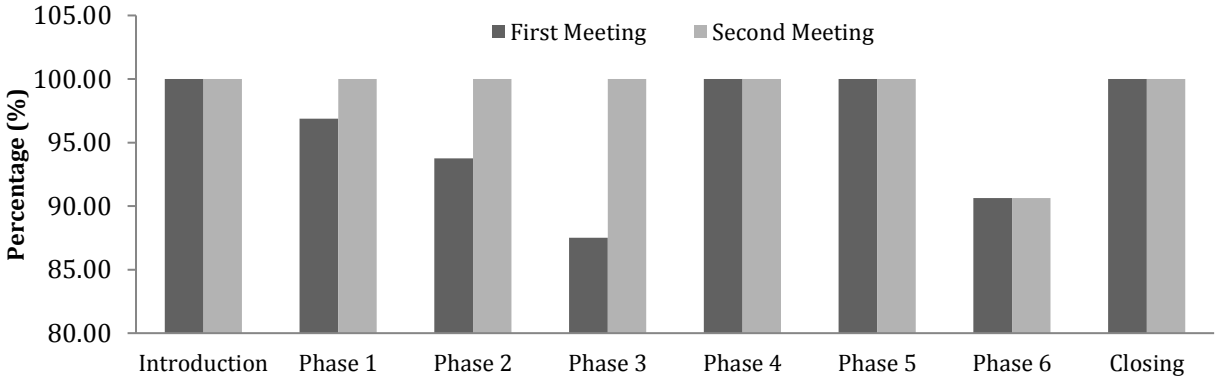

Figure 2. Graph of Implementation of Each Activity and Phase

The percentage of implementation of the learning in each activity and phase in meetings 1 and 2 is more than 61%. These results indicate that the learning model applied is very well implemented. Phase 1 focuses students' attention and explains the process of inquiry [20]. The teacher begins learning by apperception and motivating students regarding the material to be studied and conveying the learning objectives that students must achieve.

Phase 2 presents the inquiry problem [20]. Students are divided into several groups in this phase and then given the student worksheet for the reaction rate factor. The teacher guides students to formulate problems according to the phenomena presented and accommodates all student opinions to develop the right issue. This phase trains one component of critical thinking, namely interpretation.

Phase 3 is helping students formulate hypotheses to explain the problem [20]. After developing the problem, the teacher guides students to determine the appropriate hypothesis and variables from the phenomena contained in the worksheet. Formulating hypotheses is included in critical thinking components is interpretation and inference.

Phase 4 is encouraging students to test hypotheses [20]. The activity in this phase is that students observe practicum videos related to the reaction rate factor through the Google Meet screen.

The teacher-guided students to write down the observational data on the experimental video into the observation table and graph provided on the worksheet. According to Ningsih, guided experiments can significantly improve students' ability to understand arguments and problems in the class [20]. Students also conduct discussions to analyze the data to find answers to the analytical questions contained in the student worksheet based on literature and other sources. The component of critical thinking skills that emerges in this phase is analysis.

Phase 5 is formulating an explanation [20]. Students with teacher guidance make conclusions based on experimental videos that have been seen. The critical thinking component that emerges is inference.

Phase 6 reflects on the problem situation and thought process [19]. In this phase, students convey the benefits obtained and the difficulties encountered during the learning process [20]. Each discussion group can accept or reject the work of other groups and provide alternative solutions for them to get the right results [21]. Furthermore, the concepts that have been formed in students are applied to phenomena that exist in everyday life. Students intend to link ideas with images in daily life [22].

Based on a well-executed learning syntax, students' skills in critical thinking can be improved [23]. Following the results of Berlian's research, implementing the Guided Inquiry learning model is in the very good category because students make concept discovery independently by maximizing all their thinking activities to improve their skills in critical thinking [24].

Students Activities

Observation of student activities aims to know all student activities during the learning process. This observation was carried out by two observers every 3 minutes. Students' actions during two meetings have increased, and they are trained to think critically, evidenced by the relevance of student activities when learning activities occur at the first and second meetings in the very good category with 97.9% and 98.7%. Following previous research conducted by Ayu that student activities are very good because the relevance of activities is higher than the irrelevant of actions [25].

Students' Critical Thinking

Critical thinking is an active process of thinking about everything for themselves, raising questions and obtaining information for themselves, and tending to consider and think about a problem that arises from their own experience [26]. In this study, only four indicators of critical thinking skills were tested using critical thinking pretest and posttest question sheets. Before implementing the guided inquiry model, students were given a pretest sheet about the reaction rate factor material. The pretest results obtained that the average score is 22.50 with a percentage of completeness of 0% or, in other words, all students stated that none of them reached the school minimum completeness criteria, which was 78.

After being given the treatment in the learning model, students were given a posttest sheet. The average posttest score was 89.00 with a completeness of 87.10%, or 27 students completed. From these data, students in class XI-MIPA 6 have finished classically. Students who complete show that they have achieved a value above the minimum completeness criteria with the results of the posttest answers meeting all the assessment indicators.

An increase in the interpretation component can be seen in phase 1 of syntax learning by making a problem formulation based on the phenomena given to the student worksheet, determining experimental variables in phase 2, and creating tables of observations and graphs in phase 4. Based on the posttest scores, the percentage of students who completed by 90.32%.

The inference component can be improved by applying phase 2 by making hypotheses and conclusions based on the experiment results in phase 4. Based on the posttest scores, it was obtained that 87.10% of students completed.

From the application of phase 4, the analysis component can be improved by answering the experimental results. Based on the posttest scores, the number of students who completed the test was 67.74%.

The explanatory component can be improved by applying phase 4 by answering questions about the application of reaction rate factors using collision theory in everyday life. Based on the posttest scores, the number of students who completed this component was 77.42%.

Based on the pre and post-scores obtained, the increase in critical thinking skills can be calculated using the N-gain score. Students' skills in critical thinking are said to increase if the N-gain score increases in the moderate or high category. The average N-gain score of students for each component is shown in Figure 3.

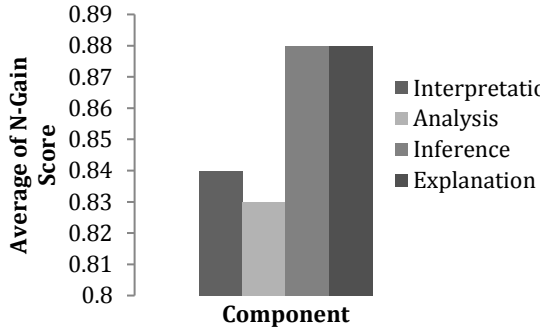

Figure 3. Average N-Gain Score in Each Component

Based on the graph in Figure 3, it can be interpreted that each indicator has an N gain value of 0.7 or has increased in the high category. Applying the guided inquiry model to the reaction rate material can improve students' critical thinking skills [27].

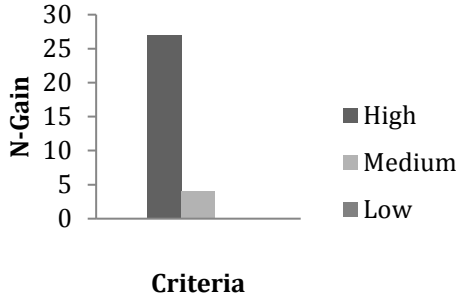

Figure 4. N-Gain Score of Critical Thinking Skills

Figure 4 is the calculation of the pretest and posttest scores for critical thinking, where 87,10% of students or 27 students are in the high category; 12.90% of students or four students are in the medium. There are no students in the low category. These results indicate that the learning model used effectively improves skills in critical thinking, which is supported by research by Agustina, which states that the KBK of students increases with the N-Gain score. The posttest results show the percentage is 66.67% in the medium category and 33,33% in the high category [28].

Student Responses

Student responses are obtained through a questionnaire that has been filled out by students online. This student response questionnaire contains questions in the learning model used to understand the material provided. Student responses are positive if they get a percentage of 61%. From the results of the questionnaire analysis, the average rate was 90.37%. It can be said that students positively respond to the learning model used. Previous research showed that students gave a positive response to the learning model that had been applied with an average gain in the very good category [29]. The guided inquiry application in improving critical thinking received a positive response with very good criteria, evidenced by an average percentage of 99% [30].

CONCLUSION

Based on the research, it can be concluded that the guided inquiry model can improve the critical thinking skills of class XI MIPA 6 in SMAN 1 Gedangan Sidoarjo. Learning was supported by the syntax application of the guided inquiry model. Students' activities during the teaching and student response are very good criteria. The student's critical thinking has increased with N-gain value in the high category.

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