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The Effectiveness of Using Guided Inquiry-Based E-LKPD on Global Warming Material to Increasing Students' Understanding of Concepts

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Abstract: This study aims to determine the effectiveness of guided inquiry-based E-LKPD on students' global warming material. This type of research uses a pretest-posttest design. The population of this study were all students of MAN 1 Yogyakarta. The research sample was 64 divided into two classes. Data collection on concept understanding uses multiple choice tests. Research data was collected from the pre-test and post-test understanding of the concept of global warming material. The results of the research show that E-LKPD based on guided inquiry on global warming material is less effective in increasing the conceptual understanding of class obtained was 0.77 in the high category and 77% in the effective category.

Keywords: Effectiveness; E-LKPD; Global warming; Guided inquiry; Physics

Introduction

Education is one of the most important aspects of life. 21st century learning, especially in learning, does not only focus on the skills possessed by students but also their ability to use technology (Nahdi, 2019). The importance of technology in learning can improve the quality of education, as a means of evaluation, and can be used to support technology-based facilities (Lai & Bower, 2019). To support effective learning, innovative teachers should be able to create adequate learning media for the continuity of the learning process (Hasiru et al., 2021). Innovative effective learning must be developed to attract the learning process.

The learning process obtained affects the creation of the quality of human resources itself. Mastery of learning material is one of the most important aspects that students need to have in physics learning activities, in order to improve learning outcomes in the cognitive domain. Mastery of material is the ability of students to understand scientific meaning, both theory and its application in everyday life (Dahar, 2003). Mastery of material is very important in physics learning activities, because with adequate mastery of material students can increase intellectual proficiency and help in solving problems in physics (Winkel, 1987; Ashadarini et al., 2017). In the learning process an interactive learning media is also needed.

One of the learning media that can be used in physics learning is the E-LKPD. However, the Student Worksheets used had not been able to bring students to be more enthusiastic in learning and doing their assignments in class (Ichsan et al., 2021). Electronic student worksheets are student practice sheets that are done digitally and carried out systematically and continuously over a certain period of time (Ramlawati et al., 2014). Some teachers agree with E-LKPD as a useful teaching material in learning (Syafitri & Tressyalina,

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2020). Literature about the degrees of impacts of student's worksheets as scaffolds is varied. Some studies demonstrated significant impacts on students' learning (Yani, 2021).

In its presentation, the E-LKPD is in the form of a live worksheet. The use of student worksheets has implications for increasing their HOTS abilities in learning (Yusuf & Widyaningsih, 2022). LKPD presented in the form of electronic media is usually called electronic student worksheets or E-LKPD. According to Prabowo (2021) live worksheet is a website that can change student worksheets in doc, pdf or jpg format into interactive student worksheets (Prabowo, 2021). Besides that, according to Khikmiyah (2021) live worksheet is a student worksheet assisted by electronic media which can present text, images, animations and videos which can prevent students from getting bored (Khikmiyah, 2021). Worksheets are the teaching materials containing all the stages of the course enabling the active participation of the students in the course by making it easy for the whole class to follow the lesson (Yurtyapan & Kandemir, 2021). This shows that the E-LKPD has an important role in learning as a means of supporting learning.

The application of guided inquiry learning begins with activities to formulate problems, and then formulate hypotheses and create experimental designs (Artayasa et al., 2021). Obstacles experienced by students in learning physics can be overcome by applying the right learning model. The model applied is a learning model that can require students to play an active role during the lesson. The learning model is a guided inquiry learning model or guided inquiry. In guided inquiry, students will be directed by the teacher with the steps or syntax in obtaining the expected new knowledge or concept.

According to Wena (2011), the syntax of guided inquiry learning has five stages, namely the first is presenting the problem or confronting students with a puzzle situation. Second is data collection and verification. Third is collecting experimental data. Fourth is organizing data and formulating explanations. Fifth is analysis of inquiry. Flipped–Guided Inquiry based learning (FGIL) learning model based on practicality tests on small groups of students is stated to have very high (Yani, 2021). Guided inquiry learning can stimulate, teach and invite students to think higher to find concepts of the various problems expressed independently, while the teacher's role includes providing learning materials and concerns for guiding students in confirming the ideas (Yani, 2021). Inquiry could achieve the purpose of conceptual understanding to a great extent (Wang et al., 2021).

Inquiry-based learning (IBL), which has proven to be an effective instructional strategy, is often seen as an educational approach involving students in experiments and investigations to construct their knowledge (Alabidi et al., 2023). Conceptual understanding of students in the inquiry-based course was significantly higher than students taught traditionally but not significantly different from students taught by other research-informed pedagogies (Thacker, 2023). Physics can be productively conceptualized as using a language and that learning to make sense of physics equations and appropriating them into novel scientific inquiry can be understood as a process of learning to read fluently with a high level of reading comprehension and to express one's thoughts in writing (Kapon & Schvartzer, 2023).

One important aspect of learning is understanding the concept of a learning material. According to Hermanto (2013) states that the concept is giving a sign to an object to help someone understand and understand a particular object (Hermawanto et al., 2013). The conceptual knowledge in Physics of most students was found to be efficient when compared to the standards determined by the Department of Education (DepEd) (Ole & Gallos, 2023). Understanding the concept is not just a simple understanding, but can also be described as the ability to understand, understand, apply, classify, generalize, synthesize, and conclude objects.

According to Smarabawa (2013) said that understanding concepts is very important with the aim that students can remember the concepts they learn longer, so that the learning process will become more meaningful (Smarabawa et al., 2013). Concept understanding is also needed to make students understand the material presented (Yani, 2021). The highest misconceptions occurred in low-category school learners on the concept of explaining 62.96% (Isra & Mufit, 2023).

Based on the description above, this study aims to determine the effectiveness of using guided inquiry-based e-LKPD on global warming material on students' conceptual understanding.

Method

This research used a one group pre-test and post-test design with research subjects consisting of 64 students of class X MIPA MAN 1 Yogyakarta Class of 2022/2023. The subjects in this study carried out learning using guided inquiry-based E-LKPD on global warming material. Students' conceptual understanding was measured using a research instrument in the form of a multiple choice test developed by the researcher. This instrument has passed the expert validation stage.

The following are the stages of this research the research design can be seen in Figure 1.

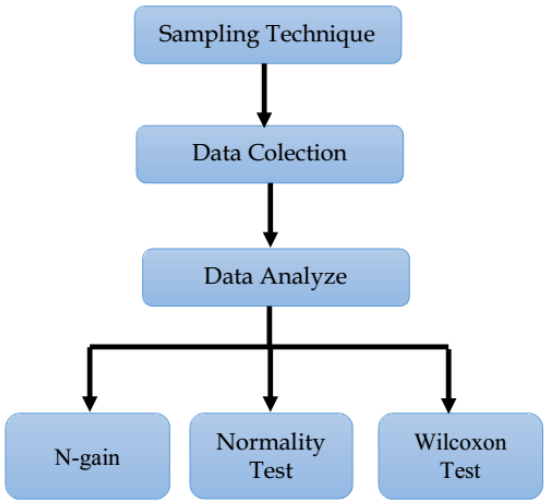

Figure 1. Research design

Tests in the form of multiple choices are given to obtain data on students' conceptual understanding abilities. To determine the increase in understanding of the concept being measured, the normalized average gain (N-gain) score data calculation developed by Hake (1999) is used with the following equation

$$g = \frac{S_{post} - S_{pre}}{S_{m\_ideal} - S_{pre}} \quad (1)$$

The obtained average N-gain value is then interpreted based on Table 1.

Table 1. Interpretation of the Average N-gain Score

Gain score	Interpretation
g < 0.40	Not effective
0.40 ≤ g ≤ 0.55	Less effective
0.56 ≤ g ≤ 0.75	Effective enough
g ≥ 0.76	effective

The research data obtained was then analyzed statistically by testing the pretest, post-test and N-gain values. The tests carried out were in the form of a normality test and a Wilcoxon test for non-normally distributed data using the IBM SPSS Statistics 22 application program. In this hypothesis test, the significance level (α) used was 0.05 or 5%. The decision to test the hypothesis is determined by the criteria: if the Asymp.Sig value <0.05 then the hypothesis is accepted. The hypothesis in this study is "There are differences in pretest and posttest learning outcomes, which means there is an effect of using guided inquiry-based E-LKPD on global warming material.

Result and Discussion

Learning activities begin with a pretest activity to determine students' initial abilities. Next, learning is carried out using E-LKPD based on guided inquiry on global warming material, then at the end of the activity a posttest is carried out. Descriptive statistical analysis and N-gain from the pretest and posttest are presented in Table 2.

Based on the data in Table 2, it is known that the average pretest score is 65 while the average post-test score is 95. After being given treatment in the form of implementing guided inquiry-based E-LKPD in learning, there was an increase in concept understanding. Increased understanding occurred by 77% in the effective category. To find out whether the data is normally distributed or not, the normality test is carried out as follows.

Research conducted by Handauyani categories the use of pocket books on students of SMA Negeri 1 Jaya can improve understanding of the concept of the experimental class with the acquisition of N-Gain 0.67 in the moderate category (Handayani et al., 2021).

Table 2. Descriptive Statistical Results and N-gain

	N	Min	Max	Mean	Std.Dev	N-gain	Category
Pretest	64	30.00	90.00	65	13.09	0.77	Tall
Posttest	64	70.00	100.00	95	9.21		
Valid N(listwise)	64						

Table 3. Normality Test Results

	Statistics	df	Sig.	Category
Pretest	.27	64	.90	Not Normal Distribution
Posttest	.24	64	.86	Not Normal Distribution

Based on the results of the normality test, it was discovered that the pretest and posttest data were not normally distributed, so it was continued with the Wilcoxon test to determine whether there was an effect of using guided inquiry-based E-LKPD on global warming material on learning outcomes.

Validated conceptual multiplechoice physics survey instruments administered before and after instruction in relevant concepts can be useful tools to

gauge the effectiveness of curricula and pedagogies in promoting robust conceptual understanding (Brundage & Singh, 2023). The results of the Wilcoxon test analysis are presented in Table 4.

Based on the results of the Wilcoxon test, negative ranks are 0 and ties are 6, which indicates that there is no decrease in pretest scores to posttest scores. Positive ranks show that the remaining 58 people experienced an increase in learning outcomes from pretest to posttest scores and as many as 6 people did not experience an increase in learning outcomes through the pretest and posttest, namely an average of 29.50. As for Asymp.Sig. (2-tailed) obtained at 0.000 < 0.05 so the hypothesis is accepted, namely that there is a difference in pretest and posttest learning outcomes, which means there is an influence of using guided inquiry-based E-LKPD on global warming material to increase students' understanding of concepts.

Table 4. Wilcoxon Test Results

	N	Mean Rank	Sum of Ranks	Z	Asymp.Sig. (2-tailed)
Negative ranks	0	.00	.00		
Positive ranks	58	29.50	1711.00	-6.70	.000
Ties	6				
Total	64				

Research conducted by Zulham Handauyani Putri Deti Ratih that Problem-based learning-based electronic worksheets and classes that do not use problem-based learning-based electronic worksheets on acid-base materials for class XI MIPA (Ratih & Rohaeti, 2022). Student Worksheet is very feasible and satisfactory to be used for field experiments (Fatimah & Rohani, 2022). For the effectiveness of the problem-based physics e-module related to the students' conceptual understanding ability analyzed with N-gain obtained an average value of 0.42 that was in the medium category (Khuzaimah et al., 2022).

Worksheets that facilitate the forethought and performance stages of learning, as well as through encouraging the students to engage in self-reflection. Thereby, it is of highest importance that the worksheets include prompts which activate cognitive processes that are known from earlier disciplinary education research to be indicators of deep understanding of the given topic (Mešić et al., 2022). Worksheet is one type of teaching materials in which there are concrete steps that students must take in order to achieve learning goals (Nurhayati et al., 2022).

Conclusion

Based on the results of the research and discussion that has been explained that the Guided Inquiry-based Electronic Student Worksheet on global warming material is declared to have met the eligibility criteria of the expert. The use of guided inquiry-based E-LKPD has an effect on students' conceptual understanding, with an N-gain score obtained of 0.77 in the high category and 77% in the effective category.

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Author Contribution
The research team contributed to the writing of this scientific work, namely: idea, conception, data collection, analysis and interpretation of results, drafting of manuscript, A. N. S.; Guidance in writing articles, Z. K. P., and J. J.; funding acquisition, A. N. S., and D. P.

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Conflicts of Interest
The authors declare that there is no conflict of interest regarding the publication of this paper.

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