

The Effect of The Mind Mapping Technique and Prior Knowledge in Guided Inquiry Learning Model on Critical Thinking Ability of Student

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Abstract—This research aims to understand the effect of the mind mapping technique and prior knowledge in guided inquiry learning model about critical thinking ability of X grade students at SMA Negeri 1 Pitu Riawa on oxidation-reduction reaction topic. The type of research is quasi-experiment by using a 2x3 factorial design. The research population was students in class X the second semester of the 2015/2016 academic year consists of five classes with the number learning of learners as much as 136 students. Sampling was done by simple random sampling, and a selected category is class XA and XB. The results of the analysis of descriptive statistics indicate that the mean score of critical thinking ability students who are taught mind mapping and non-mind mapping technique is 79.76 (SD = 8.61) and 75.28 (SD = 8.74). On the mean score of critical thinking ability of learners with the capability of a high, medium, and low separately are 89.12 (SD = 5.79); 79.34 (SD = 5.49); and 68.23 (SD = 5.30). Hypothesis testing is done using Two Way ANOVA Analysis. The results indicated that (1) There is an effect of mind mapping technique on guided inquiry learning model toward the critical thinking ability of students on oxidation-reduction reaction topic. (2) There is an effect of prior knowledge on guided inquiry learning model toward critical thinking ability of students in class X SMA Negeri 1 Pitu Riawa on oxidation-reduction reaction topic. (3) There is no interaction between the mind mapping model and prior knowledge on guided inquiry learning model in affected the critical thinking ability of students. The average value of critical thinking skills of students taught using mind mapping techniques is higher than not using mind mapping techniques. Tukey HSD test result showed a student who has high, medium, and low prior knowledge has the critical thinking ability are different.

Keywords—mind mapping technique, prior knowledge, critical thinking ability

I. INTRODUCTION

The government has tried to improve by putting efforts to improve the quality of education in Indonesia. This effort can be seen from various aspects such as the construction and improvement of educational facilities and infrastructure, increased knowledge of teaching staff, curriculum adjustments, and so on. Moreover, [1] said that educators/teachers have different teaching styles, but teachers must be able to adjust the learning environment to the conditions of students so that positive interaction between teachers and students is established.

Based on the results of interviews conducted by researchers with chemistry teachers at SMA Negeri 1 Pitu Riawa, it is known that the graduation standard is based on the Minimum Completeness Criteria (KKM) is 70 at SMA Negeri 1 Pitu Riawa 1. Furthermore, in 2014/2015 the graduation rate of learning outcomes in the oxidation-reduction reaction material only 65%. This has not met the standards of class compliance, which is 80% of the total number of students. A common problem that usually arises is that concepts in student's memory do not last long. After some time or after receiving other subject matter, students forget the chemical concepts they have learned. This shows that learning chemistry is not only enough to memorize but needs a deeper understanding of concepts. Deep understanding of concepts requires the ability to think critically and will have an impact on student learning outcomes.

Critical thinking according to Richard Paul is thinking about one's mind (or often called metacognition) [2]. One learning model that can improve student's critical thinking skills is a guided inquiry learning model. The inquiry is a process to obtain information by making observations or experiments to find answers to problems by asking and finding out [3]. Inquiry can improve student's critical thinking skills to learn to find their answers to the questions in question so that students are more active and learning outcomes are better. This is in line with previous research, namely the application of inquiry learning can motivate students to learn [4]. Likewise, with the results of [5], that inquiry learning models can influence a student's critical thinking skills.

Guided inquiry is one type of inquiry learning model. The guided inquiry was chosen as the model used in the learning process so that students more easily understand the concept. Learning with the guided inquiry model is mostly made by the teacher's planning. The teacher provides questions that direct students to find concepts. This is in line with the results of [6] study that by applying the guided inquiry learning model in class, students will be more active in the learning process so that learning outcomes increase. Guided inquiry learning is expected to improve and expose the student's critical thinking skills. The inquiry learning model is also one of the learning models that is highly recommended in the implementation of the 2013 curriculum. The syntax (stages) of the implementation of inquiry learning models can be seen in Table 1.

Inquiry learning models have advantages where students can direct their way of learning. However, it takes a lot of time to implement it. To overcome this problem, the teacher can combine inquiry learning models with recording techniques mind mapping. According to [7], making personal notes in the form of mind mapping helps us to save time, improve memory and understanding skills. Increased ability to remember and understand concepts automatically affect a student's critical thinking skills to link one concept to another. Moreover, [8] said that many chemical concepts that are microscopic require unusual recording techniques and critical thinking skills.

TABLE I. THE SYNTAX OF LEARNING MODELS OF GUIDED INQUIRY

Phase	Teacher
Orientation	Teacher stimulates students to think about solving problems. Some things that the teacher can do in the orientation stage are (1) explaining the topics, goals, and learning outcomes that are expected to be achieved by students (2) Explaining the main points of activities to achieve goals (3) explaining the importance of topics and learning activities as motivation for Students
Formulate Problems	This step brings students to a problem that contains puzzles. The problem presented is a challenging problem of thinking.
Formulating Hypotheses	One way that teachers can develop the ability to hypothesize students is by asking questions that can encourage students to be able to formulate various estimates of possible answers to a problem.
Collecting Data	The process of collecting data requires strong motivation in learning, perseverance, and the ability to use the potential for thinking. The task of the teacher in this stage is to ask questions that can encourage students to think about finding the information needed.
Testing Hypothesis	This process determines the answers that are considered acceptable according to the data or information obtained based on data collection so that the teacher can develop students' rational thinking skills.
Conclusion Making The	The process of describing the findings obtained based on the results of testing hypotheses, to obtain accurate conclusions the teacher should be able to show students where the data is relevant.

The thing that is very needed in carrying out guided inquiry learning models and is very synonymous with the discovery of concepts that is the fundamental ability of students. This initial ability is very helpful for students to find new concepts. In the concept discovery process, linking the previous concept with the concept to be studied, and finding a solution/answer to the problem requires fundamental knowledge and supporting material to be studied or problems to be solved, in this case, called initial ability. The initial ability of students is important to analyze because each student has different abilities that can be grouped on high, medium, and low ability students. According to [9], every student has different knowledge, skills, beliefs, and attitudes. These differences affect how they present, interpret and manage the information obtained. Different ways of processing and integrating new information can also affect them in remembering, thinking, implementing, and creating new knowledge.

According to [10], the initial ability is an intellectual ability which is the basic capital of students to master teaching material. This initial ability affects the rate of

learning, the perception of the topic, and the achievement of learning objectives.

The initial ability of students is important to analyze because each student has different abilities that can be grouped on high, medium, and low ability students. The higher the initial ability of students, the more motivated to learn. At high abilities are usually indicated by high motivation in learning, attention, and seriousness in attending lessons, and others. Conversely, students who are classified as low ability are characterized by a lack of learning motivation, no seriousness in taking lessons, including completing assignments, and so on. These differences require treatment that is not the same, both in the placement and grouping of students, and also the treatment of teachers in adapting to their learning styles [11].

Initial ability is very influential in critical thinking skills. The ability to think critically is a process of high-level thinking in a reasonable and reflective appropriate and reflective way can be considered too slow manner by emphasizing making decisions about what to believe or do. So, the higher the initial ability level, the higher the level of critical thinking skills. So, the application of guided inquiry learning models by considering the initial abilities of students, then they will link the initial abilities with existing problems to find the right solution/answer.

Based on this description, it is necessary to conduct a study on the effect of techniques mind mapping and initial abilities on guided inquiry learning models on students' critical thinking skills in class X of SMA Negeri 1 Pitu Riawa in the material of oxidation-reduction reactions.

II. RESEARCH METHODS

A. Type and Location of Research

This research was a quasi-experiment. This research was carried out at SMA Negeri 1 Pitu Riawa in the 2015/2016 academic year.

B. Research Design

The research design used is 2x3 factorial design as shown in Table 2.

TABLE II. FACTORIAL DESIGN

Initial Ability (B) / Learning Techniques (A)	High (B1)	Medium (B2)	Low (B3)
Techniques Mind Mapping (A1) Technique Non Mind Mapping (A2)	A1B1KBK A2B1 KBK	A1B2 KBK A2B2 KBK	A1B3 KBK A2B3 KBK

C. Research Variables

There are two independent variables in this study, namely manipulative independent variables and attributive independent variables. Learning model (A) is an independent manipulation variable consisting of 2 parts, learning techniques mind mapping using guided inquiry learning model (A1) and learning techniques non-mind mapping using guided inquiry learning model (A2). Initial ability (B) is an independent attribute variable consisting of 3 parts: high initial ability (B1), moderate initial ability (B2), and low initial ability (B3). The dependent variable in this study is the ability to think critically of students.

D. Population and Sample

The population in this study were students of class X SMA Negeri 1 Pitu Riawa even semester 2015/2016 academic year consisting of 5 classes with a total of 136 students. Sampling was done by random sampling with random class techniques to determine class experiment I and experimental class II. Based on random results, class XA (25 students) was selected as the experimental class I (using techniques mind mapping) and class XB (28 students) as experimental class II (using techniques no mind mapping).

E. Research Procedures

Procedures in this study consist of 4 stages, namely the preparation stage, implementation phase, the evaluation phase, and reporting phase.

F. Data Collection Techniques

Initial ability test questions in the form of multiple choices with cognitive levels C1, C2, and C3 given before the first meeting of learning. The critical ability test questions in the form of essays with cognitive levels C4, C5, and C6 presented in the final session.

G. Data Analysis

Data analysis used descriptive statistical analysis and inferential analysis. Descriptive statistical analysis includes the presentation of tables, diagrams, mean values, highest values, lowest values, mode, median, and standard deviations.

Inferential statistical analysis includes the first, a prerequisite test that is the normality test using the analysis One sample Kolmogorov Smirnov Test and homogeneity test using Levene's Test. Second, test the hypothesis using Two Way ANOVA with the help of program SPSS 20.

The statistical hypothesis in this study are as follows:

Hypothesis I:

$$H_0 : \mu A1 = \mu A2$$

$$H_1 : \mu A1 \neq \mu A2$$

Hypothesis II:

$$H_0 : \mu B1 = \mu B2 = \mu B3$$

$$H_1 : \mu B1 = \mu B2 \neq \mu B3 \text{ or } \mu B1 \neq \mu B2 = \mu B3 \text{ or } \mu B1 \neq \mu B3 = \mu B2$$

Hypothesis III:

$$H_0 : \mu (A1B1 - A2B1) = \mu (A1B2 - A2B2) = \mu (A1B3 - A2B3)$$

$$H_1 : \text{there is at least one difference in the mean of the different groups}$$

III. RESEARCH RESULT

A. Descriptive Statistical Analysis

Descriptive Statistical Analysis of students' critical thinking abilities based on initial abilities (high, medium, and low) and learning techniques can be seen in Table 3.

TABLE III. DESCRIPTION OF CRITICAL THINKING ABILITY OF LEARNERS

Initial ability/ Learning Technique	Statistic	High (B1)	Medium (B2)	Low (B3)
<i>Mind Mapping</i> (A1)	N	4	16	5
	Mean	93.25	79.87	68.60
	SD	5.50	4.12	4.56
<i>Non Mind Mapping</i> (A2)	N	4	16	8
	Mean	85.00	78.12	64.75
	SD	1.63	5.88	4.52
Total	N	8	32	13
	Mean	89.12	79.00	66.23
	SD	5.79	5.08	4.76

Based on Table 3 it can be seen that the highest average value of critical thinking abilities is that students with high initial abilities are taught by mind mapping techniques.

B. Inferential Statistical Analysis

The results of testing the normality of the data using the One sample Kolmogorov Smirnov Test analysis obtained a significance value (p) = 0.422. This shows that the research data is normally distributed because the value (p) > α (0.05).

The results of the data homogeneity testing using Levene's Test analysis obtained a significance value (p) = 0.059. This shows that the research data has a homogeneous variance because the value (p) > α (0.05).

The effect of mind mapping technique and initial ability on guided inquiry learning models on students' critical thinking abilities operationally can be identified through differences of students critical thinking abilities of each treatment group. There are differences in students' critical thinking abilities in each treatment as a result of manipulation of independent variables (learning techniques and initial abilities) shows that the independent variables can be the effect the dependent variable (critical thinking abilities). The results of hypotheses testing I, II, and III in detail are presented in Table 4.

TABLE IV. RESULTS OF INFERENTIAL STATISTICAL TESTS

Source	F	Sig.
Initial abilities	55.374	.000
Technique	8.620	.005
Initial Abilities * Technique	1.475	.239

Based on Table 4 shows that the significance of that obtained for the hypothesis I (0.005) < α (0.05) means that H_0 rejected and H_1 accepted, which means there are true differences in students critical thinking abilities that teach by mind mapping techniques in the guided inquiry learning model class X in SMA Negeri 1 Pitu Riawa on the material of oxidation-reduction reactions.

In Table 4 also shows that the significance obtained for hypothesis II (0.000) < α (0.05) means that H_0 rejected and H_1 accepted, which means that there are differences in critical thinking abilities based on the students' initial abilities in guided inquiry learning models class X in SMA Negeri Pitu Riawa on the material of oxidation-reduction reaction.

The results of the Post Hoc Tukey HSD test shows that the critical thinking abilities of students with high initial abilities were higher than those with medium initial abilities

and medium initial abilities more higher than critical thinking abilities than those with low initial abilities.

The data in Table 4 also shows that the significance ($0.239 > \alpha (0.05)$) so that H_0 fails to be rejected means that there is no interaction between the use of mind mapping techniques and the initial ability of guided inquiry learning models in influencing students' critical thinking abilities class X in SMA Negeri 1 Pitu Riawa on the material of oxidation-reduction reaction. Hypothesis III can also be explained by a graph like in Figure 1.

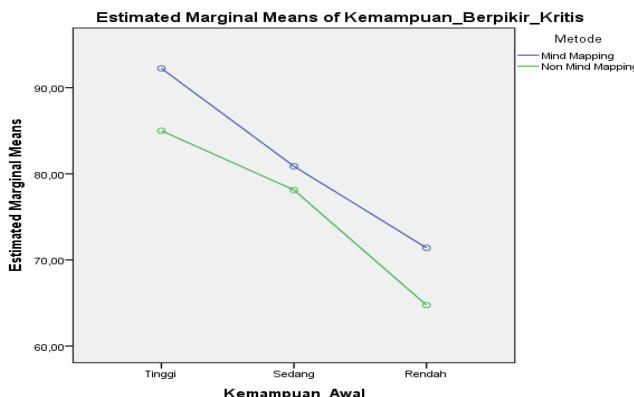


Fig. 1. Interaction Between Mind Mapping Technique and Students Initial Ability Class X in SMA Negeri 1 Pitu Riawa

Figure 1 shows that there is no intersection of lines between mind mapping techniques and non-mind mapping. This means that there is no interaction between the use of mind mapping techniques and initial abilities in the guided inquiry learning model in influencing critical thinking skills of class X students in SMA 1 Pitu Riawa on oxidation-reduction materials.

The results of testing the hypothesis I is also supported by the results of the descriptive analysis that the average value of students who were taught using mind mapping techniques was higher than the average value of students who were taught using non-mind mapping techniques. This means that mind mapping techniques are better than non-mind techniques mapping in influencing students' critical thinking abilities. This is in line with the research of [12] that his research proved that there is an effect of using mind mapping on the direct learning model of students' learning outcomes.

The reason for the influence of mind mapping techniques on guided inquiry learning, especially on students' critical thinking skills, namely the use of mind mapping techniques can make students more easily review the material. So that learning time is faster and easier to remember the concepts found during class rather than mind mapping instead. Given the inquiry learning model has advantages where students can direct their way of learning. However, using mind mapping requires a lot of time to implement it. So, combining guided inquiry learning models with mind mapping techniques can help students to improve critical thinking abilities. This is consistent with what [13] stated, that this includes differences in public records and media mind mapping. Both in the form of writing, symbols, and images, colorful, to review it requires a short time, time to study very quickly and efficiently, even though the usual note is in writing, only in one color, to review it takes a long time, the study time is longer. According to [14], making

personal notes in the form of mind mapping helps us to save time, improve memory and understanding abilities.

The results of testing hypothesis II are also supported by the results of the descriptive analysis that the average value of critical thinking abilities and the average value of students with high, medium and low initial abilities differ greatly from one another. Overall, the average value for students with the high initial ability is higher than the average score of students who have moderate and low initial abilities in the classroom using both mind mapping and non-mind mapping techniques.

The initial ability in inquiry models affects critical thinking ability because, in the guided inquiry learning model, students will investigate to find new concepts with the help of previous knowledge (initial ability) to be connected so that the ability critical thinking is increasing. Critical thinking is a high-level thinking process. The higher the initial ability level, the higher the level of critical thinking abilities. According to [15] that students who are included in high abilities are usually shown by high motivation in learning, attention, and seriousness in attending lessons, and others. Conversely, students who are classified as low ability are characterized by a lack of learning motivation, no seriousness in taking a lesson, including completing assignments, and so on.

Initial ability is an intellectual ability which is the basic capital of students to master teaching material. Initial abilities determine the pace of learning to achieve learning goals and understanding concepts. This is according to what was stated by [16] that the initial ability influences the rate of learning, the perception of the topic, and the achievement of learning objectives. This can be evidenced by the results of the Tukey HSD test that students with high, medium and low initial abilities have an average of different critical thinking abilities. Students who have high initial abilities have higher critical thinking abilities than those with moderate initial abilities. Likewise, students who have early abilities are having higher critical thinking abilities than those with low initial abilities.

In hypothesis III, there is no interaction because of the consistency of students' critical thinking abilities between the group in the experimental class I (mind mapping) and the experimental group II (non-mind mapping) which causes no intersection of lines in Figure 1. High initial ability group in class mind mapping can think critically superior to the group with high initial ability in class non-mind mapping. Likewise in groups with moderate and low initial abilities, they are always consistently superior to students' critical thinking abilities in mind mapping class compared to non-mind mapping class. So, both variables (mind mapping and initial ability) influence students' critical thinking abilities. However, between mind mapping techniques and the initial abilities of students do not influence each other. Thus no joint contribution can be contributed between mind mapping techniques and the initial ability to improve students' critical thinking abilities.

The reason for the level of critical thinking of students is consistent because in the mind class the students' initial ability to think critically is superior to the non-mind mapping class. This is because students in the mind mapping class at the end of the learning process can make conclusions outlined in the mind map that has been made. This makes it

easier for students to connect one concept to another with color and detailed, concise, solid, and clear, colorful explanations and to review it takes a short time so that learning is very fast and effective while in class non-mind mapping, students only conclude through ordinary notes only one color and to review it takes a long time.

IV. CONCLUSION

Based on the results described, it can be concluded that the use of mind mapping techniques and the application of guided inquiry learning models influence students' critical thinking skills. However, there is no interaction between the use of mind mapping techniques and the initial ability to apply the guided inquiry learning model to the critical thinking skills of class X students at SMA Pitu Riawa 1 on oxidation-reduction material.

SUGGESTIONS

Based on the results obtained, it is expected that the use of guided inquiry learning models and mind mapping techniques in oxidation-reduction material must pay attention to students' initial abilities because it greatly influences students' critical thinking skills.

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