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The Effectiveness of Guided Inquiry-Based LKPD to Improve the Student's Critical and Creative Thinking Skills

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ABSTRACT: The purpose of the study was to determine the effectiveness of the Guided Inquiry-based Student Worksheet (LKPD). The method used was a quasi-experiment with the one group pretest and posttest design. The population in this study was the students of grade XII IPA at SMA Negeri 2 Painan for the academic year 2020/2021. The sample in this study was the students from class XII IPA 1 as the experimental class and XII IPA 4 as the control class chosen by using the purposive sampling technique. The instruments used were observation questionnaires, product validation sheets, teacher and student practice sheets, and evaluation questions based on the critical and creative thinking indicators. The results of the analysis of pretest and post-test evaluation questions obtained that the mean of N-gain was 0.4 for critical thinking and Ngain was 0.5 for creative thinking. These two thinking skills had moderate N-gain scores. The results of the critical thinking t test showed that t arithmetic (0.036) < t (0.05) and creative thinking skills t test showed that t arithmetic (0.000) < t (0.05). Thus, it indicates that guided inquiry-based LKPD are effective for improving the students' critical and creative thinking skills.

KEYWORDS: Critical Thinking, Creative Thinking, LKPD, Guided Inquiry.

I. INTRODUCTION

Learning in the 21st century summarizes students' thinking skills in four competencies (4C): Critical thinking skills, Creative thinking, Collaboration, and Communication. Thinking skills that play the most and are further improved are critical and creative thinking skills. Students who are able to face the global competition in the workforce in the 21st century are creative and critical students (Agnafia, 2019). Biology is a pure science that requires high-level thinking skills for students to analyze, understand, and apply them in life (Sofnidar, 2012). Critical and creative thinking skills are higher order thinking skills.

Students' critical and creative thinking must be trained in learning biology at school so that it becomes a habit in life.

Critical thinking skills are skills that train students to analyze and identify problems in depth to get brilliant new innovations. Critical thinking is important to develop because advances in information and global competition demand in analyzing phenomena or solving problems (Hayati, 2016). Critical thinking indicators have been summarized into six parts: Focus, Reason, Inference, Situation, Clarity, and Overview (Ennis, 1996).

Creative thinking skills are skills that train students to develop ideas, imagination and increase sensitivity to phenomena. Creative thinking skills are one of the important skills for students that are applied in learning to enrich knowledge and skills. Students who think creatively tend to prefer to export new ideas to solve problems (Fuad, 2015). Critical thinking indicators have been summarized into six parts: Flexibility, Originality, Elaboration, and Metahorical Thinking (Treffinger, 2002).

The implementation of learning by improving students' critical and creative thinking skills at school has not been maximized because they only memorize learning material (Sutama, 2014). Teachers also have not trained and measured the students' thinking. Teachers are expected to provide challenging and interesting learning for students so that the students' thinking skills are improved. Learning requires teaching materials as a medium to improve students' thinking skills. The teaching materials are expected to be able to help students in stimulating critical and creative thinking skills. Teaching materials can contain problems in the context of everyday life and direct students to experiment or present data creatively and critically (Windariani, 2016).

Based on observations, the students want the developed teaching materials which are in the form of LKPD or student worksheet. Based on the analysis, they need teaching materials that provide detailed material. The activities in teaching materials can help students to be active, and help them understand learning. There are 93% of them want the development of teaching materials, namely LKPD. LKPD is simply a sheet containing materials and complete tasks with steps to complete them (Rizki, 2016). This student worksheet (LKPD) is ideally oriented to the development of thinking because students should be given opportunities and be creative.

Model-based LKPD are teaching materials that are able to train students' thinking skills. The suggested model should lead to the 2013 curriculum (Zikri, 2020). The LKPD developed is a guided inquiry-based LKPD. Guided inquiry-based learning is appropriate in the 21st century which requires students to be more active in learning. They will find their own solutions to problems so that they will be independent (Kuhlthau, 2007). The guided inquiry syntax consists of: 1) orientation, 2) formulating problems, 3) formulating hypotheses, 4) collecting data, 5) drawing conclusions (Zikri, 2020).

The LKPD developed contains biotechnology materials. Based on the results of observations on 60 students, the students assess difficult biotechnology material. Biotechnology material is considered difficult by 46.7% of the students because many terms are confusing. 78.3% of them said that the teaching materials used were not packaged properly, and were not equipped with illustrations. 58.3% of them said that the material had not been presented in detail and 70% said that the teaching materials had not helped them understand the concept.

LKPD made by teachers are from textbooks and the internet. The concepts presented in the LKPD made by the teachers have not facilitated and have not trained students' critical and creative thinking skills. Based on the questionnaire, it was found that 100% of the teachers stated that they had never trained and measured the thinking skills of students. It was known that there had been no development of guided inquiry-based LKPD. This has prompted researchers to conduct a research on the effectiveness of Guided Inquiry-based student worksheet (LKPD) to improve the critical and creative thinking skills of the students of grade XII SMA in the Biology Subject.

II. RESEARCH METHOD

This research is a quasi-experimental (quasi-experimental). This study aims to test the effectiveness of guided inquiry-based worksheets in improving students' critical and creative thinking skills. The design of this study used a one group pretest-posttest design. this is a Table I for research design.

Table I. One Group Pretest-Posttest Design.

Class	Pretest	Treatment	Posttest
Experimental	T1	X	T3
Control T2	-	T4	

***Source*:** (Lufri, 2015)

Table description:
X = Learning using Guided Inquiry- based LKPD.
- = Learning without Guided Inquiry- based LKPD.
T1 = Initial ability test to see the initial ability of the students in the experimental class.
T2 = Initial ability test to see the initial ability of the students in the control class.
T3 = The final test is given to the experimental class at the end of the lesson.
T4 = The final test is given to the control class at the end of the lesson.

The population of this study was the students of grade XII SMAN 2 Painan. The sample of this study was the students from class XII IPA as the experimental class and class XII IPA 4 as the control class taken by using the purposive sampling technique. The independent variable in this study was the use of guided inquiry-based LKPD. The dependent variable in this study is critical and creative thinking skills. The type of the data of this study is primary data because it is obtained directly based on LKPD responses and scores from essay tests. The research instruments used were (1) analytical questionnaire, product validation sheet, teacher and student practicality sheet. (2) the instruments of the data collection were essay test instruments based on critical and creative thinking indicators. The data analysis technique was to see the effectiveness of students on guided inquiry-based worksheets based on pre-test and post-test scores.

Posttest and Pretest assessments are categorized based on critical and creative thinking assessment indicators. Critical thinking indicators according to critical thinking assessment based on the following rubrics:

Table II. Critical Thinking Skills Assessment Rubric.

Score	Description
5	• All concepts are correct, clear and specific. • The flow of thinking is good, all concepts are interrelated and integrated. • All descriptions of answers concluded are correct, clear, and specific, supported by strong reasons, true, clear arguments. • All aspects are clear, the evidence is good and balanced. • Grammar is good and correct by paying attention to the correct terms.

4	• Most of the concepts are correct, clear but not specific. • The flow of thinking is good, most of the concepts are interrelated and integrated. • Most of the descriptions of answers concluded are correct, clear, and specific, supported by strong reasons, true, clear arguments. • All aspects are visible, but not yet balanced. • Grammar is good and correct, there are minor errors.
3	• Some of the concepts are correct and clear. • The flow of thinking is quite good, some are interrelated. • A small part of the answer description is concluded correctly and clearly but the reasons and arguments are not clear. • Most of the aspects seem correct. • Grammar is quite good, but there are spelling errors.
2	Unfocused or exaggerated or dubious concepts. • The flow of thinking is bad, the concepts are not related to each other. • Descriptions of answers are not concluded correctly, clearly, and specifically, and are not supported by strong, true and clear reasons. • Few aspects seem correct. • Good grammar, incomplete sentences.
1.	All concepts are incorrect or insufficient. • The flow of thinking is bad. • The description of the conclusion of the answer is incorrect. • Overall aspects are not sufficient. • Poor Grammar.
0.	No answer or the answers are incorrect

Source: *(Zubaidah S. , 2015)*

Posttest and Pretest assessments are categorized based on critical and creative thinking assessment indicators. Critical thinking indicators according to critical thinking assessment based on the following rubrics:

Table III. Creative Thinking Assessment Rubric.

Category	Description	Score
Fleksibility	Writing several alternative answers that are logical and relevant to the problems given from several different points of view.	4
	Writing several alternative answers that are quite logical and relevant to the problems given from several different points of view.	3
	Writing several alternative answers that are logical but less relevant to the problems given from several different points of view.	2
	Writing an answer that is quite logical and relevant to the problems given from one point of view.	1
Originality	Providing some interesting unique ideas that are logical, relatively new and relevant to the given problems.	4
	Giving some interesting unique ideas logically, relatively new but less relevant to the given problems.	3
	Providing some quite unique ideas that are logically interesting and relevant to the given problems.	2
	Providing some ideas that are commonplace, logical and relevant to the given problems.	1
Elaboration	Explaining some logical details on existing ideas so that the formulation of ideas becomes easier to apply clearly.	4
	Explaining one logical detail on an existing idea so that the formulation of the idea becomes easier to apply and clear.	3
	Explaining some logical details on existing ideas but does not fit the main concept, so it cannot be used to clarify ideas.	2
	Not adding details to the existing ideas so that the formulation of the concept is less applicable.	1

Fluency	Providing more than 5 different ideas, suggestions, or alternative answers.	4
	Giving 3 different ideas, suggestions or alternative answers.	3
	Providing several ideas or alternative answers that are not always different.	2
	Mentioning ideas, suggestions or alternative answers.	1
Metahorical Thinking (Berpikir Metafora)	Combining several ideas, modifying, and explaining the formulation of ideas with logical and coherent analogies.	4
		3
	Combining several ideas, modifying, but unable to explain the formulation of ideas with logical and coherent analogies.	2
	Combining several relevant ideas but does not explain the formulation of ideas with logical analogies.	
	Less able to combine relevant ideas so that they become a coherent whole.	1

Source: **(**Treffinger, 2002)

The pretest and posttest results were analyzed using the formula according to (Ermayanti, 2016)

$$\text{Result} = \frac{\text{Total Score}}{\text{Maximun Score}} \text{X100\%}$$

LKPD is effective if the students' understanding has increased by the N-Gain test (Santoso, 2015). The formula for determining N-Gain is as follows:

$$\text{Result N} - \text{Gain} = \frac{\text{Posttest} - \text{Pretest}}{\text{Ideal Score} - \text{Posttest}}$$

The N-Gain result obtained is then confirmed with the criteria that can be seen in Table IV.

Table IV.Criteria Result N-Gain.

Result N-Gain	Category
N-Gain>0.7	High
N-Gain 0,3 ≤ G ≤ 0,7	Medium
N-Gain G < 0,3	Low

Source: (Corcoran, E.2005)

Hypothesis testing criteria H0 is accepted (H1 is rejected) if the significance value is >0.05 H0 is rejected (H1 is accepted) if the significance value is <0.05. Before the t-test is carried out, the normality and homogeneity tests are first carried out. The data is normal if the significance is > 0.05 and the data is homogeneous if the significance is > 0.05.

III. RESULTS AND DISCUSSION

A. Hypothesis Testing of Critical and Creative Thinking Skills

Hypothesis testing used Independent Samples T Test. The results of the hypothesis test of critical and creative thinking skills in the experimental and control classes can be seen in Table V.

Table V. Hypothesis Testing Critical and Creative Thinking Skills

Thinking Skills	Class	Average	SD	Significance	Explanation
Critical	Experimental	61.49	16.665	0.036	H1 accepted
	Control	52.77	17.314		
Creative	Experimental	70.71	17.952	0.000	H1 accepted
	Control	52.63	18.330		

Based on Table V, it is known that the significance resultof the students' critical thinking skills is 0.036 and creative thinking skills is 0.000. This indicates that the value of sig < 0.05, which means that H0 is rejected and H1 is accepted. Thus, it is known that the use of guided inquiry-based LKPD has an effect on improving the critical and creative thinking skills of the students grade XII of SMAN 2 Painan.

Guided inquiry-based LKPD is integrated with aspects of critical and creative thinking skills which students are directed to be able to express ideas or ideas in more detail, clearly, and differently than in general and solve and find solutions to problems by finding their own. Students' activities in participating in learning activities with the guided inquiry model can support critical thinking skills because inquiry learning involves students to search, investigate systematically, critically, logically and analytically

(Firdausichuuriyah, 2017). Learning using the guided inquiry syntax can improve thinking skills creative students because they will be trained to find answers or ideas that are different from one another (Yanti, 2016). Students have the process of finding facts for themselves then being tested, evaluated and then applied in everyday life. The factors that influence the guided inquiry model in improving students' thinking skills because of the guidance from the teacher and providing broad opportunities in finding learning concepts (Elvira, 2020).

B. Data Description of Students' Critical and Creative Thinking Skills.

Critical and creative thinking skills are part of higher-order skills. Higher order thinking is an ability that includes three aspects: *analysis, evaluation* and *creation* (Anazalia, 2020). Thinking can affect students' learning skills, speed and effectiveness (Windyarani, 2016). The assessment of critical and creative thinking was seen from the initial knowledge test (pretest) before being given the guided inquiry-based LKPD, and the final knowledge test (post-test) after learning using the guided inquiry-based LKPD. Critical and creative thinking skills were measured using essay test questions consisting of 5 questions leading to critical and creative thinking indicators. The data taken for the effectiveness test were the students' critical and creative thinking skills. The learning process in the experimental class used guided inquiry-based LKPD. Meahwhile, the learning process in the control class still used the LKPD which was commonly used by teachers. The effectiveness was measured by using the *N-Gain* method. The results of the mean results and scores of *N-Gain* critical thinking in the control and experimental classes can be seen in Table VI.

Table VI. Average and Score N-Gain Critical Thinking Scores.

Class	Average		Scores of N-Gain	Category
	Post-test	Pre-test		
Experimental	39.8	61.48	0.4	Medium
Control	26.85	52.77	0.3	Low

The results of the mean scores and N-Gain scores for creative thinking in the control and experimental classes can be seen in Table VII.

Table VII. Average and Score N-Gain Creatuve Thinking Scores.

Class	Average		Scores of N-Gain	Category
	Post-test	Pre-test		
Experimental	46.11	70.71	0.5	Medium
Control	27.74	52.62	0.3	Low

Based on Table VII, it can be seen that the mean and N-Gain scores of critical and creative thinking skills of experimental class students are higher than the mean and N-Gain scores of the control class. Based on the table, it can be seen. that the use of guided inquiry-based LKPD to improve critical and creative thinking skills is effectively carried out in the medium category. The results of the N-Gain index for the control class obtained for critical thinking skills were 0.3 with low criteria, and for the N-Gain index for creative thinking skills was 0.3 with a low index. From the analysis, it is known that the experimental class using guided inquiry-based LKPD is more effective than the control class without guided inquiry-based LKPD. Product effectiveness is a product quality criterion developed based on the the effect on users (Nieveen, 2007). The results of the experimental class *N-Gain* index for critical thinking skills were 0.4 with moderate criteria, and the results of NGain index for creative thinking skills were 0.5 with moderate index.

The factor that affects effectiveness is learning in the Covid-19 pandemic condition. The students were limited in discussion and the teacher also emphasize the concept of a short learning time.The application of guided inquiry-based LKPD based on the research results can be effective in improving the students' critical and creative thinking skills. The researcher tried to develop an effective learning by using guided inquiry-based LKPD, even in the conditions of the Covid-19 pandemic. The current conditions required teachers to be able and skilled in determining good teaching materials or learning tools. The skills that must be possessed by a professional teacher in carrying out their duties are creativity to be able to develop innovative, varied, interesting, contextual teaching materials, and in accordance with the students' need (Zuriah, 2016).

The assessment of critical thinking skills based on the modified critical thinking indicator rubric (Zuriah, 2016). The assessment of creative thinking based on the indicator rubric creative thinking modification (Zubaidah S., 2016). The results of the critical thinking assessment of the experimental class were analyzed based on indicators that can be seen in the following graph.

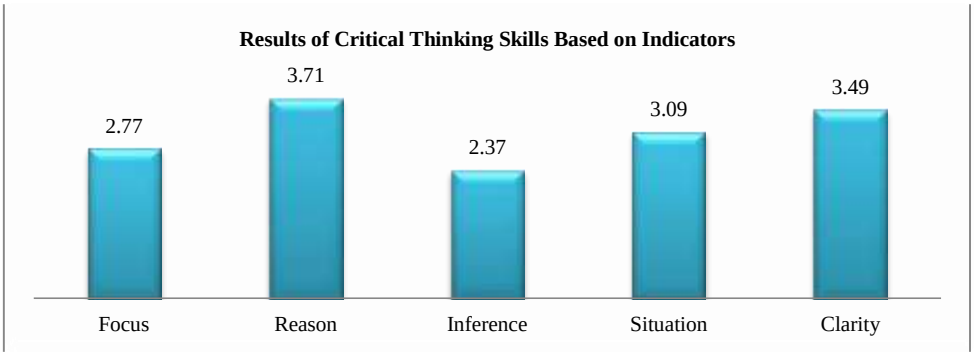

Figure 1. Results of Critical Thinking Skills Based on Indicators

Based on Figure 1, it means that the average students from the experimental class have good and very good critical thinking skills after learning using guided inquiry-based LKPD. Based on the post-test score, the mean result of the *focus* aspect was 2.77 with a good category. It can be concluded that students are able to focus the questions and make decisions with good thinking. Critical thinking skills of the focus aspect on the syntax of phenomenon exploration is to train students' focus on issues or facts on phenomena, in order to make the right conclusions (Ennis, 1996). The mean of post-test assessment of the critical thinking indicator of inference aspect was 2.37 with a good category. The students are able to make reasonable and convincing assumptions or opinions (Affandy, 2019). Based on the results of the post-test, the mean score of students at this stage was 3.71 with a very good category. This means that the students can find out the reasons that support or reject decisions made based on the facts contained in the questions (Affandy, 2019).

The reason aspect is an aspect that trains students in identifying the relationship of several statements, concepts and descriptions (Ennis, 1996). Based on the results of the post-test, the mean score of the students at this stage was 3.71 with a very good category. This means that the students can find out the reasons that support or reject decisions made based on the facts contained in the questions (Affandy, 2019). The results of the post-test showed that the mean clarity result was 3.49 with a very good category. Based on the results, it was concluded that the students were very good in explaining the meaning or terms used. The result of the post-test score on the situation aspect was 3.09 with a good category. This means that the students can understand the situation and keep the situation in mind to help clarify questions and know the meaning of supporting the decisions taken (Affandy, 2019).

The results of the experimental class's creative thinking assessment were analyzed based on indicators that can be seen in Figure II.

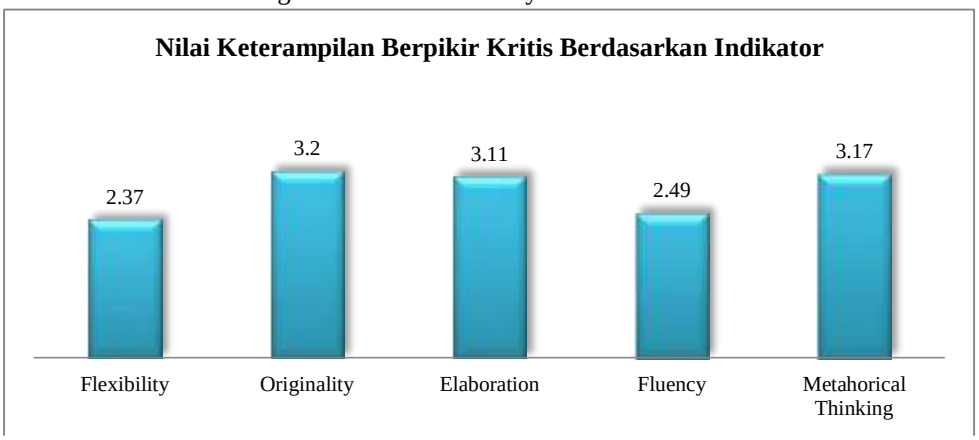

Figure 2. Results of Creative Thinking Skills Based on Indicators

Based on Figure 2, it means that the average students from the experimental class have good creative thinking skills after learning using guided inquiry-based LKPD. The *fluency* aspect of the creative thinking indicator will help students to solve problems with various answers (Treffinger, 2002). The mean of the post-test obtained for the fluency aspect was 2.49 with a good category. This means that after using guided inquiry-based LKPD, the students already have the ease of solving problems (Affandy, 2019). Based on the post-test assessment of the *flexibility* aspect, the mean of the creative thinking indicator was 2.37 with a good category. This means that the students have considered things from different perspectives, proposed various alternative solutions, were open and flexible (Andiyana, 2018).

The *originality* aspect trains the students' ability to solve problems and generate unusual new ideas through investigations that will be carried out. In the post-test the mean obtained for the *originality* aspect was3.20 with a good category. This means that the students' ability to answer questions is they are able to think originally or answer questions uniquely and differently than those that existed before (Sari, 2018). Based on the results of the post-test, the mean score of the students at this stage was 3.11 with a good category. Based on the mean, it can be concluded that participants solve problems by thinking in detail. The post-test assessment of

the *metahorical thinking* aspect, the mean of the indicator of creative thinking was 3.17 with a good category. This means that the students are able to make an analogy of something into a concept that is easy to be understood (Treffinger, 2002).

IV. CONCLUSION

Learning using Guided Inquiry-based LKPD on biotechnology materials is effectively used in class XII biology learning and in improving the students' critical and creative thinking skills. The mean results of the effectiveness assessed by students were 86% and the teachers were 94% with very effective category. The results of the pre-test and post-test of critical and creative thinking increased, the mean of N-gain was 0.4 for critical thinking and N-gain was 0.5 for creative thinking skills, with moderate criteria. The results of the critical thinking t test showed that t arithmetic (0.036 < t (0.05) and creative thinking skills t test showed that t arithmetic (0.000) < from t (0.05). This indicates that guided inquiry-based LKPD are effective in improving the students' critical and creative thinking students.

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