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Effects of guided discovery learning models on students' critical thinking ability on the materials of immune system

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Abstract

Critical thinking is a skill needed in the 4.0 era of education so to improve critical thinking requires the right method so that learning can develop students' critical thinking skills. The purpose of this study was to determine the effect of guided discovery learning models on students' critical thinking skills on the material of the immune system. This type of research is quasi-experimental and post-test only control group design. Samples were taken by cluster random sampling technique. A total of 69 students were made respondents divided into 2 classes, namely class XI IPA 2 (n = 35) and XI IPA 3 (n = 34). The research instrument in the form of multiple choice questions of critical thinking skills was used as a data collection tool. Data were analyzed using normality test, homogeneity test, and t test. The results of this study indicate that there are significant differences between the experimental class and the control class with tcount (2,031)> ttable (1,668). Conclusion: It can be concluded that the use of guided discovery learning models has an effect on students' critical thinking skills with the use of syntax involving students to actively think at a high level to hone their critical thinking skills.

Keywords: Guided Discovery Learning; Critical thinking skills; Immune system

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1. INTRODUCTION

The ability to think critically is a mental attitude that must be possessed by someone in order to formulate and find solutions in solving problems to change so quickly. The challenge in the current industry 4.0 era is that critical thinking skills are needed by everyone. Education has an important role and responsibility in improving the ability to think critically of human resources. Argues that critical thinking is a skill to infer and argue. Therefore, in the process of learning critical thinking needs to be trained to shape the tendency of students to carefully consider the problems that arise and be able to make the right decisions.

One of the factors influencing students' critical thinking skills is the learning method used by the teacher. Learning methods play an important role in shaping students' attitudes and character. In fact, until now there are still many teachers who have difficulty implementing learning methods that lead to an increase in students' critical thinking. So that an increase in critical thinking skills almost does not occur as a result of the learning process. Many students are less able to acquire and transfer critical thinking skills outside the classroom.

The selection of the right learning model will have a positive impact on students. Guided Discovery Learning (GDL) is a learning model that has been widely studied to improve students' critical thinking skills [16]. Guided Discovery Learning includes two aspects, namely direct instruction and discovery learning. For example in guided discovery the teacher guides students in solving problems. Guided discovery learning is considered more effective in the student centered method because direct instruction gives students instructions on what should be expected as evidence of learning success and then students are given the opportunity to practice with their own skills. In this case, the teacher has the role of guiding students to structure a problem and make solutions in problem solving. Students need guidance in solving problems for example critically evaluating and developing existing solutions [6, 13].

Based on the results of observations in the field when students are given questions about critical thinking skills students have not been able to answer the questions properly and correctly. The results of the study stated that the use of the Guided Discovery Learning model has a positive influence on students' critical thinking skills on environmental pollution material [4] and science process skills In addition, the use of the Guided Discovery method is more effective than the demonstration method because during the learning process students become the center (*study centered)* [3]. When viewed from the syntax, the GDL model can hone high-level skills such as critical thinking [1].

Although previous studies have provided positive results, the use of GDL on students' critical thinking skills on immune system material is rarely studied. The immune system consists of many sub-systems (for example: white blood cell types such as macrophages) that work together. Each system has functions that are such that they have little impact on the survival and reproduction of the organism. The GDL method is suitable because the function of the immune system is made as a design problem and develops knowledge with the solutions provided. Thus, research needs to be done whether the GDL method can improve students' critical thinking skills [7].

The purpose of this study is to determine whether the use of Guided Discovery Learning models can improve students' critical thinking skills on immune system material as a process in learning biology.

2. METHOD

A total of 69 students of class XI IPA in SMA Negeri 2 Rangkasbitung were used as respondents in this study. Respondents received immune system material in semester 2 of the 2018/2019 school year. Data collection in the form of multiple choice questions instruments. In this study formed two groups namely the experimental group (n = 35) taught with the GDL model and the control group

(n = 34) taught with the conventional model. Cluster Random Sampling is used for sample selection in the study area.

The study design uses posttest only group design with a quasi-experimental research type. This study was to determine the effect of using the Guided Discovery Learning (GDL) model on students' critical thinking skills.

Researchers come to the school and ask for permission from the principal and teachers at the selected school. The use of the GDL model and conventional learning models carried out for more than 4 weeks. For the GDL model group there were 35 students who were divided into 5 groups consisting of 5 students, the implementation of the GDL model was carried out for 4 weeks. Each GDL model meeting is 4 hours per week.

In the conventional learning model group followed by 34 other students for 4 hours per week for 4 weeks were given the same material as the GDL group namely the immune system. After 4 weeks posttest was given to assess critical thinking skills in both groups.

Questions are used to measure students' critical thinking skills and consist of 20 multiple choice questions with 1 correct answer. This question is specifically designed for students' critical thinking skills with 5 indicators, namely interpretation, analysis, evaluation, inference and explanation. The test is carried out for 40 minutes and each correct answer is given a score of 1 with a minimum score of 0 and a maximum score of 20. The test instruments are tested using validity and reliability.

The data that has been obtained are analyzed with the normality test to find out whether the data is normally distributed, the homogeneity test uses the Fisher test with a significance level of 0.05, and the hypothesis test with a significance test of 0.05). Test formula t [10]:

$t=\frac{\mathrm{X1}-\ \mathrm{X2}}{\mathrm{dsg}\ \sqrt{\frac{1}{\mathrm{n1}}-\frac{1}{\mathrm{n2}}}}$ with dsg= $\sqrt{\frac{(\mathrm{n1}-1)\mathrm{V1}+(\mathrm{n2}-1)\mathrm{V2}}{\mathrm{n1}+\mathrm{n2}-2}}$

Information :

$X1$: Average posttest of control class

$X2$: Average posttest of the experimental class

dsg: Combined standard deviation

$V1$: Standard deviation in the control class

$V2$: Standard deviation in the experimental class

$n1$: Number of control class students

$n2$: Number of students in the experimental class

The results of the study were in the form of a description of students' critical thinking skills data from the posttest using normality, homogeneity, and t test. Data is presented in the following details:

Table 1: Posttest result data in the experimental class and the control class

Component	Experimentation Class	Control class
Total students	35	34
The highest score	85	80
Lowest value	45	40
Average	65.57	60.29
Standard deviation (SD)	11.17	10.14
Normality test	8.54	10.08
Homogeneity Test	1.11	
Hypothesis testing	2.031	

Based on table 2 can be seen the average value of the critical thinking skills of the experimental and

control group students. The experimental group got a higher average value of 65.57 than the control group of 60.29. in addition, below are indicators of critical thinking skills of each experimental and control group.

Table 2: Posttest data on the ability to think critically in the experimental class

Indicator	Percentage	Category
Interpretation	60.95%	Medium
Analysis	62.86%	Medium
Evaluation	65.14%	Medium
Inference	67.86%	Medium
Explanation	69.29%	Medium

The critical thinking skills of the experimental class students of each indicator are classified as medium category, with aspects of interpretation (60.95%), analysis (62.86%), evaluation (65.14%), inference (67.86%), explanation (69.29%).

Table 3: Data posttest results of critical thinking skills of the control class

Indicator	Percentage	Category
Interpretation	59.80%	Medium
Analysis	69.85%	Medium
Evaluation	60.00%	Medium
Inference	56.62%	Medium
Explanation	55.15 %	Medium

The critical thinking ability of the experimental class students of each indicator is classified as medium category, with aspects of interpretation (59.80%), analysis (69.85%), evaluation (60.00%), inference (56.62%), explanation (55.15%).
From the two data above, it can be shown that there are differences in critical thinking skills in the experimental class and the control class. Comparison of experimental class indicators and control classes.

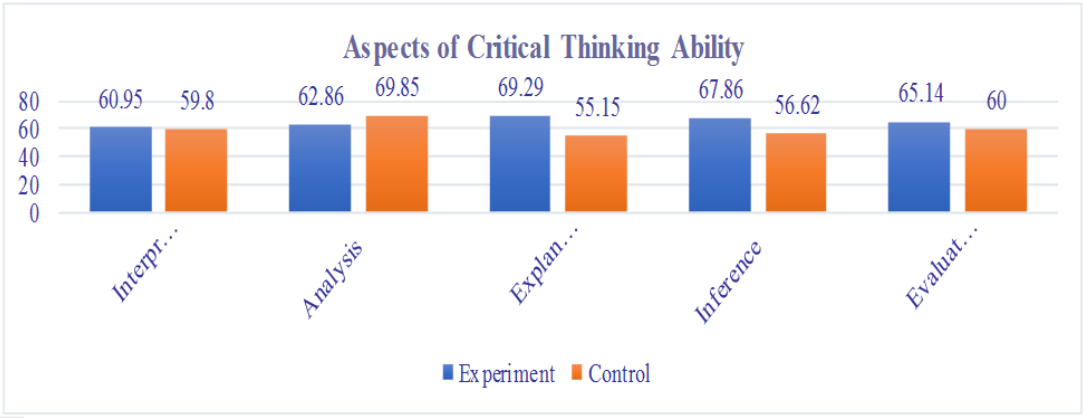

Figure 1: Comparison of indicators of critical thinking skills of the experimental and control classes

Based on Figure 1 it appears that the experimental class dominates. In the experimental class the highest critical thinking ability indicator was in the explanation aspect (69.29%). In the control class the highest critical thinking ability indicators in the analysis aspect.
Meanwhile, the lowest indicator in the experimental class is the interpretation aspect (60.95%) and the control class is the aspect of explanation (55.15%).

3. RESULTS AND DISCUSSION

Based on the results of the t-test hypothesis test results obtained H0 rejected and H1 accepted with a significance value of 2.031> 1,668 ($\alpha = 0.5$) which concluded that there is an influence of the use of guided discovery learning (GDL) models on students' critical thinking abilities on immune system material. Seen in table 4.1 that the average value of the experimental class (65.57) is higher than the control class (60.29). This is because in the GDL model students are given problems to be solved with the help of the teacher in giving directions, directions, coaching, and feedback to keep students on the path that has been set.
In addition, Discovery learning facilitates students' deep learning of fundamental understandings that see a problem from various perspectives. Guided discovery learning (GDL) has convergent thinking characteristics where the instructions given in statements or questions guide students in making discoveries that lead to the achievement of objectives. So that the teacher's role in GDL starts learning with stimulus and students respond by being actively involved so finding the right response [15].
The use of the GDL model is considered effective because it helps students find two criteria of active learning, namely (a) activating or building appropriate knowledge used to understand new information (b) integrating new information with a prior knowledge base [9]. Strengthened by research [19] which states that GDL places more emphasis on students' direct learning experiences through discovery activities and is applied to everyday life. GDL syntax consists of orientation, generating hypothesis, testing hypothesis, and conculsion. With GDL syntax that involves students to be active, students can construct their own understanding and improve their critical thinking skills.
A study explaining critical thinking can be improved if the teacher creates a classroom environment that supports active thinking. Critical thinking can be improved by conditions where students communicate with each other in solving a problem at hand. Thus students can freely explain their ideas. The critical thinking aspects used are interpretation, analysis, explanation, inference and evaluation.
The results of the percentage of critical thinking skills on the interpretation aspects of the experimental class (60.95%) are higher than the control class (59.80%). Then students are able to interpret or understand the examples of statements about the benefits of vaccination in the body. If seen the results of the experimental class and the control class have a difference of 1.15% is not significantly different. Field facts when given a posttest problem students do not do seriously. Like research states that the critical thinking ability of male students is lower than that of students because they are given a posttest problem do not do it seriously. However, in the syntax of GDL namely orientation, hypothesis generation and hypothesis testing can trigger students' critical thinking skills on aspects of interpretation because students first build their knowledge, make hypotheses with exploration, and examine hypotheses that have been made [19]. Guided learning involves the number of questions students ask until they get the right questions [5]. As for the control class that does not use the GDL model, students actively do percentages in front of the class and other students just passively listen.
The results of the percentage of critical thinking skills in the experimental class analysis aspects are (62.86%) lower than the control class (69.85%). Then students are able to analyze a statement

for example analyzing the right reasons about non-specific immunity. The syntax of GDL hypotesis generation and hypotesis testing can trigger critical thinking skills because students are required to bring up problems after that formalizing the problem by analyzing a phenomenon and raising temporary allegations that are not yet known [19]. Where the aspect of analysis requires students to bring prior knowledge related to a problem, identify the root problems that exist, and identify keywords from the answers needed [2]. But the results show that the experimental class is lower. This is because students are not familiar with the type of critical thinking questions in the analysis aspect. It's the same with research [14] that the data analysis indicator shows the lowest increase of 43% this is due to students not familiar with the type of analysis questions. A study explains the lack of standards needed to develop students' critical thinking skills on aspects of analysis, such as learning environments (intrinsic and extrinsic motivation) that are less effective for learning [18]. In addition, according to the study, an increase in students' critical thinking skills related to the learning environment is identified through personal relevance, uncertainty, and voice critic. These three factors explain 22% of the variance of the scores obtained for critical thinking skills [8].

The results of the percentage of critical thinking skills on the experimental class evaluation aspects (65.14%) are higher than the control class (60.00%). Then students are able to evaluate or interpret a statement for example the interpretation of the effects of a weakened immune system that occurs in children with autism. This is because in the syntax of the GDL model in the regulation phase students are given the task to process the data findings and after that evaluate [19]. After getting all the information students are given the opportunity to assess the credibility of the data findings. Supported statement that the evaluation aspect of students' critical thinking skills is required to be able to assess the credibility of a case. States students are motivated to assess the credibility of a statement and examine the truth of the analysis results of a photo or phenomenon. While in the control class students are only active to take notes and listen to friends who are presenting.

The results of the percentage of critical thinking skills aspects of the experimental class inference that is (67.86%) higher than the control class (56.62%). Then students are able to draw the conclusions of a statement for example drawing conclusions about the relationship of sports with the immune system in the body. This shows that the syntax of the GDL model triggers students' critical thinking skills on the aspect of inference in the Conculsion phase [19]. Where in this phase students review the data findings before making a conclusion based on the hypothesis in the hypotesis generating and hypotesis testing phases. Aspects of inference students' critical thinking skills are required to make conclusions with rational reasons based on the data that has been collected. And research [17] states before making conclusions students consider the information found in accordance with the problem.

The results of the percentage of critical thinking skills on the experimental class explanation aspects are (69.29%) higher than the control class (55.15%). Then students are able to explain a statement for example explaining the mechanism of the immune system. In the syntax of the GDL model the regulation phase provides opportunities for students to be actively involved in learning because GDL is study centered so students will better understand the concept and when asked to explain students can give their opinions well [19]. Which states that the aspect of explaining the ability of students' critical thinking is required to provide an explanation of a reason that is in accordance with the evidence, concepts and context [11, 12].

CONCLUSION

Based on data analysis and discussion on every aspect of critical thinking skills shows that there is an influence of Guided Discovery Learning models on students' critical thinking abilities on the immune system. The difference in treatment in the two classes is the experimental class using the GDL model while the control class uses ordinary learning (without the GDL model).

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