

# Implementation of Discovery Learning Model Assisted by E-Module to Improve Students' Critical Thinking Skills on Global Warming Material Quantitative Study

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**Abstract** - Critical thinking skills are one of the competencies that students must have in the 21st century. Students' critical thinking skills in Indonesia are still categorized as low because these skills are not provided in learning activities, especially in physics subjects. This study aims to determine the effectiveness of applying the discovery learning model with the help of e-modules in improving students' critical thinking skills on global warming material. Quantitative method with Pre-Experimental Design design in the form of One Group Pretest-Posttest. The research sample amounted to 30 students from one of the State Madrasah Aliyah in Garut Regency, which was selected through random sampling technique. This research instrument consists of 5 essay questions that measure critical thinking skills and 16 questionnaire statements to measure student responses. The research data obtained were analyzed using the Normalized Gain test for essay questions and percentages for student response questionnaires. The results showed an increase in the N-Gain of students' critical thinking skills of 0.66 with a moderate category. While for the student response questionnaire after learning activities with a positive interpretation. This shows that discovery learning assisted by e-module on global warming material can improve students' critical thinking skills. The application of the discovery learning model with the help of e-modules can be an effective strategy to improve students' critical thinking skills, especially on global warming material. Physics teachers can consider using it to better prepare students for the challenges of the 21st century.

**Keywords:** Discovery Learning Model; E-Module; Critical Thinking.

## INTRODUCTION

Learning activities in the classroom are part of an educational process that aims to bring a situation into a better state than before. Learning in the classroom requires students to be able to understand material or concepts and be able to relate the material or concepts received in everyday life. The material or concepts received can generally be found in everyday life or even experienced by the students themselves. In the 21st century, schools are required to have creative thinking, critical thinking and problem solving, communication, and collaboration skills or commonly referred to as the 4Cs. According to Wayan (2019) 21st century skills are important skills that must be mastered by everyone in facing life in the

21st century. (Rosmawati, 2023) argues that one of the thinking skills that students must have is critical thinking skills.

(Martini, 2018) states that the learning system in Indonesia is currently plagued by problems, namely inadequate learning and moral crises occurring in society, even some of the schools still have not reached standards, especially in remote areas there are still complaints that the government has not paid attention to. This is due to the learning that is mostly carried out still using conventional learning which only emphasizes the demands of the curriculum so that in practice students are passive and narrow the mindset about a problem they learn. As a result, students are unable to

develop higher thinking skills in solving problems (Adi & Dian, 2022).

Physics learning is a learning process that involves students in studying natural phenomena through a series of scientific processes built on the basis of scientific attitudes to gain knowledge, skills and attitudes (Rizka, Putri et al., 2017). Many students think that physics is one of the difficult and complicated subjects with formulas (Mardiana, 2021). In physics learning in schools, many show that the average physics learning outcomes are lower than the learning outcomes of other subjects (Memes. 2011; Rizka, Putri et al., 2017). In learning physics, students can also develop critical thinking skills (Puspitasari & Nurhayati, 2019).

Based on the results of preliminary studies conducted by researchers, it was found that: (1) students consider physics subjects difficult, (2) students are less prepared in the learning process so that it triggers the low critical thinking skills of students in studying physics subjects, (3) teachers do not apply varied learning in improving students' critical thinking skills, (4) student learning outcomes in the physics learning process still do not reach KKM. (5) students have difficulty in learning physics material, especially in Global Warming material. This is reinforced by the results of observations made at MAN 3 Garut that 83% of students have difficulty solving physics problems. The model used by the teacher is less varied, one of the problems is that the teacher only applies the lecture method and then students are assigned to do a large number of problems.

The problems that have been stated, there is a need for a learning model and teaching materials that can promote active learning between students and teachers. One way to make learning in the classroom students are actively involved by applying

the discovery learning model with the help of e-modules. The discovery leaning model is a learning model designed with the aim of helping problems in everyday life, developing a problem-solving ability. (Fitira, 2023).

The facts that have been presented show that the physics learning process in schools is important to be improved. So, according to the researchers, the solutions that can be done include: 1) Provide a variety of teaching materials that can be easily understood by students; 2) Using the discovery learning model in the learning process so that students can find their own concepts and think critically in doing exercise problems; 3) Changing the role of the teacher who previously provided information (transfer of knowledge) to encourage learning (stimulation of learning); 4) A teacher needs to develop his own teaching materials according to the characteristics of students such as e modules that contain animations, images, videos, simulations, verbal, mathematical equations, graphs, and are equipped with examples and evaluation questions to train critical thinking skills so that students can be active and responsible for their learning.

The use of electronic modules in learning can be integrated with the internet, can directly play videos and music and take quizzes presented (Puspitasari, 2019). Then (Laraphaty et al., 2021) mentioned that the use of e-modules is very helpful for educators in the classroom learning process and can help students in the learning process independently, understand the material and can increase learning outcomes and interest in learning from students.

However, from previous studies, it is still rare to examine the use of teaching materials in the form of e-modules using the discovery learning model to train students' critical thinking skills. The use of e-modules

as an aid to teach high school students is expected to be carried out in accordance with their cognitive level. E-module teaching materials can reduce teacher-oriented learning (teacher center), students are more directed in finding concepts, more active in learning, improve critical thinking skills and increase intellectual potential in this case is a learning goal. E-modules that will be used in learning discovery learning models in the form of a website, namely heyzine flipbook.

The application of the discovery learning model is considered successful in improving students' critical thinking skills if it has reached a level of learning completeness that is considered good. Therefore, researchers are interested in conducting research on improving students' critical thinking skills entitled: Application of Discovery Learning Model Assisted by E-Module to Improve Critical Thinking Skills of High School Students on Global Warming Material. This study aims to identify the application of the discovery learning model with the help of e-modules to improve students' critical thinking skills on global warming material. To be able to achieve the research objectives, the following research questions were formulated 1) How is the implementation of discovery learning model with the help of e-module on Global Warming material; 2) How is the improvement of students' critical thinking skills after learning the discovery learning model with the help of e-modules on Global Warming material; 3) How do students respond after the implementation of discovery learning model with the help of e-modules on global warming material? The contribution of this research is that high student motivation certainly has better critical thinking skills than students with moderate or low learning motivation. It is expected that teachers can foster physics learning motivation in students in various

ways according to the teacher's ability and interesting for students to realize learning in the 21st century.

## RESEARCH METHODS

The research method used in this study is a quantitative research method Pre-Experimental Designs with the form of One Group Pretest-Posttest. According to Arikunto (2013) observations in this design were made twice, namely before the experiment and after the experiment. The test conducted before the experiment is called the pre-test and the test conducted after the experiment is called the post-test. The pre-experiment design is used to test the improvement of students' learning abilities in the cognitive domain. The researcher's rationale for choosing this method is because the researcher aims to test and determine the application of using the discovery learning model assisted by e-modules to improve students' critical thinking skills. In addition, because it only uses one group, there is no comparison group to see if the changes that occur are really caused by the treatment given or other factors outside the study.

This research was conducted at Madrasah Aliyah Negeri 3 Garut. The population of this study were all grade X students. The research sample was determined using the random sampling method. The sample in this study was class X-E at the school which amounted to 30 students. Data collection techniques are done through pre-test and post-test. The critical thinking skills instrument used consisted of 14 essay questions that were done before treatment (pre-test) and after treatment (post-test). Teacher observation sheet with the aim of obtaining data on the implementation of the learning process using the discovery learning model with the help of e-modules. The observation was conducted by the teacher to observe the

Source: Hake (1998) researcher in the learning process. The observation sheet instrument contains a list of identities (teacher's name and day/date), instructions for filling in with scoring carried out with a value of 1 to 4. Then the percentage of the implementation of the discovery learning learning model assisted by e-modules at each level is calculated using the equation:

$$\alpha = \frac{\text{Accomplished score}}{\text{Total score}} \times 100\% \quad (1)$$

Apart from using percentages, the implementation of learning can also be seen by analyzing the notes given by the observers. The research instrument used to measure students' critical thinking skills in this study is to use pretest and posttest instruments in the form of descriptions totaling 5 questions on global warming material to determine the application of the Discovery Learning learning model assisted by e-modules to improve critical thinking skills according to (Tiruneh et al., 2017).

**Table 2.** Instrument Assessment Rubric

Aspects	Assessment			
	0	1	2	3
Answers obtained	No answer	Incomplete answer	Complete answer, but some are wrong	Complete answer and written correctly

Essay question assessment score:

$$\text{Nilai} = \frac{\text{jumlah perolehan skor}}{\text{skor maksimal}} \times 100 \quad (3)$$

Student response is a social reaction carried out by students in response to influences or stimuli from situations carried out by others. Student response in this study is the response or response given by students after using the e-module. The student response to the e-module uses a student response questionnaire. The measurement plan uses a Likert scale with 4 rating scales, namely strongly disagree (SD), disagree (D), agree (A), and strongly agree (SA). The questionnaire is arranged based on 3 aspects,

The N-Gain test was carried out with the following equation.

$$\langle g \rangle = \frac{\langle \text{Posttest} \rangle - \langle \text{Pretest} \rangle}{100 - \langle \text{Pretest} \rangle} \quad (2)$$

Description:

$\langle g \rangle$  = N-Gain value

$\langle \text{Pretest} \rangle$  = pretest score

$\langle \text{Posttest} \rangle$  = posttest score

The N-Gain values obtained were then interpreted based on the criteria according to Hake (1999) as in Table 1.

**Table 1.** N-Gain Interpretation

N-Gain	Criteria
$\langle g \rangle < 0,3$	Low
$0,3 \leq \langle g \rangle \leq 0,7$	Medium
$\langle g \rangle > 0,7$	High

Source: Hake 1999

This question is given at the time of the pretest and at the time of the posttest is equipped with an assessment rubric.

namely responses with relevance indicators and reaction aspects with indicators of interest, satisfaction and confidence. The questionnaire was given after the physics learning process on Global Warming material to class X students of MAN 3 Garut who were selected as research subjects.

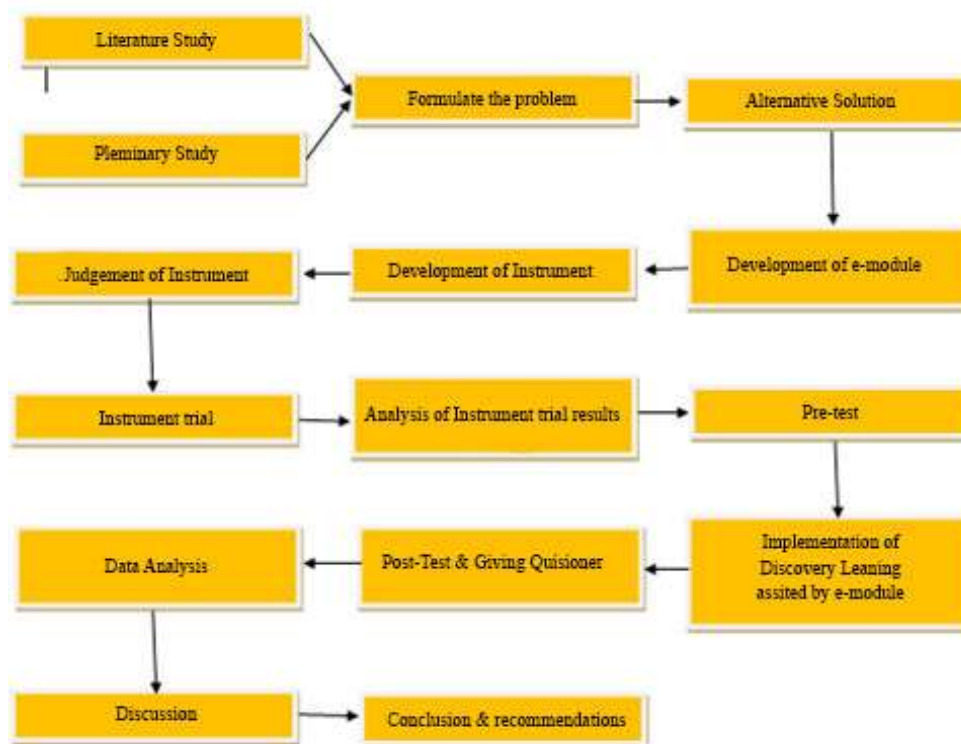
**Table 3.** Distribution of Response Questionnaire Items

Aspects	Indicator	Question Item
Response	Relevance	1-4
Reaction	Interest	5-8
	Satisfaction	9-12
	Confident	13-16

The results of each scale obtained can be converted into a percentage with the following calculation:

$$\% = \frac{\text{Jumlah yang diperoleh}}{\text{Total jumlah keseluruhan}} \times 100 \quad (4)$$

Research procedures used in the study (Figure 1).



**Figure 1.** Research Procedure

In the data collection technique in this study through observation, at the implementation stage students will be given an initial test (pretest) to determine the initial knowledge of students before being given learning using the Discovery Learning model with the help of e-modules, carrying out learning using the discovery learning model with the help of e-modules on global warming material with a predetermined schedule, carrying out the final test (posttest) to determine the final knowledge of students after being given learning using the discovery learning model with the help of e-modules, after the implementation of learning, the teacher is given an observation sheet related to the implementation of the discovery learning model with the help of e-modules and after the implementation of

learning, a student response questionnaire is given.

Validity according to Sugiyono (2018) shows the degree of accuracy between the data that actually occurs on the object and the data collected by the researcher to find the validity of an item, correlating the item score with the total of these items. The test validity test is a test used to determine which test questions have a sufficient level of validity so that they can be used to obtain valid data. This test is used to measure whether a test is valid or not. The test instrument is said to be valid if the statement on the test is able to reveal what the test will measure. Test instruments that have been made related to students' critical thinking skills on the subject of global warming are consulted with the relevant experts.



The validity test was carried out by experts (three lecturers and one teacher) on the test instrument. Each expert is given a test instrument and a validation sheet that has been provided in the form of a rating scale ranging from 0 which indicates that the question is not appropriate, to 3 which indicates that the question is appropriate. To process the results of the validity test by this expert using Aiken validity using Aiken validation (Aiken, 1985).

### RESULTS AND DISCUSSION

The research was conducted for 3 meetings (6JP) by providing treatment in the form of applying the discovery learning model assisted by e-modules on global warming material. The application of discovery learning was conducted for three meetings. The first meeting conducted a pretest to identify students' initial concepts, the second meeting provided treatment of the discovery learning model, the third meeting for the beginning of learning was carried out learning the treatment of the discovery learning model and then at the end of the learning provided a posttest to determine the response of students in discovery learning assisted by e-modules. In this study, the pretest was conducted outside of learning and the posttest was completed. The pretest was conducted a few days before the learning took place and the posttest was conducted on the same day after learning (treatment) was the completed.

**Table 4.** Recapitulation of the percentage of learning implementation of discovery learning assisted by e-modules

Observer	Percentage Implementation (%)	Category
Observer 1	90,6%	Very good
Observer 2	92,7%	Very good
Average	91,6%	Very good

The learning implementation was measured through the learning implementation observation sheet by two observers. Each observer filled in the implementation observation sheet and the observation data was processed in the form of a percentage of learning implementation.

The improvement of students' critical thinking skills was analyzed using N-Gain based on data from students' pretest and posttest results. The aspects of critical thinking skills measured are (1) Giving reasons, (2) Thinking as hypothesis testing, (3) Analyzing arguments, (4) Analyzing possibilities and uncertainties, and (5) Problem solving and decision making. The N-Gain obtained was then interpreted using the criteria according to Hake (1999). The results of the N-Gain analysis are shown in

**Table 5.** Average Improvement of Critical Thinking Skills

Pretest	Posttest	<g>	Criteria
35,1%	77,5%	0,66	Medium

Based on Table 5. obtained the average pretest score of 35.1% and the average posttest score of 77.5% which shows an increase in critical thinking skills after being given treatment in the form of a discovery learning model assisted by e modules with the acquisition of N-Gain of 0.66 which is in the medium category. While the results of the analysis of critical thinking skills in each aspect are shown in Table 3. Below.

**Table 6.** Improvement of Critical Thinking Skills in Each Aspect

KBK	Pretest	Posttest	<g>	Criteria
Aspect 1	30	72,2	0,60	Medium
Aspect 2	34,4	77,7	0,66	Medium
Aspect 3	31,1	73,3	0,61	Medium
Aspect 4	34,4	76,6	0,64	Medium
Aspect 5	45,5	87,7	0,78	High

Based on Table 6. it can be seen that the N-Gain value obtained for each aspect varies in magnitude. N-Gain in the aspect of giving reasons has an N-Gain value of 0.60 with a medium category. The highest N-Gain value is in the aspect of problem solving and decision making which has a value of 0.78 with a high category, In the aspect of thinking as hypothesis testing of 0.66 with a moderate category. Then in the aspect of analyzing arguments of 0.61 with a medium category and in the aspect of analyzing possibilities and uncertainties of 0.64 with a medium category. Based on the research data, it can be concluded that in general students' critical thinking skills have increased after the application of the discovery learning model assisted by e-modules.

In the implementation of the e-module assisted discovery learning model, the student response questionnaire was followed by all students who were used as research samples. This response questionnaire was given after students participated in pretest, treatment, and posttest activities. The response questionnaire has 4 indicators, namely relevance, interest, satisfaction and confidence. The following is Table 7 of the student response questionnaire results.

**Table 7.** Recapitulation on Student Response Questionnaire Indicators

No	Response Questionnaire Indicator	No. Item	Score	Interpretation
1	Relevance	1-4	79.3%	High
2	Interest	5-8	77.9%	High
3	Satisfaction	9-12	77.%	High
4	Confident	13-16	78.5%	High
Average			78,2%	

Based on Table 7. for the relevance indicator, 79.3% of students gave the same opinion that they felt happy to follow the discovery learning model assisted by e modules in learning Global Warming

material by giving an assessment of agreeing and strongly agreeing. While 20.7% of students argued that they disagreed with the statement on the relevance indicator, students felt that the global warming material presented could not be applied in everyday life. Students argue that the quizzes in the Discovery Learning model with the help of e-modules with phenomena and their abilities answer less agree.

The attraction indicator shows that 77.9% of students give the same opinion that learning using videos and images in e modules is very interesting and fun. While 22.1% of students disagree that learning using videos and images in e-modules is very interesting and fun, the quizzes displayed are less interesting, they feel bored learning by using the Discovery Learning learning model with the help of e modules and they feel less interesting by studying things related to nature.

The satisfaction indicator shows that 77% of students argue in the first statement that they feel happy with learning using the Discovery Learning learning model with the help of e-modules on Global Warming material with an assessment of agreeing and strongly agreeing. While 23% of students argue that they are less happy with learning using the Discovery Learning learning model with the help of e-modules on Global Warming material, they do not feel satisfied following Discovery Learning learning with the help of e-modules and e-modules cannot be used anytime and anywhere with an assessment of less agree and disagree.

In the self-confidence indicator, 78.5% with a high category of students argue that they are motivated in participating in Discovery Learning with the help of e modules with an assessment of agreeing and strongly agreeing.

While 21.5% of students argued that they were not motivated in participating in

Discovery Learning with the help of e modules, they did not understand the causes of global warming around them, they did not feel enthusiastic about participating in Discovery Learning with the help of e modules with an assessment of less agree and disagree and they were less motivated in studying natural phenomena that occurred with an assessment of less agree and disagree.

This study shows significant differences before and after the treatment of discovery learning model assisted by e module on global warming material. Based on Table 4. the average percentage of the overall learning implementation is 91.6% Referring to Table 4. category of overall learning implementation is included in the "Very Good" category. So that the discovery learning model assisted by e-modules on global warming material as a whole in this study was very well implemented. Observation of the implementation of discovery learning learning activities assisted by e-modules was observed in terms of the implementation of students using the Learner Worksheet (LKPD). The LKPD is done in groups with the aim that learning activities using the discovery learning learning model assisted by e modules can be observed and there is discussion.

N-Gain on the aspect of giving reasons has a moderate category. In line with research conducted by (Agustiana, 2019) which states that in the aspect of giving reasons students have sufficient experience to answer these questions because when learning takes place they are used to direct interaction with the teacher. The highest N-Gain value is in the aspect of problem solving and decision making with a high category, this indicator measures students' ability to make assumptions in solving a problem. Students conduct investigations to solve problems that are contextual in nature,

so that an explanation of the problems obtained from basic skills is produced. In this indicator, students want the discussion of each problem to only focus on the material learned that day so that students can develop their basic skills and can analyze the problem properly and can provide reasons for their answers.

In the process of learning physics requires the ability to think critically to analyze the symptoms and phenomena that arise. (Ayu et al., 2013). To build critical thinking skills, students need to be faced with problems so that students construct their minds to find solutions with clear reasons. In the aspect of thinking as testing with a moderate category. Thinking as hypothesis testing is an effective way to solve problems, make decisions, and develop students' knowledge. By understanding the basic principles of hypothesis testing, students can become more critical learners. The increase in scores in the aspects of giving reasons, thinking as hypothesis testing, analyzing arguments, analyzing possibilities and uncertainties is not too much different. The lowest score increase was in the aspect of giving reasons. This increase occurred because researchers trained students on this aspect in the learning stages of the discovery learning model assisted by e modules and LKPD.

The increase in student learning activities is caused by many factors, including the Discovery Learning model which requires students to be more active in finding concepts and materials because it is equipped with e-modules, discussion activities that train students to be active in expressing opinions in group learning, responding to statements from both friends and teachers and asking questions about things that have not been understood in the presentation of group LKPD results. This is in accordance with the opinion of (Ridho &



Setyawan, 2022) the use of the discovery learning model with e-modules can increase student activeness as evidenced by an increase in student activeness and can also improve students' creative thinking skills. According to (Rahayu et al., 2023) stated that learning with the discovery learning model can improve student learning outcomes by increasing the value of learning outcomes and the target of students who are complete in learning.

According to (Haryanti & Saputro, 2016) states that the development of discovery learning-based math modules assisted by flipbook maker to improve students' concept understanding abilities on triangle material is feasible to be used by students by looking at the assessment of three material experts 82.03% stated that it was feasible to use. While three media experts 81.25% stated that it was feasible to use in the learning process. Based on this, the use of e-modules can be used in the learning process and can even improve students' understanding of concepts. The results of student responses to the discovery learning-based math module assisted by flipbook maker were found to be in the very good category. So the discovery learning-based math module assisted by flipbook maker is valid to be used to improve students' concept understanding ability on triangle material.

Based on the results above, students' responses to discovery learning assisted by e-modules overall students gave an assessment of agreeing and strongly agreeing with a value of 78.2% in the high category. So it can be stated that students' responses are good to the application of the discovery learning model assisted by e modules. This is in accordance with the opinion of (Anggraeni et al., 2023) that students have successfully carried out learning according to the syntax compiled and students strongly agree with the use of

teaching materials because it can facilitate collaboration skills, critical and creative thinking.

## CONCLUSION

The application of the discovery learning model assisted by e-modules has been shown to enhance students' critical thinking skills. The research concluded that the model was effectively implemented with a 91.6% success rate and received positive feedback from students. Improvements in critical thinking were noted across various aspects, with notable gains in problem-solving, decision-making, and argument analysis. However, the development of hypothesis testing and giving reasons remained at a moderate level.

Challenges were encountered during the initial stages, particularly in formulating problems, where students struggled to prioritize issues in question form. The researcher suggested providing clearer examples to help students better frame their questions. Future research should address other critical thinking indicators and focus on identifying students who struggle with problem formulation for more accurate results.

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