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IMPLEMENTATION OF GUIDED INQUIRY LEARNING MODEL TO TRAIN STUDENTS CRITICAL THINKING SKILLS ON REACTION RATE TOPIC

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Abstract: This research describes students' critical thinking skills by implementing guided inquiry learning models in matter reaction rate, including the syntax implementation of guided inquiry learning models, student activities, critical thinking skills, and cognitive learning outcomes. Students in class XI-IPA 4 SMA Kemala Bhayangkari 1 Surabaya were the study's subjects. This study uses a pre-experimental design with a One-Group Pretest Posttest Design. The data obtained were analyzed using quantitative analysis methods. It can be concluded that (1) 2 meetings showed an average percentage of 88.84% and 94.64%, which is included in the very good criteria. (2) Relevant students' activities that appear in the learning process in meetings 1 and 2 respectively 86.67%, 93.33%, and irrelevant activities that appear in the learning process in meetings 1 and 2 respectively 13.33% and 6.67%. (3) The average value of N-gain on the interpretation indicator of 0.80 (high), analysis of 0.81 (high), inference of 0.72 (high), and explanation of 0.86 (high) indicates that students' critical thinking skills have improved. (4) Students' cognitive learning outcomes show that 27 of 32 students completed or 84.37%, and five students did not complete or 15.63%.

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

INTRODUCTION

Chemistry is a branch of natural science that is very important in everyday life [1]. In chemistry, it explains facts, concepts, principles, and discoveries through a search process with actual action or an experiment by applying the scientific method [2]. In essence, most of the knowledge in chemistry is obtained from research in the laboratory. Many chemical concepts are abstract in learning chemistry, so it is difficult to understand.

It can be proven based on the results of a pre-research questionnaire on October 4, 2021, on 31 class XII students at SMA Kemala Bhayangkari 1 Surabaya, stating that chemistry is a subject that is difficult to understand as much as 80.64%. Reaction rate material is a material that is considered quite tricky, with a percentage of 58%. 42% stated that the material for the reaction rate was a lot of rote, and 39% the material was not accompanied by practicum. in learning, no real media supported it. According to interviews with chemistry teachers at SMA Kemala Bhayangkari 1 Surabaya on the reaction rate material, some students find it difficult because of the many abstract concepts and the methods used are less effective online learning on this material there are no practical activities. Students have not understood the material and have not been trained in thinking skills to solve problems directly in practicum. According to relevant research, students learn only by listening and memorizing to forget the quickly taught material [3]. But it is also due to internal factors from students who are not hard enough in mastering concepts in learning [4]. The purpose of learning chemistry on the reaction rate material has not been achieved optimally.

Various other surveys show that understanding the reaction rate material is also relatively low. It was supported by research conducted by Hake, which shows that most students have difficulty understanding the reaction rate material with a percentage of 63.89% [5]. Then it is also strengthened where 72.5% of students consider the reaction rate the most challenging material in chemistry learning, by Hariyanti and Ismono [6]. Difficulty in material reaction rate because the material is abstract, as stated by Kirik and Yezdan [7].

One of the essential competencies in the reaction rate material is to explain the factors that affect the reaction rate using collision theory. Based on the analysis of these crucial competencies, it can be seen that in the reaction rate material, students are required to understand theoretical concepts, design, carry out, and conclude as well as present experimental results on factors that affect reaction rates and reaction orders. The skills that are trained are components of critical thinking skills.

Critical thinking is a higher-order thinking skill [8]. Critical thinking is a skill that aims to understand problems in-depth, be open to the opinions of others and understand the information received before making decisions both in the learning process and the daily environment [9]. According to Facione, critical thinking skills have several skills, including interpretation, inference, analysis, explanation, evaluation, and self-regulation [10]. Based on the results of the pre-

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research conducted at SMA Kemala Bhayangkari 1 Surabaya class XII IPA 6 on October 4, 2021, from 31 students, it was found that students' critical thinking skills were still relatively low. For interpretation, critical thinking skills had not been completed with an average of 37, 5 out of a scale of 100, analysis 29, inference 50.8, and explanation 50. Based on the results of the pre-research critical thinking skills at SMA Kemala Bhayangkari 1 Surabaya have not yet reached completeness. To solve problems like the above, of course, requires critical thinking, interpretation, analysis, inference, and explanation contained in critical thinking skills. Students lack critical thinking skills because only material is given without daily life [11]. Therefore we need an appropriate learning model because using the wrong learning model in the learning process can lead to boredom and impact students' understanding [12]. One of the learning models following the reaction rate's material characteristics can involve students being active and directly involved and practicing critical thinking skills, namely the guided inquiry learning model.

The guided inquiry learning model consists of 6 syntaxes. Namely, focusing students' attention and explaining an inquiry process, presenting an inquiry problem or phenomenon, encouraging students to formulate hypotheses to explain problems or phenomena, collecting data to test hypotheses, formulating explanations and conclusions, and reflecting on problem situations thought processes [13]. According to relevant research on the same topic, research shows that the inquiry learning model is maximally applied [14].

The guided inquiry learning model is applied to build their knowledge to think critically and participate actively in learning. Students are not simply released in their application but still receive teacher guidance [15]. It is necessary to apply guided inquiry learning to train students' critical thinking skills.

RESEARCH METHODS

This study uses a pre-experimental type of research. The research was carried out in class XI IPA 4 SMA Kemala Bhayangkari 1 Surabaya in the odd semester of 2020/2021, totaling 32 students. The research design used is *One group pretest-posttest design* to measure critical thinking skills.

$$O_1 - X - O_2$$

Description :
O_1 : pretest value before being given treatment
X : Treatment by applying the guided inquiry learning model to improve critical thinking skills
O_2 : posttest scores after the guided inquiry learning model was applied

[16]

According to the Guided Inquiry syntax, observations were observed with the implementation observation sheet. The results of the observation data will be analyzed according to the rubric of the observation sheet used.

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

The percentage of scoring results from each observed using the following formula:

$$\% \text{ average} = \frac{\% \ implementation}{number\ of\ observer}$$

The data obtained is then converted into scores in table 1 below.

Table 1. Implementation Criteria

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

[17]

Based on the implementation criteria in table 1, it can be implemented if the average percentage of learning implementation obtained is 61% [17].
Then the analysis of the results of student activities is seen based on activity data from students who appear every 2 minutes in the learning process using activity sheets from students, which are calculated by the formula:

$$\%\text{Student activity} = \frac{\sum frequency\ of\ activity\ that\ appear}{s\sum frequency\ of\ all\ activity} \times 100\%$$

Students' activities can be well implemented and supportive in practicing critical thinking skills if the percentage of relevant activities is greater than those not pertinent [18].

Data analysis of critical thinking skills is seen based on the values before (pretest) and after (posttest) according to the assessment rubric that has been provided. The Critical Thinking Skills rubric of the students assessed includes the skills of interpretation, analysis, inference, and explanation skills. The test was given is in the form of an essay test.

Critical thinking skills were analyzed by calculating the value of N-gain score to find out how big the difference between pretest and posttest scores is.

$$\text{N-gain score} = \frac{posttest\ score - pretest\ score}{maximum\ score - pretest\ score}$$

[19]

The score obtained was converted into categories, such as in Table 2.

Table 2. Gain Score Criteria

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

[19]

Cognitive learning outcomes illustrated the level of mastery of students towards the learning objectives. Learning outcomes of student's knowledge was obtained at pretest and posttest. Analysis of cognitive student's learning outcomes was done by analyzing the pretest and posttest on sub matter factors that affect reaction rate. Cognitive learning outcomes were obtained using the formula: Cognitive Learning Outcomes = $\frac{\sum right\ answer}{\sum all\ question}$ x 100

RESULTS AND DISCUSSION

Implementation of the Guided Inquiry Learning Model

The implementation of the guided inquiry learning model on the material factors that affect the reaction rate was observed by three observers using the learning model implementation sheet. This observation aims to describe the implementation of the syntax of the guided inquiry learning model.

The results of the guided inquiry learning model implementation at the 1st and 2nd meetings are shown in Figure 1 regarding the percentage of observations on the application of the guided inquiry learning model.

Figure 1 implements the inquiry learning model percentage at two meetings consisting of 6 phases. The following is a discussion of each stage.

Phase 1 is to focus students' attention and explain the inquiry process [13]. At the first meeting, the percentage was 87.04%, and the second meeting was 92.59%, with each getting very good criteria. The activity carried out in phase 1 is that the teacher starts learning by appreciating the students by linking the material with the students' prior knowledge about collision theory with the previous material. The teacher motivates students and conveys the objectives of learning.

Phase 2 presents the problem of inquiry [13]. Meetings 1 and 2 were carried out with very good criteria with percentages of 87.50% and 89.58%, respectively. In this phase, the teacher distributes student worksheets to students. The teacher also asks students to read and understand the phenomena presented in the student worksheet.

Phase 3 helps students formulate hypotheses to explain problems or phenomena [13]. The first and second meetings were carried out with a percentage of 94.44% and 100% with very good criteria. The teacher guides students in formulating problem formulations following the phenomena in the student worksheet, preparing problems including critical thinking skills of interpretation [10]. Then, students develop appropriate hypotheses, including inference critical thinking skills [10]. Then the teacher guides the students to determine experimental variables based on the phenomena in the student worksheet, defining the variables included in interpretation critical thinking skills [10].

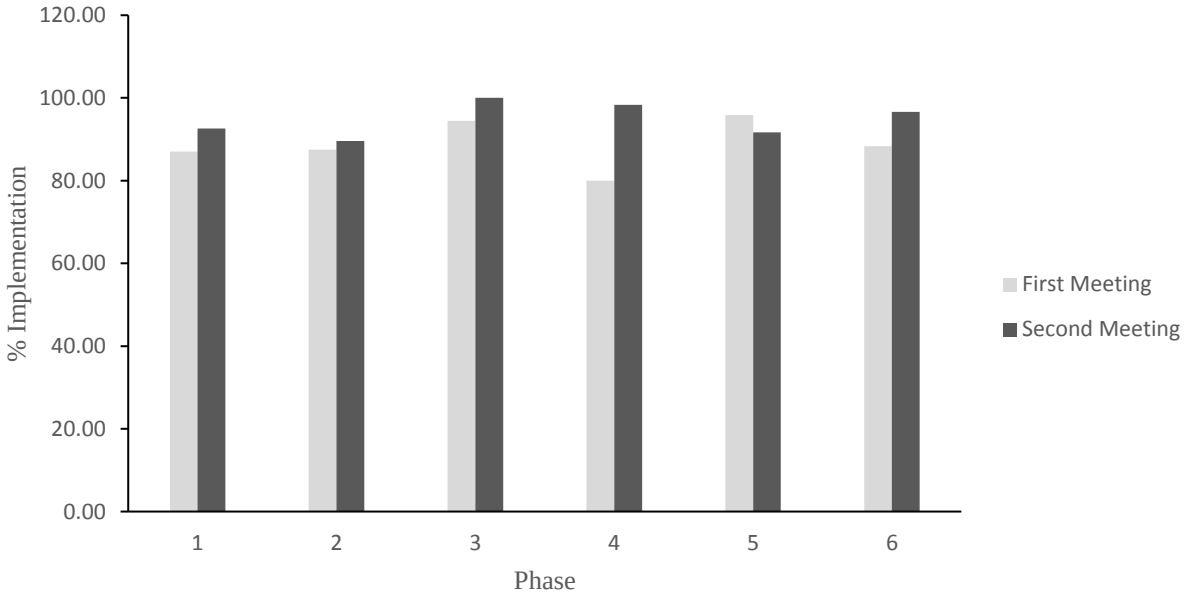

Figure 1. Percentage of Implementation of Guided Inquiry

Phase 4 encourages students to collect data to test hypotheses [13]. Meetings 1 and 2 were carried out with a percentage of 80% and 98% with very good criteria. In this phase, the teacher previously asked students to read and study work procedures in solving problems in the student worksheet. Students were asked to experiment at home using tools and materials that are easy to find in their respective lives by documenting the results in videos. And students collect and organize the data that has been obtained. Then the teacher also guides students to analyze experimental data, which is included in analytical, critical thinking skills [10].

Phase 5 formulates explanations and conclusions [13]. At meetings 1 and 2, it was carried out with 95.83% and 91.67% with very good criteria. The activity in this phase is to make conclusions based on the experiments that have been carried out. Then the teacher asks the group representatives to present the analysis and findings, showing the results, including the critical thinking skills of explanation [10].

Phase 6 reflects the problem situation and thought process [13]. At meetings 1 and 2, it was carried out with a percentage of 88.33% and 96.67% with very good criteria. In this phase, the teacher provides a re-discussion of the learning that has been carried out.

Based on the results of data analysis on the implementation of the guided inquiry learning model to train students' critical thinking skills, the teacher can carry out learning activities according to the guided inquiry learning model phase. Critical thinking skills can also be trained with the guided inquiry learning model. The guided inquiry learning syntax implementation for two meetings has been carried out very well based on the descriptions above.

Student Activities

Observation of student activities aims to see all student activities in the learning process using the guided inquiry learning model. Three observers carried out this observation, observing 3-4 groups. In the class, there were ten groups. Student activities are monitored every 2 minutes during learning activities. The following is picture 2 of the activities of students during two meetings.

Based on Figure 2, in general, it can be seen that student activities are more dominant in positive activities or relevant activities compared to irrelevant activities.

Activity 1 students pay attention to the teacher's explanation at the first and second meetings by 16.67% and 15.67%, respectively. The activity of paying attention to the teacher's description is in phase 1 of the syntax of the guided inquiry learning model. At the beginning of the lesson, students pay attention to the teacher's explanation of the initial concept of the factors that affect reaction rate. Students ask the teacher with the results of the first and second meetings of 2.34% and 3%. Activity 2, following phase 4, the syntax of the guided inquiry learning model is to encourage students to collect data to test hypotheses. Students are asked to conduct experiments to prove the hypothesis made in this phase. Previously, students were asked to read work procedures. If students do not understand the procedure, they can ask the teacher.

Activity 3 argues in class with the percentage of the first and second meetings of 4.67%. Activity 3 follows phase 1 of the syntax of the guided inquiry learning model. At this stage, the teacher gives apperception and motivates students. Activity 4 forms groups with the first and second meetings, respectively 3.34% and 3.67%. Activity 4 follows phase 2 of the syntax of the guided inquiry learning model that presents inquiry problems.

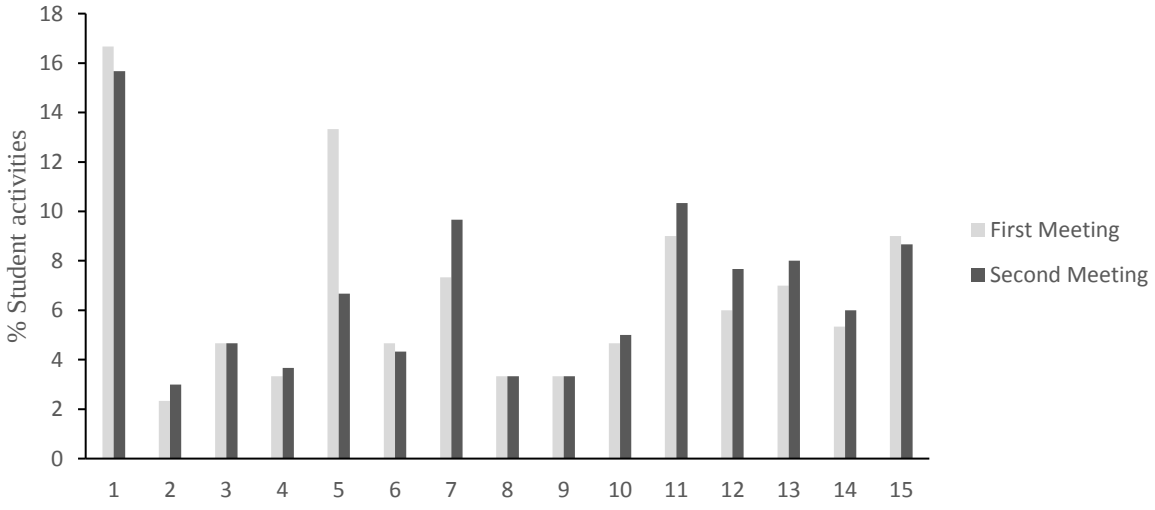

Figure 2. Student activities

Activity 5 is doing irrelevant activities (such as disturbing other friends, making noise in class, playing *on cellphones*, etc.) with the percentages of the first and second meetings of 13.34% and 6.67%, respectively. Activity 5 follows phase 4 of the syntax of the guided inquiry learning model. When conducting experiments and conveying experimental results, these irrelevant activities will appear. Several students carry out activities other than discussing and analyzing the experiment results in one group.

Activity 6 reads phenomena in student worksheets with the percentages of the first and second meetings of 4.67% and 4.34%, respectively. Activity 7 conducted group discussions with the percentages of the first and second meetings of 7.34% and 9.67%, respectively. The teacher guides students in formulating hypotheses following the formulation of the problem made.

Activity 8 formulates the problem with the percentage of both meetings of 3.34%. Critical thinking skills that are trained on students in activity 8 are interpretation. Activity 9 formulates a hypothesis with the percentage of the first and second meetings of 3.34%. Activity 9 follows phase 3 of the syntax of the guided inquiry learning model to help students formulate hypotheses to explain the problem. Critical thinking skills that are trained on students in activity 9 are inference.

Activity 10 identifies experimental variables with the percentages of the first and second meetings of 4.67% and 5%. Activity 10 follows phase 3 of the syntax of the guided inquiry learning model to help students formulate hypotheses to explain the problem. Critical thinking skills that are trained on students in activity 10 are interpretation. Activity 11 experimented with the percentages of the first and second meetings of 9% and 10.34%. Activity 11 follows phase 4 of the syntax of the guided inquiry learning model, which encourages students to collect data to test hypotheses.

Activity 12 recorded experimental results with the percentages of the first and second meetings of 6% and 7.67%. Activity 12 follows phase 4 of the syntax of the guided inquiry learning model, which encourages students to collect data to test hypotheses. The experimental results of students are entered into the observation table that is already available in the student worksheets.

Activity 13 analyzed the experimental data with the percentage of the first and second meetings of 7% and 8%. Activity 13 follows phase 4 of the syntax of the guided inquiry learning model, which encourages students to collect data to test hypotheses. Critical thinking skills that are trained in activity 13 are analysis. Activity 14 concludes the experimental data with the percentages of the first and second meetings of 5.34% and 6%, respectively. Activity 14 corresponds to phase 5 in the syntax of the guided inquiry learning model, namely formulating explanations and conclusions. Critical thinking skills that are trained on students in activity 14 are inference.

Activity 15 conveys the discussion results with the percentages of the first and second meetings of 9% and 8.67%. Activity 15 follows phase 6 of the syntax of the guided inquiry learning model, which reflects on problem situations and thought processes. Critical thinking skills that are trained on students are explanations. The teacher here acts as a facilitator whose only duty is to guide students in presenting their experiments' results and correcting students' answers.

Learning Outcomes Test for Students' Critical Thinking Skills

Critical thinking skills are measured using a test that refers to the critical thinking component. Critical thinking skills test in the form of pretest questions which were carried out before learning without the application of the model and posttest was carried out after being given the application of the guided inquiry learning model. The questions used are in the form of description questions, where the pretest and posttest questions have included four critical thinking components: interpretation, analysis, inference, and explanation [10].

Interpretation is an activity to formulate questions from a problem that aims to explain the meaning of the problem. Interpretation skills are carried out by students, namely preparing problems, determining variables, and making tables of observations. In interpreting skills in formulating problems and determining hypotheses, students have initial knowledge to solve these problems. This rubric for assessing interpretation skills uses a score of 1-4 with specific criteria. Most students did not get the maximum score when working on this interpretation. The students did not write down the formulation of the problem following the existing phenomenon and only contained one variable. The score was obtained was not optimal. The interpretation indicator at the first meeting was 87, and at the second meeting, it was 92.

The analysis is a skill in testing ideas, analyzing and identifying an argument. The analytical abilities trained are analyzing experimental data by answering the questions contained in the student worksheets. However, only a tiny percentage of students get the maximum score. Students are less thorough and do not complete the answers to questions. The analysis indicator at the first meeting was 87, and the second meeting was 95.

The inference is students' skill in questioning facts, estimating solutions, and concluding. Inference skills that are trained are making tentative assumptions (hypotheses) and making conclusions. When working on this inference, some students had answered with the maximum score, but there were

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still some who were less thorough. Students are expected to identify the relationship from information to a conclusion so that it can be used to find the concept of a problem. The inference indicator at the first meeting was 87 and at the second meeting was 94.

The explanation is the ability to explain the results of thoughts based on evidence or facts that have been obtained. The explanatory skills that are trained present the results of the analysis and conclusions made based on student worksheets. The explanation indicator at the first meeting was 87, and the second meeting was 90.

The improvement of critical thinking skills can also be seen from the average N-gain value. The following table 3. In the form of assessment, the average pretest and posttest and the value of N-gain on each indicator of critical thinking skills.

Table 3. The result of the Pretest-Posttest and N-gain Score of Critical Thinking Skills

CTS Component	Pretest	Postest	N-gain
Interpretation	33.98	87.89	0.80
Analysis	25.78	85.94	0.81
Inference	38.28	86.33	0.72
Explanation	19.53	89.06	0.86

Description :
CTS = Critical Thinking Skill

Based on the table above, each indicator of critical thinking skills has increased. The data was obtained from the average value of each critical thinking indicator in 32 students. The increase in each indicator of critical thinking skills can also be seen from the N-gain score, which has a value of more than 0.7 with high criteria. It is in line with previous research, which showed an increase in critical thinking skills with the success obtained from the N-gain value in the high category [20].

Knowledge Area Learning Outcomes Test

The test of knowledge learning outcomes was measured using pretest and posttest sheets in the form of multiple-choice questions with ten queries. This test was carried out two times, namely before and after learning. The value obtained from the pretest is used to determine the students' initial abilities before the research is carried out. The posttest results are used to assess the understanding of students' concepts after the analysis is carried out. The value of learning outcomes in personal knowledge is said to be complete if students get a value equivalent to the minimum criteria of mastery learning. at SMA Kemala Bhayangkari 1 Surabaya, namely $\geq$ 78.

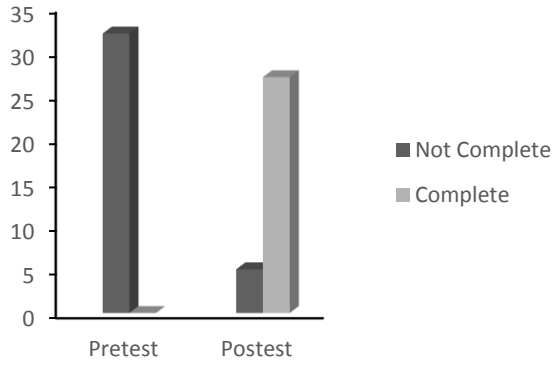

Figure 3. Pretest and Posttest Learning Outcomes in the Knowledge Area of Learners

Based on figure 3, it is known that the average pretest score for student learning outcomes is 28.75, with a completeness percentage of 0%. In other words, all students with pretest results are declared to be incomplete, which means that all students' scores are in the minimum criteria of mastery learning. After being given the application of the guided inquiry learning model, the average posttest score was 82.50, with data from 27 of 32 students achieving completeness of 84.37% and five other students incomplete by 15.63%. The data obtained shows that the guided inquiry learning model has succeeded in increasing, which is indicated by the completeness with a percentage of 84.37%. Students with other research show that applying Guided Inquiry learning can improve results [21].

CONCLUSION

Based on the discussion, it can be concluded that applying the guided inquiry learning model can train critical thinking skills. Implementing the syntax of the guided inquiry learning model goes well with very good criteria. Student activities are carried out very well because relevant activities are higher than irrelevant activities. Critical thinking skills were carried out well in the high category on the N-gain score, and the test of learning outcomes in the realm of knowledge was carried out well.

REFERENCE

[1] Rusmansyah, Yuanita, L., Ibrahim, M., Isnawati, & Prahani, B. K. (2019). Innovative Chemistry Learning Model: Improving The Critical Thinking Skill and Self-Efficacy of Pre-service Chemistry Teachers. *Journal of Technology and Science Education*.

[2] Pratono, A., Sumarti, S. S., & Wijayati, N. (2018). Contribution of Assisted Inquiry Model of E-Module to Students Science Process Skill. *Journal of Innovative Science Education*.

[3] T., N. I. (2019). The Effectiveness of Inquiry Learning Method to Enhance Student's

Learning Outcome. *International Journal of Chemistry Education*, 1-5.

[4] Omek, F., William, R. R., & Mark, P. H. (2008). What Makes Physics Difficult. *International Journal of Environmental & Science Education*, 30-34.

[5] Hariyanti, A., & Ismono. (2018). Penerapan Model Pembelajaran Inkuiri Terbimbing Untuk Melatihkan Keterampilan Proses Sains Siswa pada Sub Materi Faktor-Faktor yang Mempengaruhi Laju Reaksi. *Unesa Journal of Chemical Education*.

[6] Kota, M. F., & Muchlis. (2019). Penerapan Model Pembelajaran Inkuiri Terbimbing Pada Materi Laju Reaksi Untuk Melatihkan Kemampuan Analisis Peserta Didik Kelas XI SMA Negeri 1 Kamal Bangkalan. *Unesa Journal of Chemical Education*.

[7] Yezdan, K. a. (2012). Cooperative Learning Instruction for Conceptual Change in the Concepts of Chemical Kinetics. *R. Soc. Chem.*, 2012.

[8] Maryam, Kusmiyati, Merta, I. W., & Artayasa, I. P. (2019). Pengaruh Model Pembelajaran Inkuiri terhadap Keterampilan Berpikir Kritis Siswa Kelas XI MIA MAN 2 Mataram. *J. Pijar MIPA, Vol. 14 No. 3*, 154-161.

[9] Jamaluddin, Jufri, A. W., Muhlis, & Bahtiar, I. (2020). Pengembangan Instrumen Keterampilan Berpikir Kritis pada Pembelajaran IPA. *Jurnal Pijar MIPA, 15*(1), 14.

[10] Facione, P. A. (2015). *Critical Thinking : What It Is and Why It Counts.* California: The California Academic Press.

[11] Isindanah, N. S., & Azizah, U. (2016). Penerapan Model Pembelajaran Inkuiri Terbimbing untuk Melatih Keterampilan Berpikir Kritis pada Materi Pokok Larutan Penyangga di Kelas XI SMA Antartika Sidoarjo. *Prosiding Seminar Nasional Kimia dan Pembelajarannya.*

[12] V., A. (2016). The Effectiveness of Inquiry Learning Method to Enhance Student's Learning Outcome. *J. Educ. Prac.*, 38-42.

[13] Arends, R. I. (2012). *Learning To Teach.* Yogyakarta: Pustaka Pelajar.

[14] Ramadhanti, A., & Agustini, R. (2021). Analisis Keterampilan Berpikir Kritis Peserta Didik Melalui Model Inkuiri Terbimbing Pada Materi Laju Reaksi. *Jurnal Kependidikan*, 385-394.

[15] Mukmainah, S. A., & Yonata, B. (2020). Penerapan Model Pembelajaran Inkuiri Terbimbing untuk Meningkatkan Keterampilan Berpikir Kritis Peserta Didik pada Materi Laju Reaksi di SMAN 1 Rengel. *UNESA Journal of Chemistry Education*, 133-139.

[16] Sugiyono. (2013). *Metode Penelitian Kuantitatif, Kualitatif dan R&D.* Bandung: Alfabeta.CV.

[17] Riduwan. (2015). *Skala Pengukuran Variabel-Variabel Pendidikan.* Bandung: Alfabeta.

[18] Arifin. (2011). *Metode Penelitian Kualitatif, Kuantitatif, dan R&D.* Bandung: Alfabeta.

[19] Hake, R. (2002). *Analyzing Change/ Gain Score.* USA: Indiana University.

[20] Saekawati, R., & Nasrudin, H. (2021). Effectiveness of Guided Inquiry-Based on Blended Learning in Improving Critical Thinking Skills. *Jurnal Penelitian Ilmu Pendidikan*, 53-68.

[21] Almuntasheri, S., Gillies, R. M., & Wright, T. (2016). The Effectiveness of a Guided Inquiry-based, Teachers' Professional Development Programme on Saudi Students' Understanding of Density. *Journal of Science Education International*, 16-39.