GUIDED INQUIRY LEARNING MODEL APPLICATION TO TRAIN STUDENTS CRITICAL THINKING SKILLS ON CHEMICAL EQUILIBRIUM MATERIAL

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Abstract: The purpose of this study is to analyze the effect of the application of the guided inquiry learning model on activities of students, the products of student learning, students' skills in critical thinking, and student reactions to chemical equilibrium material. The design of this study applies a one-group pretest-posttest design. Thirty students of the eleventh grade at Kemala Bhayangkari 1 Surabaya Senior High School were used as the subject of this study. The percentage of application of each phase of the guided inquiry learning model are meetings 1, 2, and 3 was 96.9%, 98.6, and 100%, respectively. Student activities support the application model with a percentage of the total relevant activities of 92.69%. Student learning outcomes on factors that affect the shift in the direction of chemical equilibrium with n-gain obtained a score of 80%, which is high in the category. The results of students' skills in critical thinking in every phase with a high n-gain score are 53.33% interpretation, 40% inference, 63.33% analysis, 60% explanation, and 80 % evaluation. The student responses have a very good category with 99.15%.

INTRODUCTION

Education plays an essential role in human life. With the development of technology and information, the government hopes to improve the quality of Indonesia's education by improving the latest curriculum in 2013. Based on the 2013 curriculum, students can actively seek, manage, construct, and use knowledge [1].

Chemistry is a science that specializes in the structure and composition of matter, changes, and the energy that accompanies these changes. Chemistry learning emphasizes the process of developing skills and attitudes so that students can explore and understand the natural surroundings scientifically [2]. Based on the preliminary research conducted at Kemala Bhayangkari 1 Surabaya Senior High School reported that 72% of students find chemistry difficult. One of the most challenging materials to study is chemical equilibrium. The pre-study shows that as many as 78% or 21 out of 29 students considered chemical equilibrium as difficult material. To be able to apply the material of chemical equilibrium in the teaching process, mature concepts are needed and concepts that are understandable to teachers. Understanding concepts in learning is essential because it can influence attitudes, decisions, and problem-solving. The students were unable to overcome the challenges in the learning process with the concepts they had. On that basis, the concepts in the chemical equilibrium material must be confirmed by making observations in a video practicum experiment. Students are invited to think critically because students must find concepts based on observations.

Beyer defines critical thinking skills as making reasonable judgments [3]. Critical thinking skills consist of several skills, namely: interpretation, analysis, inference, explanation, evaluation, and self-regulation [4, 5]. Critical thinking skills possessed by students are still low. The preliminary research carried out at Kemala Bhayangkari 1 Surabaya Senior High School showed that interpretation skills were known as 44.83% from the students included in the category of poor. 37.93% have the sufficient category, and 17, 24% fall into the good category. Analytical skills as many as 89.66% of the students are included in the poor category. 3.45% are in the sufficient category, and 6.90% are in a good category. For inference skills, 44.83% of the students are included in the poor category, 41.38% are in the sufficient category, and 13.79% are in the good category. In the explanation skill, 51.72% of students are in the less category, and 48.28% are in the sufficient category. Meanwhile, in evaluation skills, 48.28% of students were included in the category of poor, 37.93% were in the sufficient category, and 13.79% were in a good category. Based on the above facts, students' overall critical thinking ability still needs to be improved.

Based on these facts, we require a learning model that improves students' skills in critical thinking so that they can better understand the materials and the concept they are taught. One of the learning models that can be used to improve students' critical thinking skills is guidance in inquiry learning with a scientific approach. Guided inquiry learning helps improve their critical thinking skills as it can empower science as critical and analytically emphasized thinking processes and processes for problem-solving processes [6]. Arends found that inquiry-based learning involves students systematically, critically, logically, and analytically searching and investigating [7]. In this learning model, students can actively engage in the teaching and learning process,

apply scientific methods, and make learning less teacher-centric.

RESEARCH METHOD

This type of pre-experimental study was conducted in only one team without a comparative team. The targets of this study were students in class XI IPA 3 at Kemala Bhayangkari 1 Surabaya Senior High School in odd semesters. The design applied in this study is a design called *one-group pretest-posttest,* which is described as:

$$O_1 \qquad X \qquad O_2$$
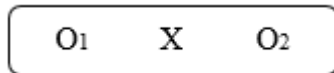
Description: O_1 = test before being treated (*pretest*)
X = treatment using the model; O_2 = test after being treated (*posttest*)

This research applies learning devices from the syllabus, paper works of the students, and learning plans. The research devices used consisted of observation papers for application of the learning model with the guided investigation, activity of students papers, exam papers for critical thinking skills, exam sheets of knowledge learning results, and questionnaires for student responses.

The methods of collecting data in this research include tests, questionnaires, and observation methods. The observation method is the execution of the inquiry learning from syntax and activities of the students during the learning process, while the test method is to measure the skills of critical thinking scores and students' learning outcomes. The questionnaire method is applied to determine responses from students to the practice of the model of guidance in inquiry learning to train their skills in critical thinking.

Application of the Learning Model

The application of the learning model is given a score based on Table 1.

Table 1. Interval Scale Score Learning

Score	Criteria
4	Executed very well
3	Well-executed
2	Executed well enough
1	Implemented poorly
0	Not implemented

Analysis of observational data application of learning models analyzed by using the formula:

$$\% \text{ application} = \frac{\sum observed\ aspect\ score}{\sum total\ aspect\ score} \times 100\%$$

Then the score obtained is converted to the criteria table 2 below:

Table 2. Interpretation Score of Learning Application

Percentage	Criteria
0% - 20%	Very poor
21% - 40%	Poor
41% - 60%	Good enough
61% - 80%	Good
81% - 100%	Very good

[8]

The percentage of learning applications is said to be good if it has reached the limit of 61%, where the application of the learning is in good and very good criteria.

Student Activities

Analysis of student activity observation data was analyzed using the following formula:

$$\% \text{Student activities:} \frac{frequency\ of\ activity\ that\ appears}{\sum total\ frequency\ of\ activity} \times 100\%$$

[9]

This research states that student activities can be good if the percentage of relevant activities reaches 61%.

Analysis of Learning Outcomes and Critical Thinking Skills

Analysis of student learning outcomes in knowledge and critical thinking skills was performed by analyzing student results before and after the test. The value obtained from the test of learning outcomes of knowledge is then analyzed using the equation:

$$\text{Value} = \frac{correct\ score\ obtained}{maximum\ score} \times 100\%$$

Student learning outcomes are complete if students obtain a minimum completeness criteria score of 78, and students are considered classically complete if 75% of students get a score of 78.

Improving students' skills in critical thinking after doing a model of learning called guided inquiry learning using N-gain analysis and t-test. In the t-test, the hypothesis and research hypothesis was determined. The research hypothesis of learning outcomes is to increase learning outcomes related to the products of a preliminary and subsequent test of students after applying a learning model.

$$\% \text{Student response} = \frac{\sum the\ number\ of\ answer\ yes}{\sum total\ of\ respondent} \times 100\%$$

The research hypothesis of skills in critical thinking after applying the guidance in inquiry learning, the improvement of critical thinking skills can be seen from students' pretest and posttest scores.

Regarding the necessary level (a) of 0.05 at the 95% level of confidence, the guidelines for decision making on the data analysis that had been conducted are:

a) If the value Sig. (2-tailed) < 0.05, then the hypothesis (H_0) is admitted, and the reserve hypothesis (H_1) is declined.

b) If the value Sig. (2-tailed) > 0.05, then the hypothesis (H_0) is declined, and the reserve hypothesis (H_1) is admitted.

For n-gain data analysis, you can use the formula. The equation to get the n-gain score is.

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

Then, the estimated N-gain obtained is adjusted according to the criteria of Table 3:

Table 3. Criteria for the N-gain Score

N-gain Score	Criteria
g < 0.3	Low
0.3 < g < 0.7	Medium
g ≥ 0.7	High

[10]

Student Response Questionnaire

Analyzing students' responses based on the results of the questionnaire were given to students. Student answer questionnaire contains responses to continuous learning through a directed inquiry form. The collected questionnaire refers to the Guttmann scale. The criteria for the Guttmann scale can be seen in Table 4.

Table 4. Criteria for the Guttman Scale

Answer	Score
Yes	1
No	0

Descriptively analyzed data from student answers by describing the percentage of each question. Then, use the following formula to calculate the student's learning response to the application of the guided inquiry learning model.

Participants' responses to the learning process are analyzed by distributing the learning model of the questionnaire and then analyzed using quantitative description methods. Student answers lead to positive results if the percentage obtained is 61%.

RESULT AND DISCUSSION
Application of the Guided Inquiry Learning Model

The application of this research activity starts with the pretest activity, then the guidance in the inquiry learning model is applied, and finally posttest activity. Inquiry is the process of obtaining information through observation or experimenter to use critical and logical thinking skills to solve problems [11]. The guided inquiry learning model emphasizes find important concepts based on suggestions formulation for more active learning knowledge [12]. The use of a guide query model helps improve students' critical thinking skills. The

application of the guided inquiry learning model plays an essential role in achieving the desired goal.

The data for performing the learning process were taken from the syntax application observation sheet, which 3 observers completed. A comparison of the application of each phase at meetings 1, 2, and 3 are presented in Figure 1.
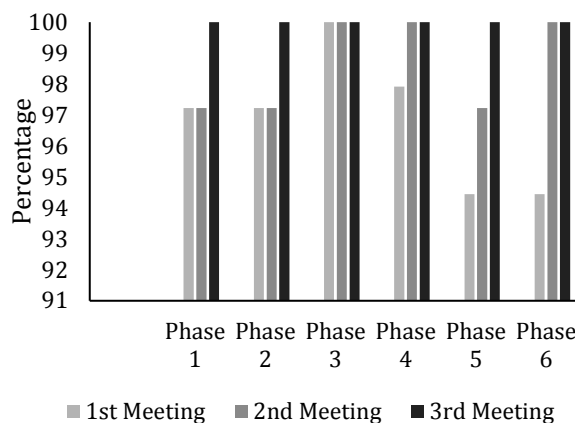

Figure 1. Percentage of Application of Each Phase of Guided Inquiry Learning Model

As seen in Figure 1, the application of each phase of the guided inquiry learning model can be described:
1. Phase 1: Focusing attention on students and explaining the inquiry process.

Guided inquiry learning model in the first meeting, the application rate of the first stage reached 97.2%, and the category was very good. At the second meeting, the percentage of very good categories was 97.2%. At the same time, the percentage of very good categories was 100% at the third meeting, which means that everything in the first phase was implemented consistently.

2. Phase 2: Present the inquiry problem or phenomenon.

In the second stage, students are provided with phenomena that help to find information about existing problems and find solutions to problems. In the first and second meetings, the application rate of the second stage of the model of guided inquiry learning was 97.2%, the category was very good, and in the third meeting, the application rate was 100%, and the category was very good. It means that all activities are carried out in Phase 2 and are carried out continuously.

3. Phase 3: Helping students formulate hypotheses to clarify the formulation of the problem or phenomenon.

In Phase 3, students make appropriate hypotheses based on the problem formulation. Phase 3 application in the guided exploration learning model at the first, second, and third meetings was

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obtained at 100% in a very good category. That is, all Phase 3 activities were performed consistently.

4. Phase 4: Promote students to collect data to test hypotheses.

In the 4th stage, students make observations to test hypotheses. The application of the fourth stage of the guided inquiry learning model achieved a 97.9% very good category in meeting 1, while in meeting 2 and meeting 3, it got a 100% very good category. It means that all activities are carried out in phase 4 and are carried out continuously.

5. Phase 5: Organizing and formulating explanations and conclusions.

In Step 5, students formulate conclusions from their observations. Implementing Phase 5 in a demand-driven learning model in the first session yielded 94.4%, with a very good category. At the second meeting in the category "very good" the percentage was 97.2%. At the third meeting, the percentage was 100% in the category very good, which means that all activities in stage 5 were completed and consistently.

6. Phase 6: Reflect on the problem situation and thought process.

The application of phase 6 in the guided inquiry learning model from the first meeting got a score of 94.4%, with a very good category. Meanwhile, at the second and third meetings, the percentage was 100% in the very good category, meaning that all activities in phase 6 were carried out and coherently.

The application rate of every phase from the inquiry learning model has reached 61%, which means that learning activities can be performed using this model called guided inquiry. The application of each phase of the guided inquiry learning model in the first, second, and third meetings based on Figure 1 is very good, with each phase implemented and a total of 96.6%, 98.6 in the first meeting. It indicates that they are classified at a 100% rate at the 2nd and 3rd meetings. There are very good standards for implementing a model of guided inquiry learning. It means that all activities in each phase of the guided exploratory learning model are on track.

Student Activities

The activities that students do during the learning activities using the directed inquiry form are the activities that are observed. Student activities during the learning process can be a parameter of the quality and success of learning. Relevant and fun learning will make students active in building concepts that can improve students skills [13].

3 observers carried out this observation. Student activities are observed every 3 minutes during learning activities. In practice, observing student activities includes several stages to practice critical thinking skills. This observation is supported by

student worksheets that have been designed to be able to train students to think critically with a guided inquiry learning model. Comparison of observations between relevant and irrelevant activities is presented in Figure 2 below:
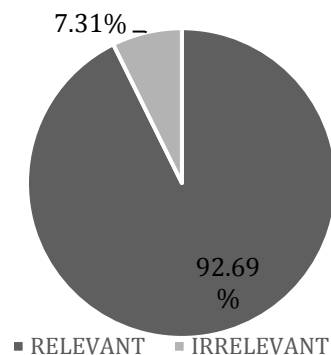

Figure 2. Percentage of Student Activity

From the observations, the percentage of relevant activities is 92.69%, while the irrelevant activities are 7.31%. All of these student activities can be carried out supported by applying the guided inquiry learning model. It means that the activities carried out by both teachers and students can run well to increase students' skills in critical thinking.

Student Learning Outcomes

Student learning products in the realm of knowledge were measured using a posttest sheet in the multiple-choice questions category with 10 questions. Student learning products are complete if the students can obtain a score of 78, namely the minimum completeness criteria value at Kemala Bhayangkari 1 Surabaya Senior High School. Students are said to have completed classically if the individual completeness percentage is 75%. Regarding the outcomes of the study, it can be seen that there was an improvement between the outcomes of the pretest and posttest. The outcomes of the calculation of the n-gain score of 80% are included in the high category. It proves that learning using the guided inquiry learning model can gain students' understanding so that the value of student learning outcomes can increase. After the guided inquiry learning model was carried out, the students' classical completeness became 100% at the posttest. The outcome from relevant research supports these results. Namely the study reveals that the learning products of knowledge are entirely complete using guided inquiry learning model [14]. Based on these results, no students did not complete the learning outcomes test because all students had understood the concept of the material given during the learning process.

Critical Thinking Skills

Critical thinking skills are the capability to think rationally and reflectively based on what students

believe or do [15]. In this case, what is meant is that students can do and find answers to their questions.

Six main critical thinking skills are involved in the critical thinking process, specifically interpretation, analysis, inference, self-regulation, evaluation, and explanation [16]. In this research, only five of the six components of critical thinking skills were taken, specifically interpretation, analysis, inference, explanation, and evaluation. Before getting learning in the form of applying a learning model in the form of a guided inquiry learning model were given a pretest sheet containing description questions about the factors that affect chemical equilibrium by containing components of critical thinking skills. Pretest has the aim of identifying the initial skills of students.

Students train their skills in critical thinking by applying the syntax of the guided inquiry learning model and using student worksheets in which there are learning activities by training of critical thinking skills components [17]. After carrying out the guided inquiry learning model for three meetings, the next step was to post a posttest. The increase in students' critical thinking skills was calculated using SPSS application with t-test and n-gain analysis. Figure 3 indicates the average pretest and posttest points for critical thinking skills obtained by the students.

Next, after performing the normality test with the t-test of the SPSS application, the pretest, and the posttest data were obtained, and the paired t-test with signifying the difference of 5% was tested. As a result, the significant difference was 0.000. The value is <0.005, so H_0 is accepted. It means that after the guided inquiry learning is applied, the student's learning outcomes will increase in posttest and pretest scores. Table 5 shows the outcomes of the t-test.

Table 5. Results of Pretest-Posttest Critical Thinking Skills with T-Test

		t	df	Sig. (2-tailed)
Pair 1	Pretest - Posttest	-22.307	29	.000

Then an analysis is carried out with an n-gain score for skills in critical thinking. Details of the n-gain scores in every component of skills in critical thinking are presented in Figure 4.

Figure 4 shows that 53.33% of students scored in the high category on the interpretation component. Answering questions on student worksheets about formulating problems based on a given phenomenon and answering questions about determining experimental variables can improve the interpretation component of the students. Then on the inference component, as much as 40% of students scored in the high category. Answering questions about making hypotheses can train the inference component of the students. 63.33% of students scored in the upper section in the analysis component. Answering questions about analyzing experimental results help improve the students' analysis component. Then on the explanation component, as much as 60% of students scored in the upper section. Making conclusions regarding the experimental results trains students to gain their explanation component. Meanwhile, 80% of students scored in the high category in the evaluation component. By answering questions related to the phenomenon of elements that can affect the chemical equilibrium in daily life, students can improve their evaluation component.
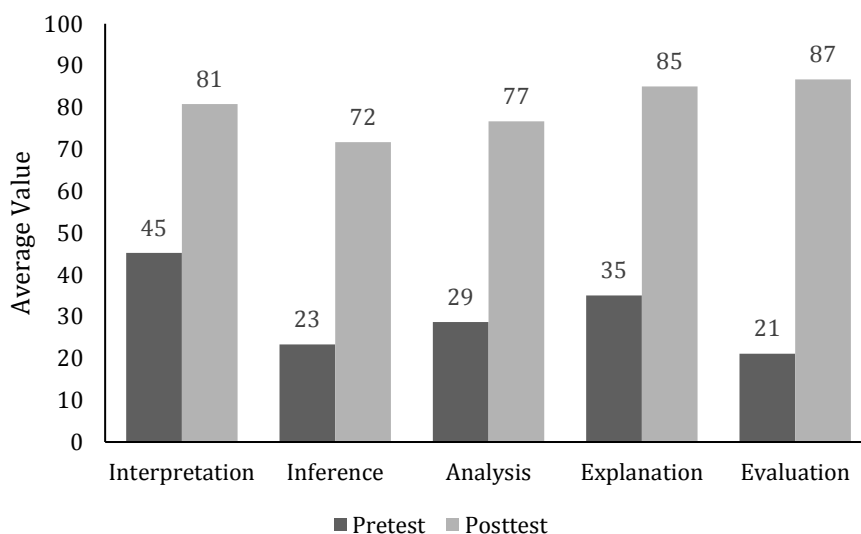

Figure 3. The outcome of the pretest-posttest critical thinking skills of each component
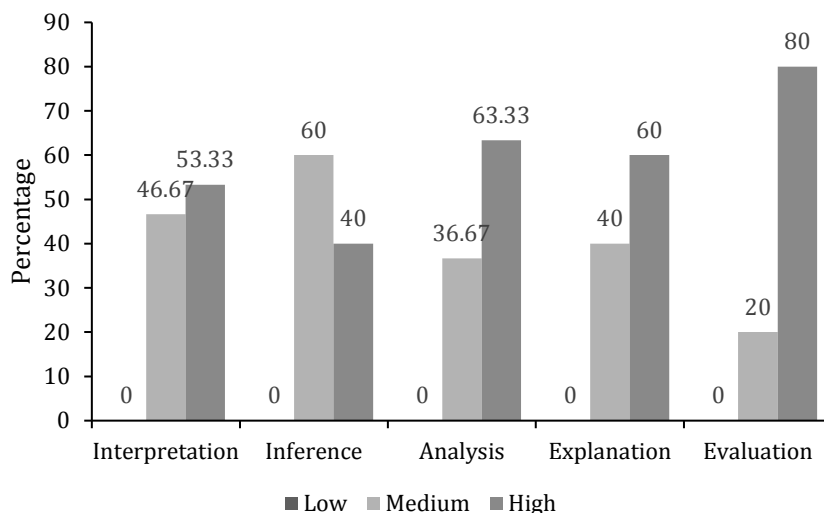
Figure 4. The n-gain score of every component of critical thinking skills

Based on an analysis of n-gain scores for five critical thinking skills components, the inference component has the lowest n-score score: 40% in the high tier and 60% in the middle tier, while the interpretation, analysis, explanation, and evaluation components have the n-win rate in the high category is higher than in the middle category. Students who are low on the inference component are due to their lack of accuracy when making hypotheses.

This research is similar to a study by Afifah and Mitarlis, which stated that students' skills in critical thinking liven up in every meeting with the posttest n-gain score indicating a percentage of 66.67% in the section of medium and 33.33% in the section of high [18]. Ramadhani and Novita's research states that the lowest average N-gain score for critical thinking skills is an analysis component of 51.42% at the time of the reaction rate material. Still, in the chemical equilibrium material research, the lowest critical thinking skill is the inference component [19].

Student Responses

Student responses are known based on response questionnaire data that students have filled out after doing the posttest. Through this student response questionnaire, the teacher can reflect on the learning that has been done. The overall student response was an average percentage of 99.15%, with a very good category from the research results. This proves that applied learning can make students more active and involved in learning chemistry to better understand [20]. Through the response questionnaire, it was found that students stated that learning with the guided inquiry model was fun and could improve critical thinking skills, and could improve material understanding of the factors that influence the shift in the direction of chemical equilibrium so that this model of guided inquiry learning proved to be of positive value to be applied. These findings are supported by research suggesting that students using a guided research model to improve critical thinking skills received a 99% positive response [21].

CONCLUSION

Guided inquiry learning models can help students to train their critical thinking skills. The application of guided inquiry learning models boost student activities and student responses. According to the research results, guided inquiry learning helps students improve learning outcomes knowledge and critical thinking skills.

REFERENCES
[1] Kemendikbud. (2013). *Permendikbud No 81 A Tentang Implementasi Kurikulum Sekolah Menengah Atas/Madrasah Aliyah*. Jakarta: Kemendikbud.
[2] Mulyasa, H. E. (2005). *Menjadi Guru Profesional*. Cetakan 3. Bandung: PT. Remaja Rosdakarya.
[3] Beyer, B. K. (1995). *Critical Thinking, Bloomington*. IN: Phi Delta Kappa Educational Foundation.
[4] Filsaime, D. K. (2008). *Menguak Rahasia Berpikir Kritis dan Kreatif*. Jakarta: PT. Prestasi Pustakaraya.
[5] Facione, P. A. (2015). *Critical Thinking: What It Is and Why It Counts*. Hermosa Beach: Measured Reasons LLC.
[6] Sanjaya, W. (2006). *Strategi pembelajaran berorientasi standar proses pendidikan*. Bandung: Kencana
[7] Arends, R. I. (2013). *Belajar untuk mengajar*. Jakarta: Salemba Humanika.
[8] Riduwan. (2016). *Skala pengukuran Variabel-Variabel Penelitian*. Bandung: Alfabeta.
[9] Arifin, Z. (2011). *Penelitian Pendidikan*. Bandung: PT. Remaja Rosda Karya.
[10] Hake, R. R. (1998). Interactive-engagement versus traditional methods: A six-thousand-student survey of mechanics test data for

introductory physics courses. *American journal of Physics*, *66*(1), 64-74.

[11] Putra, S. R. (2013). *Desain Belajar Mengajar Kreatif Berbasis Sains*. Yogyakarta: Diva Press.

[12] Aris, S. (2014). *Model Pembelajaran Inovatif dalam Kurikulum 2013*. Yogyakarta: Ar-Ruzz Media.

[13] Dijaya, A., Pitasari, R., & Kurniasih, S. (2018). Penerapan Model Pembelajaran Inkuiri Terbimbing untuk Meningkatkan Keterampilan Proses Sains Siswa pada Konseplarutan Elektrolit Dan Nonelektrolit. *JTK: Jurnal Tadris Kimiya*, *3*(2), 190198.

[14] Berliana, Y., & Yonata, B. (2019). Penerapan Model Pembelajaran Inkuiri Terbimbing untuk Melatihkan Keterampilan Proses Sains Kelas XI SMAN 1 Cerme pada Submateri Faktor-Faktor yang Mempengaruhi Pergeseran Kesetimbangan Kimia. *UNESA Journal of Chemical Education*, *8*(2).

[15] Fisher, A. (2009). *Berpikir Kritis: Sebuah Pengantar*. Jakarta: Erlangga.

[16] Joyce, B., Calhoun, E., & Hopkins, D. (2008). *Models of learning, tools for teaching*. McGraw-Hill Education (UK).

[17] Sanjaya, W. (2012). *Strategi Pembelajaran Berorientasi Standar Proses Pendidikan*. Bandung: Kencana.

[18] Afifah, N. N., & Mitarlis. (2019). Penerapan Model Pembelajaran Inkuiri Terbimbing untuk Meningkatan Keterampilan Berpikir Kritis Siswa SMA Kelas XI pada Materi Asam Basa. *UNESA Journal of Chemical Education, 8*(3), 443-449.

[19] Novita, D. (2018). Keterampilan Berpikir Kritis Siswa pada Materi Laju Reaksi di Kelas XI MIA SMA Negeri 1 Manyar. *J-PEK (Jurnal Pembelajaran Kimia)*, *3*(2), 19-30.

[20] Wati, S., Al Idrus, A., & Syukur, A. (2021). Analysis of student scientific literacy: study on learning using ethnoscience integrated science teaching materials based on guided inquiry. *Jurnal Pijar Mipa*, *16*(5), 624-630.

[21] Risma & Muchlis. (2020). Penerapan Model Pembelajaran Inkuiri Terbimbing untuk Melatihkan Keterampilan Berpikir Kritis Materi Asam Basa SMAN 3 Lamongan. *UNESA Journal of Chemical Education, 9*(2), 228-237.