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## Development of Guided Inquiry-Based Physics e-LKPD to Improve Students' Critical Thinking Abilities

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Physics e-LKPD; Guided Inquiry; Critical Thinking Ability

### ABSTRACT

*The development of guided inquiry-based physics e-LKPD is based on the lack of learning media in the MAN 1 Yogyakarta physics subject that can help students think critically. The purpose of this research is to develop a proper, effective, and practical guided inquiry-based physics e-LKPD to help students improve their critical thinking ability. The method is the R&D 4D design model, including: define, design, develop, and disseminate. The data analysis technique used is quantitative. Quantitative data analysis is used to determine the level of feasibility, practicality, and effectiveness. The results showed that the guided inquiry-based physics e-LKPD that had been developed was feasible to apply with a percentage of 100% media experts, 89% material experts, and 100% language experts, and the e-LKPD was stated to be practical as seen from the achievement of teacher response sheets with an average of 100% and student response sheets with an average of 90.07%. The e-LKPD was also declared effective in terms of the post-test completeness achievement of 0.70 in the moderate category. Based on the results above, it can be concluded that the guided inquiry-based physics e-LKPD that has been developed is declared feasible, practical, and effective to use and can improve students' critical thinking ability.*

## INTRODUCTION

Technology and science continue to develop, making problem-solving skills very important in 21st century learning. 21st century learning must aim to form humans who are not only able to keep up with technological developments [1], but are also able to integrate this technology with real life in a meaningful way [2]. The use of technology in learning is a big challenge and opportunity for teachers to innovate in teaching methods such as teaching media [3]. The use of this technology is very important in learning to support learning to become more meaningful through learning media.

There are many learning media used in learning activities. The learning media used are usually audio, video, e-text, slides, hypermedia, etc. [4] [5]. The use of learning media in electronic form that does

not only contain learning material can help the learning process become more effective and efficient to improve students' abilities [6] [7]. Learning media makes students more interested in learning physics compared to explaining physics material only with lectures or PowerPoint presentations [8] [9]. Teaching media is a guide for teachers to help students develop their cognitive aspects through investigative or problem-solving activities [10]. One of the teaching media that teachers need in the learning process is the Electronic Student Worksheet (E-LKPD) [11]. The Electronic Student Worksheet (E-LKPD) is a student work guide that will make it easier for students to understand learning material in electronic form which can be applied using a desktop computer, notebook, smartphone or cellphone [12]. E-LKPD is one of the important learning media in learning physics.

Physics is a very important science and must be studied at school. Physics provides a basic conceptual and theoretical framework for the development of technology and other natural sciences [13]. Physics theory can be applied in everyday life, making the material more relevant and meaningful for students [14]. Physics shows that it is a form of science that includes facts, concepts, principles, laws, formulas, theories and systematic scientific methodology [15]. One of the physics concepts related to natural phenomena such as global warming, must be observed and thought logically by students [16]. Physics concepts can be easily understood by students if students have critical thinking skills.

Critical thinking skills are an organized and clear method of mental activity, namely problem solving, decision making, scientific operational discovery, and analysis of assumptions [17]. The ability to think critically is seen as a basic competency that is very necessary to be mastered, like reading and writing in 21st century learning [18]. The 21st century requires humans to have the ability to think more critically and be able to accept rapid technological developments [19]. Critical thinking skills are described as a high-level thinking process that emphasizes a logical and rational basis of belief, and is able to provide a series of standards and procedures to activate the skills of interpreting, analyzing, identifying questions, evaluating evidence/ideas and making conclusions [20]. Critical thinking skills can be developed and improved in learning activities using the guided inquiry learning model.

The guided inquiry learning model is a learning model where the teacher is a facilitator and director while students actively carry out activities according to procedures or work steps to develop their curiosity [21] [22]. The guided inquiry learning model can improve learning outcomes by enabling students to discover learning concepts through direct experience, make decisions, and find relevant supporting information [23]. Inquiry-based learning involves students in searching and investigating systematically, critically, logically and analytically [24]. In guided inquiry-based learning, the teacher's role is to guide and direct students to participate in discussions and provide explanations as necessary [25]. The guided inquiry learning model can be used in physics learning activities with e-LKPD learning media, especially on global warming material.

This research and development were carried out to complement previous research. Research conducted by Wang et al [26] states that global warming material requires a dynamic approach in learning methods that is student-centered and includes relevant, challenging and significant circumstances. Research conducted by Gungordu et al [27] stated that students still do not understand global warming material. This is supported by research conducted by Kurniawan & Kuswanto [28], which showed that 81.25% of students had difficulty answering questions on the topic of global warming. So, students need to be provided with learning media that can provide dynamic visualization of global warming phenomenon material [29]. This is supported by research conducted by Safarati & Zuhra [30] that learning media that is able to teach and present physics concepts in various abilities, especially critical thinking abilities, is needed to make learning easier for students to understand.

Based on research conducted by previous researchers, no one has conducted research regarding the development of Guided Inquiry-based Physics e-LKPD on global warming material. This research was conducted to test students' critical thinking skills on guided inquiry-based Physics e-LKPD on global warming material to complement previous research. Considering the importance of students' critical thinking skills, the researcher conducted this research with the aim of finding out how to improve

critical thinking skills in developing guided inquiry-based Physics e-LKPD on global warming material.

### METHOD

The type of research used in this research is R&D (Research and Development). The development model used is 4D which consists of 4 stages, namely defining, designing, developing and deploying. The Define stage is the initial stage in research which aims to be the basic basis for conducting research obtained from the observation and interview process that has been carried out on the learning process in schools. The design stage is the stage of product design, where the e-LKPD design is carried out based on the stages of the guided inquiry learning model. The material used is global warming. The development stage is the product development stage where at this stage it produces an e-LKPD that has been validated by expert validators (media, material and language). The disseminate stage is the stage of disseminating products that are ready for use by teachers and students.

The population of this study was class X students at MAN 1 Yogyakarta. The selection of research samples was carried out using simple random sampling techniques. So the research sample was 32 students. Research instruments use non-test and test instruments. The non-test instruments used were teacher interview and observation sheets, response questionnaire sheets, and expert validation sheets. The test instrument used was multiple choice questions on global warming with a total of 10 questions.

The data analysis techniques in this research consist of feasibility analysis, practicality analysis, and effectiveness analysis. The feasibility analysis of the guided inquiry-based Physics e-LKPD was analyzed from validation data from media, material and language experts. The results of the validator assessment were then analyzed using Likert scale calculations in table 1 below:

**Table 1.** Likert Scale Assessment Score Guidelines

Assessment criteria	Score
Strongly agree	5
Agree	4
Doubtful	3
Don't agree	2
Strongly Disagree	1

The validation score results are then calculated using the following equation [31]:

$$\text{Index } 100\% = \frac{\text{Score Obtained}}{\text{Maximum Total Score}} \tag{1}$$

The results of calculating the eligibility percentage are then interpreted based on the eligibility criteria in Table 2.

**Table 2.** Likert Scale Assessment Criteria

Value Interval	Information
0% - 20%	Not feasible
21% - 40%	Not worth it
41% - 60%	Decent Enough
61% - 80%	Worthy
61% - 80%	Very Worth it

Analysis of the practicality of the guided inquiry-based Physics e-LKPD was analyzed from data resulting from student and teacher responses regarding the implementation of the learning stages. The assessment is carried out using the Guttman calculation scale with the answer "Yes" getting a score of

1 and the answer "No" getting a score of 0. To calculate the percentage, the following equation is used.

$$P (\%) = \frac{F}{N} \times 100\% \quad (2)$$

Information:

P = Percentage Number;

F = Total score obtained; and

N = Max Score.

Then the calculation results are interpreted using the Guttman scale criteria which can be seen in table 3 below.

**Table 3.** Guttman Scale Criteria [32]

Score Intervals	Information
81 - 100	Very Practical
61 - 80	Practical
41 - 60	Pretty Practical
21 - 40	Impractical
0 - 20	Very Impractical

Analysis of the effectiveness of using the guided inquiry-based Physics e-LKPD was analyzed from pre-test and post-test data. The calculation of pre-test and post-test results uses the student's classical completeness equation as follows.

$$P = \frac{Pa}{Pb} \times 100\% \quad (3)$$

The calculation results are then interpreted into effectiveness assessment criteria which can be seen in Table 4 below.

**Table 4.** Effectiveness Assessment Criteria

Score Intervals	Information
80 - 100	Very effective
60 - 80	Effective
40 - 60	Less effective
0 - 40	ineffective

The increase in students' critical thinking skills is analyzed using N-Gain score analysis with the following equation.

$$N - \text{Gain} = \frac{\text{Posttest Value} - \text{Pretest Value}}{\text{Maximum Value} - \text{Pretest Value}} \quad (4)$$

The calculation results are then interpreted into the n-gain score assessment criteria which can be seen in table 5 below.

**Table 5.** N-Gain Score Rating [33]

Category	Information
Tall	N - Gain > 0.7
Currently	0,3 < N - Gain ≤ 0,7
Low	N - Gain ≤ 0,3

## RESULTS AND DISCUSSIONS

The research results obtained aim to determine the increase in students' critical thinking skills on global warming material towards the development of guided inquiry-based e-LKPD. Research data was obtained from non-test instruments and test instruments given to the research sample, namely class X students at MAN 1 Yogyakarta. The research results obtained were based on the development model used, namely 4D (Define, Design, Develop, Disseminate).

The define stage obtained research results based on the results of interviews with physics teachers and field observations related to the implementation of learning in class facts, thus causing students' low critical thinking abilities. Second, the use of teaching materials in schools is still focused on textbooks and other internet sources. Third, when learning physics there are some students who are still passive and not enthusiastic when following the lesson. Fourth, the physics teacher also said that he had never used guided inquiry-based physics e-LKPD as a physics learning medium. After obtaining the basic problem to develop a guided inquiry-based physics e-LKPD, then proceed to the design stage.

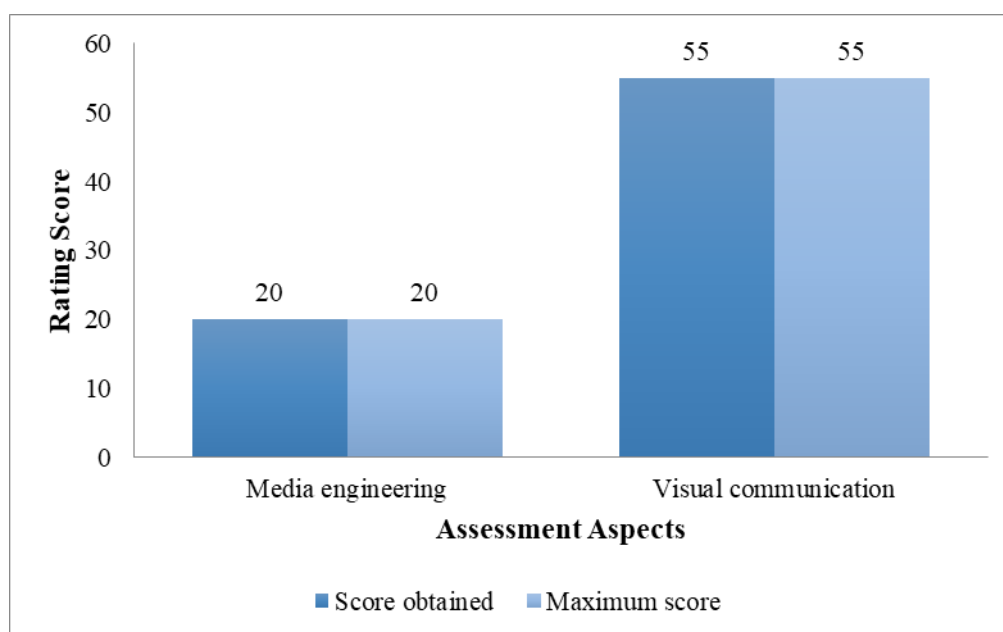
In the design stage, the physics e-LKPD was designed based on guided inquiry and the design of research instruments. The results obtained at the design stage are the design of a physics e-LKPD based on guided inquiry and research instruments. The guided inquiry-based physics e-LKPD is designed and designed in accordance with the guided inquiry stages and includes critical thinking indicators, as well as material content adapted to global warming, then added picture and color illustrations to make it interesting to read. The instrument designed consists of an expert validation sheet to see the feasibility of e-LKPD, teacher and student response sheets to determine the practicality of e-LKPD, and a pre-test post-test grid to see the effectiveness of e-LKPD. The guided inquiry-based physics e-LKPD and research instruments have been designed and are ready to be tested at the development stage.

The develop stage aims to produce a final development product with 2 steps, namely expert assessment and development trials. The expert assessment was carried out with the aim of determining the feasibility of guided inquiry-based physics e-LKPD carried out by media expert validators, material experts and language experts. The results of the assessment by media experts can be seen in table 6 below.

**Table 6.** Media Expert Validation Results

Aspect	Score Earned	Maximum Score	Percentage	Criteria
Media engineering	20	20	100%	very worthy
Visual communication	55	55	100%	very worthy
Total score obtained	75			
Total Maximum Score	75			
Percentage	100%			
Criteria	very worthy			

Based on table 6, it shows that the results of validation by media experts on the guided inquiry-based physics e-LKPD which was assessed based on aspects of media engineering and visual communication obtained scores of 20 and 55 with a percentage of 100% in both aspects. So, the guided inquiry-based physics e-LKPD was declared very suitable by media experts for use in learning activities. The validation results by media experts are also visualized in a bar chart which can be seen in Figure 1 below.



*Fig 1. Graph of Media Expert Validator Result Data*

Based on Figure 1, it shows that the bar chart was validated by media experts for the guided inquiry-based physics e-LKPD. The bar diagram in the media engineering aspect shows the total score obtained is 20 and the maximum score is 20, then in the visual communication aspect it shows the total score obtained is 55 and the maximum score is 55. So, the total score as a whole from validation by media experts is 75 with very high criteria. worthy.

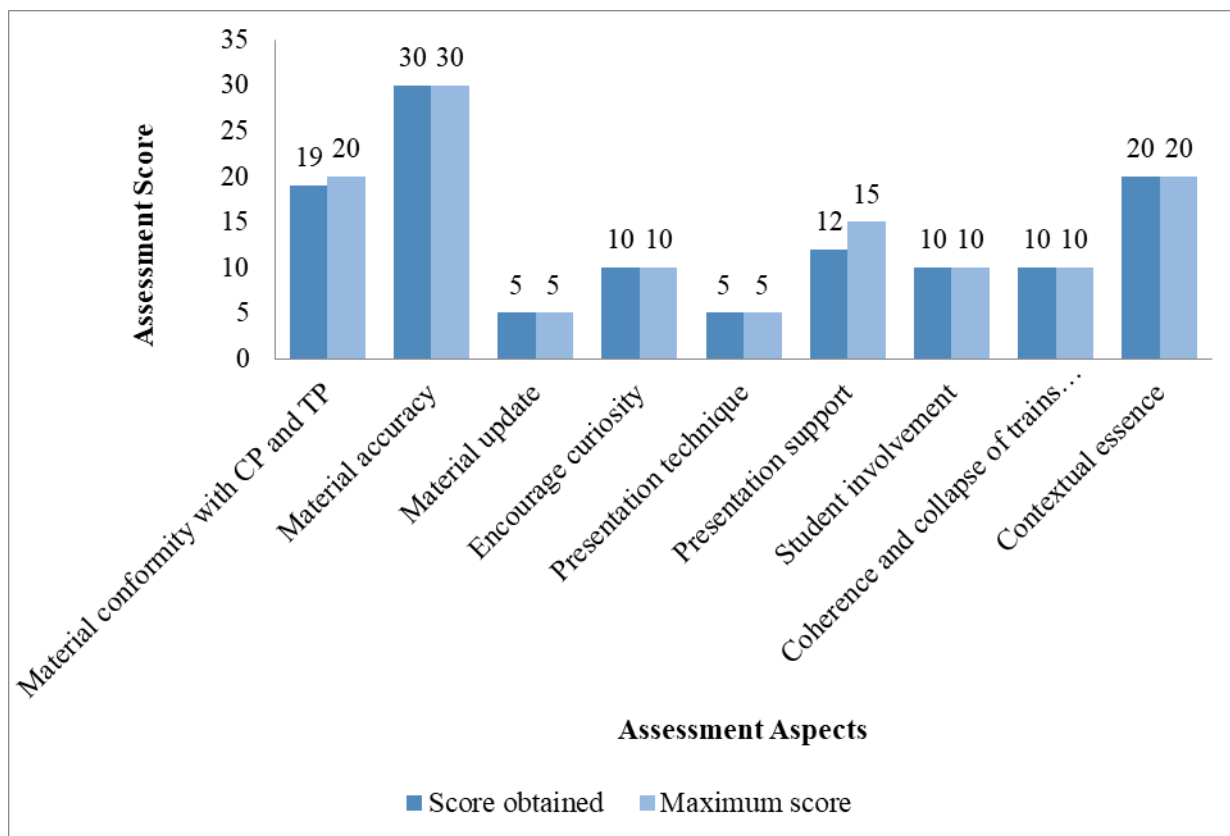
The next validation assessment is by a material expert. The results of the material expert's assessment of the guided inquiry-based physics e-LKPD can be seen in table 7 below.

**Table 7. Material Expert Validation Results**

Aspect	Score Earned	Maximum Score	Percentage	Criteria
Material conformity with CP and TP	19	20	95%	very worthy
Material accuracy	30	30	100%	very worthy
Material update	5	5	100%	very worthy
Encourage curiosity	10	10	100%	very worthy
Presentation technique	5	5	100%	very worthy
Presentation support	12	15	80%	very worthy
Student involvement	10	10	100%	very worthy
Coherence and continuity of thought flow	10	10	100%	very worthy
Contextual essence	20	20	100%	very worthy
Total score obtained	121			
Maximum total score	135			
Percentage	89%			
Criteria	very worthy			

Based on table 7, it shows the results of validation by material experts on guided inquiry-based physics e-LKPD with 9 assessment aspects. The material conformity aspect with CP and TP received a score of 19 and a percentage of 95% with very appropriate criteria, the material accuracy aspect received a score of 30 and a percentage of 100% with very appropriate criteria, the material sophistication aspect received a score of 5 and a percentage of 100% with very appropriate criteria. decent, the aspect of encouraging curiosity gets a score of 10 and a percentage of 100% with very decent criteria, the presentation technique aspect gets a score of 5 and a percentage of 100% with very

decent criteria, the presentation supporting aspect gets a score of 12 and a percentage of 80% with very decent criteria, the aspect of student involvement received a score of 10 and a percentage of 100% with very appropriate criteria, the aspect of coherence and coherent thought flow received a score of 10 and a percentage of 100% with very appropriate criteria, and the contextual essence aspect received a score of 20 and a percentage of 100% with the criteria very worthy. Overall, the research aspects in validating the guided inquiry-based physics e-LKPD material are in the very feasible criteria, so it can be stated that the global warming material in the guided inquiry-based physics e-LKPD is very suitable for use. The validation results by material experts are also visualized in a bar chart which can be seen in Figure 2 below.



**Fig 2.** Material Expert Validator Result Diagram

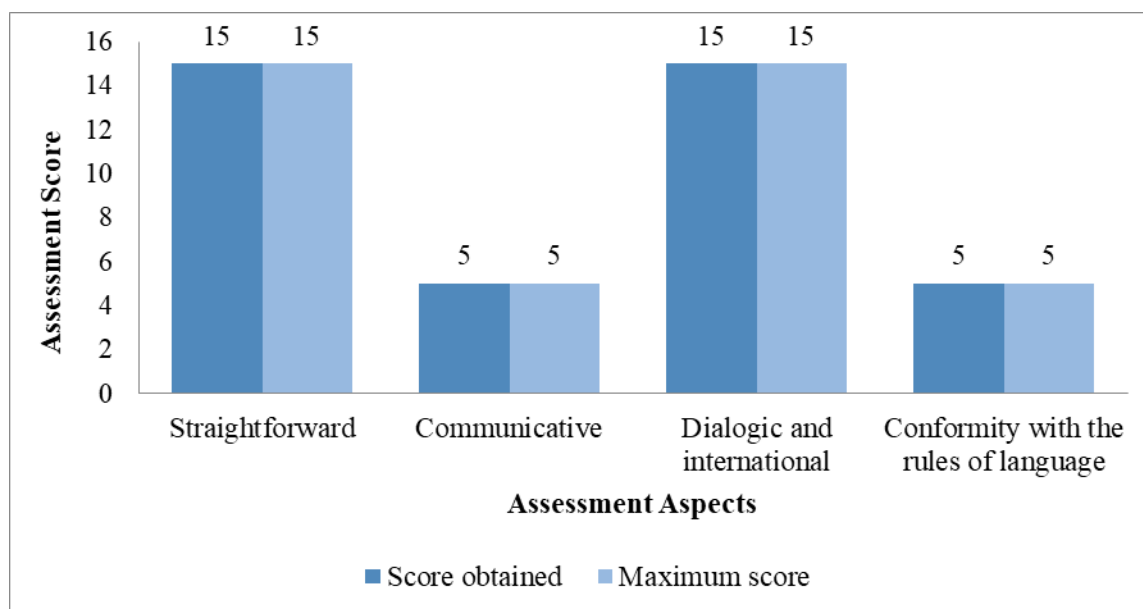
Based on Figure 2, it shows that the results of the total score for each aspect of the assessment and the maximum score for each aspect of the validation assessment by material experts for the guided inquiry-based physics e-LKPD. The results of the bar diagram show that there are 7 assessment aspects that received the same total score as the maximum score, namely the material accuracy aspect, the material up-to-date aspect, the encouraging curiosity aspect, the presentation technique aspect, the student involvement aspect, the coherence and coherent flow of thought aspect, and the contextual essence aspect. . The aspects of research that received a total score that was not the same as the maximum score were the aspect of suitability of the material with CP and TP and the presentation support aspect. Even though these two aspects received a total score that was not the same as the maximum score, they were within the very appropriate criteria.

The next validation assessment is by a linguist. The results of the linguist's assessment of the guided inquiry-based physics e-LKPD can be seen in table 8 below.

**Table 8.** Linguist Expert Validation Results

Aspect	Score Earned	Maximum Score	Percentage	Criteria
Straightforward	15	15	100%	very worthy
Communicative	5	5	100%	very worthy
Dialogic and international	15	15	100%	very worthy
Conformity with the rules of language	5	5	100%	very worthy
Total score obtained	40			
Maximum total score	40			
Percentage	100%			
Criteria	very worthy			

Based on table 8, it shows the results of validation by a linguist on the guided inquiry-based physics e-LKPD with 4 assessment aspects. The straightforward assessment aspect received a score of 15 and a percentage of 100% with very appropriate criteria, the communicative assessment aspect received a score of 5 and a percentage of 100% with very appropriate criteria, the dialogical and international assessment aspect received a score of 15 and a percentage of 100% with very appropriate criteria, and the aspect of assessing conformity with language rules received a score of 5 and a percentage of 100% with very appropriate criteria. Overall, the research aspect on the validation of the guided inquiry-based physics e-LKPD language is in the very appropriate criteria, so it can be stated that the language used in the guided inquiry-based physics e-LKPD is very suitable for use. The validation results by language experts are also visualized in a bar diagram which can be seen in Figure 3 below.



**Fig 3.** Data Diagram of Language Validator Results

Based on Figure 3, it shows that the results of the total score for each aspect of the assessment and the maximum score for each aspect of the validation assessment by language experts on the guided inquiry-based physics e-LKPD. The bar chart results show that the four assessment aspects received the same total score as the maximum score. So, it can be concluded that the language in the guided inquiry-based physics e-LKPD is suitable for use.

An expert assessment of the guided inquiry-based physics e-LKPD has been carried out and the results show that the guided inquiry-based physics e-LKPD is very suitable for use based on the assessment of media experts, material experts and language experts. Next, a development trial was carried out to determine the practicality and effectiveness of using guided inquiry-based physics e-LKPD. The

practicality of using guided inquiry-based physics e-LKPD was analyzed based on the results of teacher response sheet data and student response sheets that had been distributed. The results of the teacher response sheet can be seen in table 9 below.

**Table 9.** Teacher Response Questionnaire

<b>Teacher</b>	<b>Score Earned</b>	<b>Percentage</b>	<b>Criteria</b>
1	19	100%	Very Practical
Total number	19		
Percentage	100%		
Criteria	Very Practical		

Based on table 9, it shows that the total score of the teacher response sheets obtained was 19 and the percentage was 100% with very practical criteria. So, it can be concluded that the guided inquiry-based physics e-LKPD is practical for teachers to use. Then look at the results of students' responses to the guided inquiry-based physics e-LKPD in table 10 below.

**Table 10.** Teacher Response Questionnaire

<b>Learners</b>	<b>Score Earned</b>	<b>Percentage</b>	<b>Criteria</b>
1	15	88%	Very Practical
2	15	88%	Very Practical
3	15	88%	Very Practical
4	17	100%	Very Practical
5	17	100%	Very Practical
6	13	76%	Practical
7	13	76%	Practical
8	17	100%	Very Practical
9	16	94%	Very Practical
10	17	100%	Very Practical
11	17	100%	Very Practical
12	17	100%	Very Practical
13	17	100%	Very Practical
14	15	88%	Very Practical
15	13	76%	Practical
16	14	82%	Very Practical
17	17	100%	Very Practical
18	14	82%	Very Practical
19	15	88%	Very Practical
20	17	100%	Very Practical
21	16	94%	Very Practical
22	14	82%	Very Practical
23	13	76%	Practical
24	17	100%	Very Practical
25	14	82%	Very Practical
26	15	88%	Very Practical
27	15	88%	Very Practical
28	16	94%	Very Practical
29	14	82%	Very Practical
30	16	94%	Very Practical
31	16	94%	Very Practical
32	13	76%	Practical
Total number	490		
Percentage	90.07%		
Criteria	Very Practical		

Based on table 10, it shows the results of the total score of students' response sheets to the guided  
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inquiry-based physics e-LKPD with a total of 32 students. The scores obtained by students on the practical criteria were 5 students and the scores obtained by students on the very practical criteria were 27 students. Overall, students' responses obtained a percentage score of 90.07% with very practical criteria. The results of the responses obtained from teachers and students regarding the guided inquiry-based physics e-LKPD are in very practical criteria, so it can be concluded that the use of guided inquiry-based physics e-LKPD on global warming material is practical for use in learning activities.

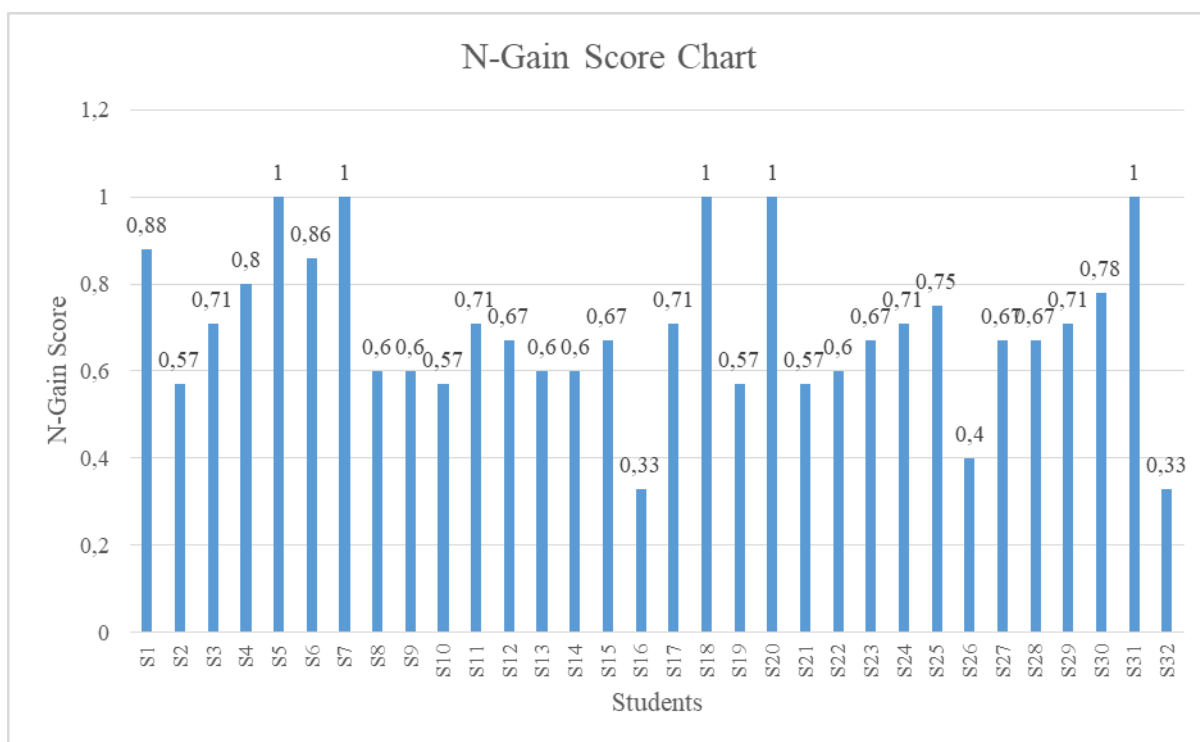
The guided inquiry-based physics e-LKPD has been declared very feasible and very practical to use. Next, an analysis of the effectiveness of the guided inquiry-based physics e-LKPD was carried out with the aim of finding out the effectiveness of using the guided inquiry-based physics e-LKPD to improve students' critical thinking skills on global warming material. The increase in critical thinking skills was analyzed using n-gain score analysis using the results of pre-test and post-test data on global warming material. The results of the n-gain score analysis can be seen in table 11 below.

**Table 11.** N-Gain Score Results

Students	Pre-test	Post-test	N-Gain Score	Criteria N-Gain Score
S1	20	90	0.88	Tall
S2	30	70	0.57	Currently
S3	30	80	0.71	Tall
S4	50	90	0.80	Tall
S5	40	100	1.00	Tall
S6	30	90	0.86	Tall
S7	40	100	1.00	Tall
S8	50	80	0.60	Currently
S9	50	80	0.60	Currently
S10	30	70	0.57	Currently
S11	30	80	0.71	Tall
S12	40	80	0.67	Currently
S13	50	80	0.60	Currently
S14	50	80	0.60	Currently
S15	40	80	0.67	Currently
S16	70	80	0.33	Currently
S17	30	80	0.71	Tall
S18	10	100	1.00	Tall
S19	30	70	0.57	Currently
S20	40	100	1.00	Tall
S21	30	70	0.57	Currently
S22	50	80	0.60	Currently
S23	40	80	0.67	Currently
S24	30	80	0.71	Tall
S25	20	80	0.75	Tall
S26	50	70	0.40	Currently
S27	40	80	0.67	Currently
S28	40	80	0.67	Currently
S29	30	80	0.71	Tall
S30	10	80	0.78	Tall
S31	60	100	1.00	Tall
S32	70	80	0.33	Currently
Total number	0.70			
Average	22.32			
N-Gain Criterion	Currently			

Based on table 11, it shows the pretest scores, posttest scores, and n-gain scores of students. The

results of students' test scores on global warming material after using the guided inquiry-based physics e-LKPD experienced an increase as shown in the students' posttest scores. It can be seen that the test scores of students before using the guided inquiry-based physics e-LKPD shown in the pretest scores are lower than the posttest scores. So it can be stated that students' critical thinking abilities have increased after using guided inquiry-based physics e-LKPD. Based on the test scores obtained by students, it shows that the guided inquiry-based physics e-LKPD is effectively used to improve students' critical thinking skills on global warming material. This is supported by the n-gain score obtained by students who are in the medium and high criteria. So, it can be concluded that guided inquiry-based physics e-LKPD is effectively used to improve students' critical thinking skills on global warming material. The results of the n-gain score analysis is visualized in a bar chart which can be seen in Figure 4 below.



**Fig 4.** N-Gain Score Chart

Based on Figure 4, it shows a diagram of the n-gain scores obtained by students. It can be seen that the n-gain values obtained are > 0.3 and > 0.7 with medium and high criteria. These results show that there was an increase in students' critical thinking abilities after using guided inquiry-based physics e-LKPD in learning activities on global warming material. So, it can be concluded that the guided inquiry-based physics e-LKPD is effectively used to improve students' critical thinking skills.

The development of guided inquiry-based physics e-LKPD has been tested for its feasibility, practicality and effectiveness. The results obtained show that the guided inquiry-based physics e-LKPD is very suitable for use by validators, very practical for use by teachers and students, and is effectively used to improve students' critical thinking skills on global warming material as shown in the learning results obtained by learners. Using the right learning tools will make it easier for students to understand learning material [34] [35]. Learning tools are very important to develop in order to improve the quality of learning [36] [37]. Teachers must use learning tools so that learning activities become more efficient and effective. Student worksheets can make students more enthusiastic and improve critical thinking skills in solving problems [38] [39]. Student worksheets are a learning tool that presents material and questions aimed at directing students to understand learning optimally [40] [41].

Research conducted by Ardiansah & Zulfiani [42] states that the development of interactive e-LKPD based on creative thinking skills on the concept of environmental change is very suitable for use in learning activities as an alternative source of teaching materials to develop students' creative thinking abilities in biology learning in line with the implementation of the Merdeka Curriculum. Then research conducted by Anbiya et al [43] stated that implementing the integration of the problem-based learning model with guided inquiry worksheets can significantly improve students' scientific process skills and critical thinking abilities. Then research conducted by Eriyanti et al [44] stated that the development of electronic student worksheets based on mobile learning with a guided inquiry model on Newton's law material is feasible and practical to use as a learning material. Based on research conducted by previous researchers, it appears that student worksheets can be used in biology and physics learning.

The research and development carried out in the research was carried out to complement previous research. The development of guided inquiry-based physics e-LKPD has been declared very feasible and very practical for teachers and students to use in learning activities on global warming material. Apart from that, guided inquiry-based physics e-LKPD is also very effective in improving students' critical thinking skills.

## CONCLUSION AND SUGGESTION

The guided inquiry-based physics e-LKPD which has been developed with the 4D development model (define, design, develop and disseminate) can be used by teachers and students in physics learning activities regarding global warming. The guided inquiry-based physics e-LKPD is stated to be able to be used in learning activities because it has been tested for feasibility, practicality and effectiveness. The feasibility analysis obtained results which stated that the guided inquiry-based physics e-LKPD was very suitable for use based on assessments by media, material and language experts. The practicality analysis obtained results which stated that the guided inquiry-based physics e-LKPD was practical for use by teachers and students. The effectiveness analysis obtained results stating that the guided inquiry-based physics e-LKPD was effective for use in improving students' critical thinking skills on global warming material based on the results of the n-gain score analysis. It can be concluded that the guided inquiry-based physics e-LKPD that was developed is declared very feasible, very practical, and effectively used in physics learning activities regarding global warming to improve critical thinking skills. This research only develops guided inquiry-based physics e-LKPD on global warming material to improve students' critical thinking skills. The researcher hopes that future researchers can continue research and development on other physical materials to complement this research.

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