

[Research Article]

## APPLICATION OF THE DISCOVERY LEARNING MODEL TO IMPROVE CRITICAL THINKING ABILITY IN VIBRATION AND WAVE MATERIALS

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### ABSTRACT

The aims of this study are (1) to determine the quality of discovery learning learning models in improving students' critical thinking skills, (2) whether discovery learning models can improve students' critical thinking skills. This type of research is Classroom Action Research with the Lewin model. The subjects of this study were 30 Junior High School students. Data was obtained from the observation sheet multiple-choice test with reasoned. The results showed that, (1) The application of the discovery learning learning model can improve students' critical thinking skills in students' science learning, this can be seen from the results of the observation analysis of the implementation of the discovery learning learning model cycle I and cycle II which experienced a good increase of 18, 07%, that is from 62.93% to 81%. (2) There is an increase in critical thinking skills by applying the discovery learning learning model in terms of aspects, namely critical thinking indicators, namely the first cycle of 65% and the second cycle of 77% with an increase of 12%. Based on the results, applying the discovery learning model can improve students' critical thinking skills in science learning with good improvement.

Keywords: Critical Thinking, Discovery Learning, Science learning, Vibration and Waves, Classroom action research

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## 1. INTRODUCTION

Today's students need to have a critical mind to be able to solve problems found in daily activities. Solving these problems needs to be based on sufficient logical thinking to reason about a problem, interpretation of problem solving, analysis and evaluation of problems or information obtained in making the right decisions (Oa, 2020; Kuku, 2020). Critical thinking is one of the useful abilities to support students in the long term to be able to increase the level of creativity of students in the profession that will be chosen later (Agustiana, 2019). The same statement was expressed by (Shakirova, 2007; Ibrahimi, 2021; Mozafari, 2021), it is very important for students to have critical thinking in solving social problems scientifically, effectively and practically. Michael (Fisher A., 2009) reveals that critical thinking is one of the academic abilities that is equally important when compared to writing and reading competencies. So it can be concluded that critical thinking is an active and skilled embodiment and evaluation of observation and communication, argumentation and information. Critical thinking is very necessary in equipping students in changing times and new challenges in the current era (Hussin, 2018). That way students are able to find solutions to problems effectively and can be held accountable for changes in society 5.0 and industry 4.0.

Based on interviews with science teachers, it was stated that SMP NU Bululawang had implemented the 2013 curriculum, but the lecture method was still carried out in classrooms in the science teaching and learning process. This can happen because teachers do not understand and have not been able to apply the 2013 Curriculum properly. Based on the results of observations in class VIII.2 in carrying out the science learning process, when asked a question students still cannot provide a simple explanation or mention examples, students have not been able to analyze a given problem, when given a question students have not been able to evaluate or prove a problem and combine or collect data and students do not dare

to argue or conclude a given problem. Finally, the learning process is not as expected, the learning objectives are not achieved properly. The science teacher also stated that the difficulty faced was the demand for more material than class hours so that the lesson was dominated by the teacher by mostly using a learning model that emphasized a method, namely lectures and occasional demonstrations. This causes students not to focus their attention and feel bored when learning takes place so that when the teacher gives questions the students cannot answer correctly. The average cognitive learning outcome is 72.4 while the determination of the KKM used in schools at the VIII grade level is 75. Judging from the completeness of learning only 20 students out of 31 students (78%). So it can be concluded that the completeness shown in student learning outcomes is still considered low.

Thus, the learning method used is necessary to train the development of students to become more skilled in analyzing and critically assessing information. Good packaging of learning methods needs to be done so that the learning process takes place in a fun and conducive manner as a maximum delivery of material. Discovery Learning, this model is carried out by working independently by students from looking for problems to working, this can make students continue to remember the methods used to solve problems in questions (Arif, 2020). The discovery learning model requires students to identify or examine a learning concept on their own and play an active role because educators present a learning material that begins with providing stimulation so that students are forced to think (Indarti, 2019; Astiti et al, 2021). The following are the characteristics of the discovery learning model: (1) students play an active role; (2) studying and finding solutions to a problem so as to find new things, assemble, and form general ideas or conclusions from an event or problem; (3) the follow-up combines an idea or ideas that have been formed with existing knowledge, (Nurhadi 2020). Permatasari et al (2018) explains that there are several procedures in conducting discovery learning models, namely:

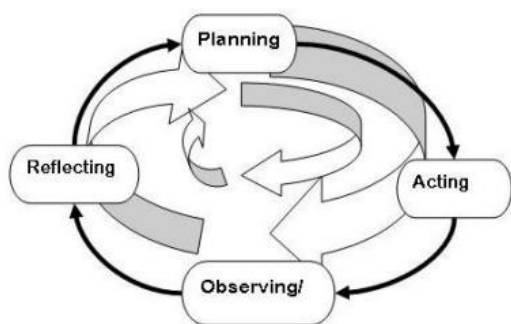
(1) providing stimulation; (2) problem identification (problem identification); (3) collect information (data collection); (4) perform information processing (data processing); (5) verification; and (6) drawing conclusions (generalization). Therefore, discovery learning is considered capable of increasing critical thinking in students.

The purpose of this research is to know the improvement of students' critical thinking skills through learning the Discovery Learning model on vibration and wave materials.

## 2. METHOD

### 2.1 Type of Research

In this study, the type of classroom action research is collaborative and participatory, which means that the researcher conducts research independently but still cooperates with the science teacher class VIII.2 SMP NU Bululawang which is carried out at the planning, implementing, observing and reflecting stages. Kurt Lewin's model was used in this research design.



**Figure 1.** Lewin's model of action research. (Coe, 2021)

### 2.2 Setting of Research

#### 2.2.1 Research Sites

SMP NU Bululawang was chosen as the research location because the school carried out face-to-face teaching with students.

#### 2.2.2 Research Time

This research was conducted in April 2021 for the 2020/2021 school year. The main material presented is vibration and waves because the material is abstract but is closely related to everyday life.

#### 2.2.3 Research Subject

The action subjects in this study were students from class VIII.2 SMP NU Bululawang with a total of 30 students as well as peers and class teachers acting as participants in this study. These subjects were chosen because their critical thinking skills are still low and need to be improved.

### 2.3 Research Instrument

The instruments used in this research are critical thinking test questions, LKPD and learning implementation sheets. The test questions are in the form of multiple choice containing the answers to the reasons with a total of 10 questions and 5 description questions. The test questions are arranged based on critical thinking indicators. This test question is used after the discovery learning model is implemented.

LKPD consists of experiments that are arranged based on the discovery learning learning model. This instrument has a purpose in analyzing the development of students' critical thinking skills in each teaching and learning process. LKPD is done in groups.

To make observations on the activities of students and teachers with learning planning, namely using a learning implementation observation sheet made in the form of a checklist and using a Likert scale.

### 2.4 Data collection technique

In collecting the data used in the study, it was done by means of a written test and observation with details, including:

### 2.4.1 Learning Implementation

Assessment of the implementation of learning by using Discovery Learning (DL) is carried out using an observation sheet on the implementation of learning. The research will be carried out by observers who are carried out to make observations in the learning process when it is carried out by the teacher. In this observation sheet using alternative points. The following assessment using alternative points on the observation sheet is presented in Table 1.

**Table 1.** Criteria for the assessment of the implementation of learning scores, (Wang, 2021)

Score	Criteria
4	Very precise
3	Precise
2	Quite precise
1	Less precise
0	Not precise

The criteria used to determine the level of achievement of the successful implementation of the learning model are as listed in Table 2.

**Table 2.** Criteria for assessment score (%) implementation of learning (Wang, 2021)

Criteria for success rate	Description
80 - 100	Very good
61 - 80	Good
41 - 60	Quite good
21 - 40	Not too good
00 - 20	Not good

### 2.4.2 Critical Thinking Ability Test

In order to get data from students' critical thinking skills, a scoring of students' answers for each item is carried out, the score assessment applies to multiple choice questions and description questions. The scoring criteria used are a modified rubric from Facione (1994) and Ismaimuza (2013) in Karim (2015)

**Table 3.** Scoring of students' critical thinking ability

Description	Score
Does not answer the question	1
Wrong answer to the question is not accompanied by a reason	2
Wrong answer to the question accompanied by reasons	3
Answer the question correctly accompanied by an incorrect reason	4
Answer the questions correctly accompanied by the right reasons	5

In critical thinking observations obtained from this study were analyzed statistically with the percentage technique (%) using the formula (Karim, 2015).

$$N = \frac{\sum score}{\text{maximum score}} \times 100\% \quad (1)$$

The calculation results are then qualified using the criteria presented in Table 4 (Coe, 2021).

**Table 4.** Criteria for students' critical thinking

Percentage (%)	Criteria for students' critical thinking
92-100	Very high
75-91	High
50-74	Medium
25-49	Low
00-24	Very low

### 2.5 Data Analysis Techniques

The data obtained by the researcher is analytical data used to measure critical thinking skills in cycle I & cycle II. The data was obtained from the results of the critical thinking ability test with scores for each critical thinking indicator. The data is then percentage. Thus it can be seen the extent of the improvement that has been obtained in learning. The results of data analysis are then presented descriptively. Giving levels on the ability to master critical thinking can use the 100 system, which is described by Ngalim (2004), the assessment criteria are in Table 5. The percentage calculation uses the equation 2.

$$Np = \frac{R}{SM} \times 100\% \quad (2)$$

where NP is the percentage value, then R is the raw score obtained and SM is the maximum score. The data from the analysis of students' critical thinking skills in cycle I & cycle II were then assessed on the average obtained and seen the comparison between the first cycle and the second cycle. If there is an increase, it means that the learning model carried out by the Discovery Learning (DL) can be used to increase students' ability to think critically in Physics Science lessons with the theme of vibrations and waves.

**Table 5.** Assessment criteria

Percentage	Criteria
≤54%	very less
55-59%	less
60-75%	Enough
76-85%	Good
86-100%	Very good

### 3. RESULT AND DISCUSSION

#### 3.1 Results

##### 3.1.1 Data on the Implementation of Cycle I and Cycle II Learning Activities

Based on the data processing from the observation of the implementation of the Discovery Learning (DL) learning model found by the observer, it is known in Table 6 below.

**Table 6.** Learning feasibility for each cycle

No.	Learning Activities	Percentage	
		Cycle I	Cycle II
1	Stimulus	70,83%	86%
2	Formulation of the problem	68,75%	82%
3	Data collection	63%	75%
4	Data processing	62,5%	82%
5	Verification	50%	75%
6	Generalization	63%	88%
	Implementation of the Learning Process Cycle I and Cycle II (%)	62,93%	81%

#### a. Critical Thinking Skills

The results of the critical thinking test carried out using Discovery Learning (DL) seen in Table 6 are known as follows.

**Table 6.** Critical thinking improvement data

Critical Thinking Indicator	Cycle I	Cycle II	Difference
Interpretation	70%	80%	10%
Analysis	64%	76%	11%
Evaluation	61%	75%	14%
Inference	65%	78%	13%
Average	65%	77%	12%

### 3.2 Discussion

#### 3.2.1 Learning Implementation

In the ongoing learning process and using the Discovery Learning method, it was found that the observation data on the implementation of learning was carried out with the stages of providing stimulus, finding the main problem, collecting data, processing data, verifying and making decisions. There is an increase in discovery learning which is shown in table 5 in cycle I & cycle II.

In cycle II, there was an increase in success of 81% which was categorized as good. This increase was caused by researchers and students having adapted to the application of discovery learning models during lessons which had an impact on the delivery of material that researchers could memorize. In addition, students are already active in learning activities starting from the stimulation stage to the generalization stage.

##### 3.2.1.1 Stimulation

Stimulation stage which consists of giving apperception. Based on the data in table 5, it can be seen that there is an increase in the percentage at the stimulation stage of 14.84%. This is because the shortcomings in Cycle I, namely when the teacher conveys the apperception is still less detailed and is still centered on one student, it can

be overcome in Cycle II by conveying the apperception in detail and clearly so that students tend to have a desire to know more and are interested in the learning process carried out. At this stage students are trained to be able to interpret or provide explanations related to lessons or a problem at hand.

### *3.2.1.2 Problem statement*

In the Problem statement stage, which consists of the teacher explaining the problem that must be solved by the students. Based on the data in table 5, it can be seen that there is an increase in the percentage at the problem statement stage of 13.25%. This is due to deficiencies in Cycle I, namely students who do not understand the problems given because the teacher or researcher does not explain the description of the problems given can be overcome by the way the teacher explains the description of the problems given. So that in cycle II students understand a problem they are facing. At this stage students are trained to analyze as a goal to observe a real problem.

### *3.2.1.3 Data Collection*

At the data collection stage, which consists of activities to assist students in collecting data. Based on the data in table 5, it can be seen that there is an increase in the percentage at the data collection stage by 12%. This is because in the first cycle the teacher does not control the students so that it looks like there are groups that are still busy playing and are not serious in finding or collecting data. So that in Cycle II there were no groups that were busy playing and students became serious in finding or collecting data. At this stage students are trained to think and analyze a problem at hand.

### *3.2.1.4 Data Processing*

In the data processing stage, which consists of guiding students to work on worksheets. Based on the data in table 5, it can be seen that there is an increase in the percentage at the data collection stage of 19.5%. This is because of the

shortcomings in cycle I, namely many students have difficulty answering questions and finding solutions because the teacher does not guide students and rarely provides assistance for students to complete them so that students are not on time in doing LKS, can be overcome by the way the teacher guides students and provides assistance in solve the problem. So that in Cycle II, most of the groups had finished working on the worksheets on time. At this stage students are trained to analyze a given problem.

### *3.2.1.5 Verification*

At the Verification stage, which consists of activities to prove by carrying out experiments. The data in table 5 shows that this stage was not fully implemented. This is because the shortcomings in Cycle I are that there are groups that are not conducive and practical tools & materials are used as toys by students and many students have difficulty in analyzing data and finding solutions because teachers do not guide students and rarely provide assistance to students to complete them, can be overcome by the teacher giving warnings to busy students and guiding students to carry out experiments and guiding students in analyzing data. So that in Cycle II students are not crowded anymore and students are able to analyze data in a timely manner. At this stage, students are trained or accustomed to analyzing and evaluating a problem that aims at making decisions.

### *3.2.1.6 Generalitation*

At the generalization stage which consists of concluding learning activities. Based on the data in table 5, it can be seen that there is an increase in the percentage at the generalization stage by 25%. This is because the shortcomings in Cycle I are that some questions are still empty of answers or do not complete the LKS in the conclusion section. This can be overcome by the teacher giving warnings and controlling each group, so that in cycle II students no longer leave blanks or work on the conclusion section on the worksheet. At this stage students are trained or accustomed

to conclude or infer a problem that has been given and students are able to make and consider the value of decisions so that students can find out the background of a problem.

### 3.2.2 Critical Thinking Ability

Critical thinking ability in this study was measured using the instrument of students' critical thinking skills which were divided into 4 indicators. Observational data on students during learning activities are known to increase students' critical thinking from Cycle I to Cycle II, from the learning outcomes of cycle I and cycle II the average critical thinking ability increased by 12%, where from cycle I by 65% to cycle II by 77%.

The increase in students' critical thinking was caused by the assistance of experiments and the delivery of Vibration and Waves material. In accordance with the opinion of Hosnan (2014: 282) which states that discovery learning is a model used in the development of active learning through the independence of students in solving problems, it is hoped that the results shown by students can remember in the long term. In this method students learn to analyze and try to solve their own problems which is indicated by the involvement of students in making observations, looking for evidence and making conclusions based on the information obtained.

This finding is in line with (Sutoyo, 2019) in his research proving discovery learning has a positive impact on improving students' critical thinking skills. And the results of this study are relevant or other appropriate, research (Susanti, 2020; Batubara, 2020) found that a significant effect is shown when students are able to learn with the discovery learning method on more critical thinking in students. Expressed by (Sri Hartati, 2020) who explained that the application of discovery learning was able to help students become more proficient in critical thinking and collaborate in science lessons. Students who are proficient in discovery learning are able to provide simple explanations, dare to ask and are

able to answer the questions posed to them, able to build basic skills, namely making judgments regarding sources that are accurate or not and able to draw conclusions based on evidence. which has been obtained. Juniarso (2020) and Siregar (2018) proves that in his research there are significant differences in students who study with the discovery learning method showing better results than expository learning.

Based on the results of the analysis obtained, the ability of students to think critically is strongly influenced by the learning model used and it is proven that the discovery learning model is able to significantly improve students' critical thinking. (Rahayu, 2019) in her research proves that the application of discovery learning helps students develop critical thinking. (Oktaviani, 2018) explains in his research that if students are given Discovery Learning, it can affect students' thinking skills to be more critical. Other findings that are in line with the results of this study were carried out by (Dian Nafisaa, 2019) which stated that discovery learning can help students to fulfill two important requirements in active learning, namely activating new understandings in students and integrating new information obtained until students can determine knowledge. correct. Students' critical abilities can also be improved by selecting good and appropriate media. According to (Toni Hidayat, 2019) who proved in his research that the discovery learning method helped students in honing their critical thinking skills. This is because the steps in this method require students to be independent and actively solve the problems in the questions and no longer just listen to the teacher's explanation.

## 4. CONCLUSION

Based on the explanation of the discussion data obtained from the research results, the conclusions that can be drawn from this research are: 1) The quality of the implementation of learning by using the Discovery Learning (DL) learning model in Physics Science subjects at

Nahdlatul Ulama Middle School in class VIII.A is quite good; 2) The application of the Discovery Learning (DL) learning model can improve students' critical thinking skills in science subjects at Nahdlatul Ulama Middle School in class VIII.A.

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