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The Effectiveness of Guided Inquiry Learning Model to Improve Students' Critical Thinking Skills on Acid-Base Materials

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Abstract:The Effectiveness of Guided Inquiry Learning Model to Improve Thinking Skills Critical Students on Acid-Base Material. This research was aimed to describe the effectiveness of guided inquiry learning model in improving students' critical thinking skills on acid-base material. The population in this study were all students of class XI MIA SMA Negeri 3 Metro in the even semester of the 2019/2020 school year with a sample of class XI MIA 2 as the experimental class and XI MIA 3 as the cotrol class. This research method is a quasi-experimental with pretest postest control group design. The effectiveness of guided inquiry learning model was analyzed using the two mean difference test at n-Gain and the effect size test on students' critical thinking skills between experimental class that applied guided inquiry learning model and control class. The results showed that guided inquiry learning model had a "large" effect on improving students' critical thinking skills with effect size about 0.94.The conclusion of this research is the guided inquiry learning model is effective for improving students' critical thinking skills.

Keywords: acid-base, critical thinking, guided inquiry learning model.

Abstrak:Efektivitas Model Pembelajaran Inkuiri Terbimbing untuk Meningkatkan Keterampilan Berpikir Kritis Siswa pada Materi Asam Basa. Penelitian ini bertujuan untuk mendeskripsikan efektivitas model pembelajaran inkuiri terbimbing untuk meningkatkan keterampilan berpikir kritis siswa pada materi asam basa. Populasi dalam penelitian ini adalah seluruh siswa kelas XI MIA SMA Negeri 3 Metro semester genap tahun ajaran 2019/2020 dengan sampel kelas XI MIA 2 sebagai kelas eksperimen dan XI MIA 3 sebagai kelas kontrol. Metode penelitian ini adalah kuasi eksperimen dengan pretest postest control grup design. Efektivitas model pembelajaran inkuiri terbimbing di analisis menggunakan uji perbedaan dua rata-rata pada n-Gain dan uji effect size terhadap keterampilan berpikir kritis siswa antara kelas eksperimen yang diterapkan model pembelajaran inkuiri terbimbing dan kelas kontrol. Hasil penelitian menunjukkan bahwa model pembelajaran inkuiri terbimbing berpengaruh “besar” dalam meningkatan keterampilan berpikir kritis siswa dengan effect size sebesar 0,94.Kesimpulan dari penelitian ini yaitu model pembelajaran inkuiri terbimbing efektif untuk meningkatkan keterampilan berpikir kritis.

Kata kunci:asam basa, kemampuan berpikir kritis, model pembelajaran inkuiri terbimbing.

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▪ INTRODUCTION

Currently, the world has entered the era of the 4.0 generation industrial revolution marked by increased connectivity, interaction and development of digital, artificial intelligence and virtual systems. The more convergent boundaries between humans, machines and other resources, information and communication technology will certainly have an impact on various sectors of life. One of them is having an impact on the education system in Indonesia. The change in this era cannot be avoided by anyone, so that adequate preparation of human resources (HR) is needed to be ready to adjust and be able to compete on a global scale. Improving the quality of human resources through education from primary and secondary education to higher education is the key to being able to keep up with the development of the Industrial Revolution 4.0 (Lase, 2019).

Facing various problems and challenges in the future, students are expected to have far better competence in attitudes, skills and knowledge, be more creative, innovative, and productive (Zubaidah, 2016). In simple terms, learning in this century can be considered as learning that can produce 4C (Critical Thinking, Communiaction, Collaboration, Creativity) skills for students, where mastery of these skills can materialize quickly not only demands on teacher performance in changing teaching methods, but also the role and the responsibility of non-formal educators in familiarizing children to implement 4C in their daily lives (Prihadi, 2017).

One of the most important skills to have in the 21st century is critical thinking skills. According to Wolfolk in Uno (2009), the ability to think critically is a person's ability to use his or her thinking process to analyze existing data and then make some ideas so that they can draw conclusions and make solutions to existing problems. The ability to think critically is the ability to think rationally and reflectively based on what is believed. Rational in collecting, interpreting and evaluating information to obtain decisions. Reflective here means to actively consider all alternatives before making a decision (Puspita & Suwarma, 2017).

Norris and Ennis in Stiggins (1994), state that there are five indicators in critical thinking, namely: 1) clarifying the basis of the problem; 2) Gather basic information; 3) Make conclusions; 4) carry out further clarification; and 5) Getting the best conclusion.

Based on the results of observations and interviews with chemistry subject teachers in class XI MIA at SMAN 3 Metro, chemistry learning that already refers to the 2013 curriculum but in its implementation is still not optimal, learning in class is still centered on teachers with one-way learning methods, namely the lecture method, where the teacher is more active than the students, and the teacher is the only source of information in learning, while students do not learn to find their own knowledge, but only wait for explanation of information to understand the subject matter. Students only receive and follow instructions from the teacher without being given the opportunity to develop their thinking skills, so students are not skilled in gathering basic information. In addition, students are also less capable of making further clarification, drawing conclusions (making and assessing decisions using existing information) this is because students are rarely given the opportunity to find and solve problems, teachers rarely train students to

do experiments. The stage of presenting questions or problems includes activities to explore students' initial knowledge through demonstrations, encouraging and stimulating students to express opinions to the group. The stage of making a hypothesis includes the activity of submitting temporary answers to the problem and directed in determining hypotheses that are relevant to the problem and prioritizing which hypotheses are the priority of the investigation. The data collection stage includes the activity of designing an experiment according to the existing steps and studying the experimental instructions for conducting an experiment to obtain information including conducting experiments and obtaining information through experiments. The data analysis stage includes the activities of finding and collecting as much data as possible and analyzing the data that has been collected in order to prove the hypothesis whether it is true or not.

The concluding stage includes the activity of concluding data that has been grouped and analyzed and conclusions are drawn then matched with the original hypothesis, whether the hypothesis is accepted or not. The acid-base material was chosen because it is very close to everyday life and easy to procure practical tools and is suitable for learning with guided inquiry models. In addition, acid-base material is material that is considered difficult by students because it involves chemical reactions and calculations and involves abstract concepts so that many of them have difficulty learning it (Wang, 2014).

A similar research has been conducted by Rahmawati, Hasan & Gani (2014), the results of guided inquiry learning on acid-base material can increase student motivation and conceptual mastery of students. Another study was also conducted by Wahyu, G., Rosilawati, I. & Efkar, T. (2015), this study shows that the application of guided inquiry models on acid-base material is effective in improving students' classification and communication skills.

Based on the description above, a study was conducted with the title "The Effectiveness of Guided Inquiry Learning Model to Improve Students' Critical Thinking Skills on Acid-Base Materials".

▪ METHOD

Population and Sample

The population in this study were all class XI MIA students of SMA Negeri 3 Metro even semester of the 2019/2020 academic year which consisted of 5 classes. Samples were taken using purposive sampling technique. The sample in this study is class XI MIA 2 as an experimental class with learning using a guided inquiry model and XI MIA 3 as a control class using conventional learning.

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Research Methods and Design

Metode yang digunakan dalam penelitian ini adalah quasi eksperimen dengan *pretest-posttest design control group design* (Fraenkel, 2012).

Research variable

The independent variable in this study is the guided inquiry learning model in the experimental class and conventional learning in the control class. The dependent variable is the students' critical thinking skills. The control variable is acid-base material.

Learning Tools and Research Instruments

The learning tools in this research are syllabus, lesson plans, worksheets using guided inquiry learning models. The instrument used in this study was a pretest-posttest question consisting of four descriptive questions to measure students' critical thinking skills on chemical equilibrium material, student activity observation sheets and observation sheets of the teacher's ability to manage learning using a guided inquiry model.

Data Analysis and Hypothesis Testing

Before the learning was carried out, a pretest was held in the two research classes, then after the learning was carried out, a post-test was held. Then the n-Gain of each student is calculated with the following formula:

$$n - G \quad = \frac{\%p \quad -\%p}{1\% \quad -\%p}$$

Next, calculate the n-Gain average for the experimental class and control class. The results of the n-Gain mean calculation are then interpreted by using the criteria as in Table 1.

Table 1. Criteria-Gain

Gain-criteria	Category
n-Gain ≥ 0,7	High
0,3 ≤ *n-Gain*< 0,7	Moderate
n-Gain= 0,3	Low

(Hake, 2002)

Test of Difference of Two *n-gain* averages

Test the difference between the two averages using the para¬metric statistical test, namely by using the t-test (Sudjana, 2005) with SPSS *version* 23.0. With the test criteria: Accept H_0 if sig (2-*tailed*) <0 , 05, and reject H_x for other prices.

Percentage of Student Activity

Student activity during learning is measured using. Descriptive analysis of student activities in learning is carried out in the following steps:

a. Calculating the number of scores given by the observer for each aspect of the observation, then the percentage of achievement is calculated using the formula:

$$\% \, Ji = \left(\frac{\Sigma J}{N}\right) \text{ x } 100\%$$(Sudijono, 2004).

Information :

% Ji = The percentage of achievement of the ideal score for each aspect of the observation at the ith meeting

ΣJi= The total score for each aspect of the observation given by the observer at the i-th meeting

N = Maximum score (ideal score)

b. Calculate the average percentage of achievement for each aspect of the observations of two observers. Then interpret the data using the percentage price interpretation as in Table 2.

Table 2. Criteria for student activities

Percentage	Criteria
80,1% - 100,0%	Very high
60,1% - 80,0%	High
40,1% - 60,0%	Moderate
20,1% - 40,0%	Low
0,0% - 20,0%	Very low

(Sunyono, 2012)

Percentage of Teacher Ability Analysis in Managing Learning

Data analysis of the teacher's ability to manage learning using a guided inquiry model, carried out the following steps:

Calculating the total score given by the observer for each aspect of the observation, then calculating the percentage of achievement with the formula:

a. % $Ji = \left(\frac{\Sigma J}{N}\right)$ x 100% (Sudijono, 2004).

Information :

%Ji = Percentage of achievement for each aspect of observation at the ith meeting

ΣJi = The total score for each aspect of the observation given by the observer at the i-th meeting

N = Maximum score (ideal score)

b. Calculate the average percentage of the teacher's ability for each aspect of the observation from two observers.

c. Interpreting the data by interpreting the price of the percentage of teacher ability is as in Table 3.

Table 3. The criteria for the teacher's ability to manage learning.

Percentage	Criteria
80,1%-100%	Very high
60,1%-80%	High
40,1%-60%	Moderate
20,1%-40%	Low
0,0%-20%	Very low

(Sunyono, 2012)

The effect size test is used to determine how much influence the treatment has on the research sample. Before calculating the *effect size*, first look for the t value obtained from the *independent sample t-test* using the value of students' critical thinking skills in each class. The *effect size* formula is as follows:

$$\mu^2 = \frac{t^2}{t^2 + d}$$

Information :

μ^2 = *effect size*

t = t count from the t-test on the pretest and posttest values

df = degrees of freedom

The Kriteia *effect size* is shown in Table 4 below:

Table 4. *Effect size* criteria

The *effect size* value	Criteria
$\mu \leq 0,15$	Negligible effect (very small)
$0,15 < \mu \leq 0,40$	Small effect
$0,40 < \mu \leq 0,75$	Medium effect
$0,75 < \mu \leq 1,10$	Great effect
$\mu > 1,10$	The effect is huge

Dyncer (2015)

▪ RESULTS AND DISCUSSION

Based on research that has been conducted on the experimental class and the control class at SMA Negeri 3 Metro, data is obtained in the form of test results, namely the pretest and posttest score data for critical thinking skills. The data that has been obtained is then processed with the help of SPSS version 23.0 for *Windows and Microsoft Office Excel.*

Average pretest and posttest scores

The effectiveness of the guided inquiry learning model can be seen from the average *n-Gain* value obtained between the control class and the experimental class. Before getting the average *n-Gain* value, first the average pretest and posttest scores were calculated in the two classes. The average pretest and posttest results for the experimental class and control class are shown in Figure 1 as follows.

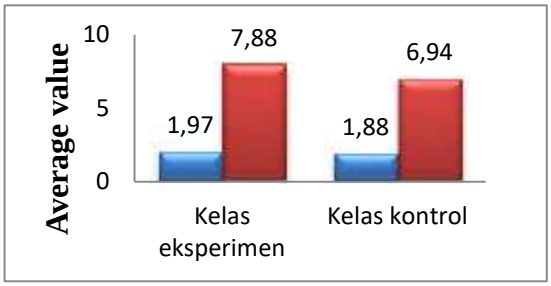

Figure 1. The average pretest-posttest score of students' critical thinking skills

N-gain average

Based on the research conducted, it was obtained that the *n-gain* average of students' critical thinking skills in the experimental class and control class was presented in Figure 2.

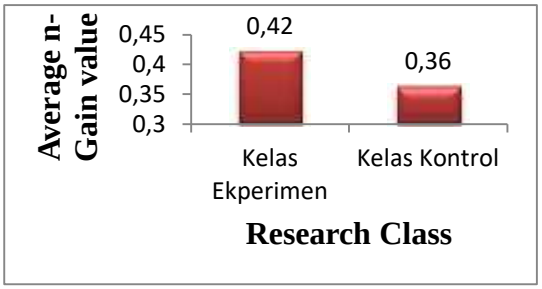

Figure 2. Average n-gain of students' critical thinking skills

In Figure 2, information is obtained that the average gain value-Gain in the class that is applied guided inquiry learning model is 0.42 and in the control class is 0.36. Based on the criteria of Hake (2002), the acquisition of n-Gain values of students' critical thinking skills in the class that was applied to the guided inquiry learning model was included in the "moderate" criteria, in the control class it was included in the "moderate" criteria.

Test the difference between the two n-gain means

Before testing the difference between the two *n-gain* averages, the normality and homogeneity tests are carried out first. The normality test was tested using the *Kolmogrov-Smirnov* test with a significance level of> 0.05. The output results of SPSS version 23.0 are presented in Table 5.

Tabel 5. The results of the normality-gain test of critical thinking skills

Research Class	Average n-Gain	N	*n-Gain*	
			Sig value.	Test Criteria
Experiment	0.36	35	0.200	Sig. > 0.05
Control	0.36	35	0.168	

Based on the table above, it is known that the normality test results on the *n-Gain* value in the experimental class and control class have a sig value. > 0.05, so that the test decision is to accept H_0 and reject H_1, which means that the research data obtained comes from a normally distributed population

The sample homogeneity test was carried out using the SPSS Statistics 23.0 program, namely the *Test of Homogeneity of Variances*. The homogeneity level of the data distribution can be seen from the Sig. In the output displayed the SPSS Statistics 23.0 program. The test criteria is to accept H_0 if the value is Sig. > 0.05 and reject H_0 if the value is Sig. <0.05.

Based on the results of the homogeneity test on the *n-Gain* value in the experimental class and the control class, it has a sig> 0.05, so the test decision is to accept H_0 and reject H_1, which means that both samples have a homogeneous variance value.

Because the data obtained were normal and homogeneous, a test for the difference between the n-gain average was carried out using a parametric statistical test, namely by using the *Independent Samples T-test.* The results of the two difference test average *n-gain* value of students' critical thinking skills showed that sig. (2-*tailed)* obtained from the *t-test for equality of means* of 0.001. This indicates that sig. <0.05, so the decision to reject H_0 and accept H_1. The n-gain average in the experimental class is higher than the *n-gain* average in the control class. This means that there is a significant difference in the average *n-gain* between the experimental class and the control class.

***Effect size* test**

The two mean difference test on the pretest and posttest results was carried out to get the t value used in the *effect size* test using the guided inquiry learning model in learning in the experimental class. After testing with SPPS 23.0 *software*, the results of

the two differences between the average pretest and posttest students' critical thinking skills along with the *effect size* test are presented in Table 6.

Table 6. Data from the calculation of the *effect size*

Class	The *effect size* value	Criteria
Experiment	0,941	Great influence
Control	0,908	Great influence

The results of data analysis on the ability of teachers to manage learning

Increasing students' critical thinking skills is influenced by the ability of teachers to manage learning well. The teacher's ability to manage this learning was observed during the learning process by 2 observers.

The results of the observations of the two observers on the teacher's ability to manage learning during this study are presented in Table 7.

Table 7. Data on the results of the teacher's ability to manage learning

Observation Aspects	Average of 5 meetings (%)
preliminary	80,826
Ask a question or problem	77,5
Formulating Hypotheses	85
Collecting data	76,25
Data analysis	91,25
Draw a conclusion	82
Closing	76,66
Assessment of Teachers	83,5
Average	81,6233
Criteria	Very high

Based on Table 7, it can be seen that the percentage of the teacher's ability to manage learning is categorized as 'very high'. The guided inquiry learning model in the experimental class can improve students' critical thinking skills with the effect size level on the "large" criteria because it has several stages that support the increase in these abilities.

The learning stages that support students' critical thinking skills include the initial stage, which is to present the questions / problems to be discussed. The appearance of questions / problems by displaying a discourse that contains a problem or question that exists in the community and directs students to the perception that the problem can be solved scientifically, this stage can train students in indicators of gathering basic information on students' critical thinking skills. The second stage is making hypotheses, at this stage students are asked to make temporary answers to existing problems. This stage can train students in gathering basic information on critical thinking skills. The third stage is collecting data, at this stage students are asked to explore and collect information

obtained from experiments carried out or literature that is read to obtain answers to existing problems, so that this stage can also improve indicators of gathering basic information on students' critical thinking skills. Furthermore, the stage of analyzing data, at this stage students are asked to analyze data that has been collected to be able to prove the hypothesis, at this stage indicators can be trained to make further clarification and make conclusions (make and assess decisions using existing information) on students' critical thinking skills. In the final stage of making conclusions, students are asked to draw conclusions from related problems based on what has been obtained from the previous stages, at this stage students are trained in indicators of obtaining the best conclusions on students' critical thinking skills.

▪ CONCLUSION

Based on the results of the discussion data analysis from the research that has been done, it can be concluded that: (1) the guided inquiry learning model is effective in improving students' critical thinking skills which consists of four indicators, namely, gathering basic information, conducting further clarification, making conclusions, and obtaining best conclusion on acid-base material. (2) The size of the effect of the guided inquiry learning model in improving students 'critical thinking skills on acid-base material with large criteria, so that the guided inquiry learning model has a positive effect in improving students' critical thinking skills on acid-base material.

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