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the Effect of LKPD-Assisted Guided Inquiry Learning Model on Students' Understanding of Concepts in Physics Learning

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ABSTRACT

Student learning outcomes in Physics are poor due to several factors. These include poor student understanding of the concepts of the material taught by teachers and availability of LKPD that does not help students understand the concept. To overcome this, a learning model is needed that actively and directly engages students in the learning process using a guided inquiry model supported by LKPD to improve students' understanding of the concepts. The research employs a Quasi Experimental Design, specifically the Randomized Control Group Only Design. The study population comprises all class XI Phase F students at SMAN 2 Pariaman enrolled in Semester 1 of the 2023/2024 Academic Year. Purposive Sampling is used, with class XI F2 designated as the experimental class and class XI F6 as the control class. Data on students' conceptual understanding are collected through a final test featuring multiple-choice questions. Statistical analyses include normality and homogeneity tests, as well as a two-sample average similarity test. The average conceptual understanding score is 76.29 for the experimental class and 59.54 for the control class. By conducting a similarity test of two averages on students' understanding of concepts at a real level of 0.05 obtained $t_{count} = 5.24$ *and* $t_{table} = 1.99$ *means* $t_{count} > t_{table}$. *Thus, the study concludes that the LKPD-assisted guided inquiry learning model significantly enhances students' understanding of concepts in physics learning at SMAN 2 Pariaman.*

Keywords : Guided Inquiry Model; LKPD; Understanding Concepts; Learning Physics.

I. INTRODUCTION

Science learning aims to help students understand scientific principles, concepts, procedures, and natural phenomena through exploration, inquiry, and problem solving. This approach motivates students to actively engage in learning and cultivate their critical and analytical thinking abilities. Learning science does not just involve memorizing facts, it teaches students to relate these concepts to real-world situations, allowing them to apply their knowledge to solve complex problems. Thus, learning science prepares students to discover scientific facts and develop their own concepts. This, in turn, has a favorable effect on the quality of the educational output in Indonesia. [1].

Physics is a division of natural science that explores phenomena in the universe, encompassing both matter and their interactions. Where physics is born from laws, theories, concepts, facts, and applications [2]. Physics delves into phenomena related to matter, energy, motion, and force, elucidating fundamental principles governing natural events. Its impact extends significantly into daily life and technological advancements, facilitating human activities [3].

Physics learning in the independent curriculum makes learning not only to solve problems but to find out and understand events in the universe. Not only to look for facts, concepts, but the discovery process so that students can think critically and innovatively based on the developments in science and technology. The independent curriculum can help teachers and students to learn physics concepts and important issues based on their development and learning stages [4].

In the independent curriculum, physics learning in high school has learning outcomes for two phases, namely phase E and phase F. By the conclusion of phase E, students can tackle global challenges and actively participate in resolving them. Similarly, upon completing phase F, students can utilize physics concepts and principles effectively. There are 5 objectives of physics subjects in the independent curriculum, namely first, forming religious attitudes, second, fostering integrity and attitudes, third, deepening understanding of consistent physical principles of the universe, fourth, having a scientific attitude, and fifth, understanding one's strengths and limitations to support learning and self-development [5].

In the independent curriculum, physics subjects are organized into two categories, one of which is the understanding of physics concepts. A comprehensive grasp of fundamental physics concepts forms the basis for students to develop critical and analytical thinking abilities. By understanding these concepts, students can develop the ability to apply the principles of physics in real-world situations, as well as relate theories to everyday phenomena. Thus, Learning physics in an independent curriculum aims to strengthen understanding of physics concepts which are important for success in various fields [6].

By emphasizing the understanding of physics concepts, it will affect the learning outcomes of students. But unfortunately, facts in the field show that students have difficulty understanding physics concepts. As in the results of observations or observations of researchers at SMAN 2 Pariaman during the Educational Field Practice, it can be seen by student learning outcomes in the form of a Final Semester Examination whose scores do not even reach KKTP, which is 75.

From results of observations and interviews with a physics teachers at SMAN 2 Pariaman, the main cause of students' low physics UAS scores is understanding concepts. This can be observed during the learning process in class seen from indicators of concept understanding, including students cannot restate the concepts taught, provide examples or phenomena, classify, even conclude so that students' understanding of concepts is low and has an impact on UAS scores.

These problems also arise due to the use of a learning model that tends to be dominant in one direction, namely using a direct learning model. The direct learning model is a teacher-focused approach, tailored to enhance the student learning experience by focusing on procedural knowledge and well-structured declarative knowledge. This model employs a step-by-step, gradual sequence of activities to effectively impart knowledge [7]. In addition, there is also minimal use of learning media and LKPD that has not been integrated with the steps of the learning model and has not helped students understand the concept.

Therefore, it is essential to enhance the understanding of physics concepts and improve learning outcomes by designing engaging and dynamic learning activities that encourage two-way interaction with students. Utilizing an appropriate learning model is one effective method to ensure the success of the learning process [8].

The inquiry learning model, which emphasizes discovery and investigation during the learning process, is well-suited for teaching physics in the independent curriculum [9]. This model prioritizes the process of analytical thinking to find answers to the problems given. This approach is anticipated to actively engage students in the learning process and have an impact on the acquisition of knowledge and understanding of concepts [10].

The inquiry model learning process engages students in actively investigating, exploring, and discovering knowledge. In this model, students are not only objects in the learning process, but also active subjects in developing their own understanding [11]. With students asking questions, identifying problems, and finding solutions, inquiry models provide opportunities for them to develop research, problem-solving, and critical thinking skills. This not only strengthens their understanding of the subject matter, but also builds independence and intrinsic interest in learning [12].

The type of inquiry that is suitable for application is guided inquiry, this is considered because students still fully need direction from the teacher to face problems in the investigation process through triggering questions so that students can still process according to the learning that has been designed.

In addition, guided inquiry model also has several disadvantages, including students needing more guidance and direction from the teacher, the inquiry model often takes longer compared to the direct learning model, this can be a problem, especially if the lesson time is limited [13].

To address the limitations of the guided inquiry model and enhance the efficacy of learning, the Student Worksheet (LKPD) serves as a supportive tool. LKPD is designed to guide students in designing experiments, collecting data, and analyzing results systematically [14]. The LKPD contains learning instructions and tasks that will later be carried out by students, which can be a support in optimizing the learning process and understanding of students' concepts [15].

According to Septian et al [16] the use of LKPD can increase students' response to learning and affect students' learning achievement. If LKPD is not used in learning, then the learning process can become less structured and less directed. Students can feel confused or lost in undergoing learning activities. In addition, teachers can have difficulty in ensuring consistency in the delivery of materials and learning activities between one group of students and another.

LKPD needs to be used in conjunction with the inkuri model to guide students in the right steps and ensure the achievement of learning objectives. With LKPD, students have clear guidance on what to do, how to do it, and what needs to be achieved. In addition, LKPD can also assist teachers in assessing student progress and achievement and providing appropriate feedback. Thus, LKPD is important in supporting the guided inquiry model by providing a structured and supportive framework for effective learning processes [17]. What is offered in the use of LKPD later is that the LKPD will be integrated with a guided inquiry model and designed attractively so that students enjoy using it.

Based on the description above, researchers want to know how students' concept understanding if the LKPD-assisted guided inquiry learning model is used at SMAN 2 Pariaman. Given that SMAN 2 Pariaman has been accredited A and its students are accustomed to learning in groups, so the guided inquiry model can be implemented at the school. This is the title of the study, namely "The Effect of the LKPD-Assisted Guided Inquiry Learning Model on Student Concept Understanding in Physics Learning".

II. METHOD

This study employs quantitative research methodology, specifically adopting a Quasi-Experimental Design. While incorporating a control group, this design cannot completely regulate external variables that may impact the experiment's execution. More precisely, a Randomized Control Group Only Design is utilized to evaluate students' conceptual comprehension [18]. The research design is outlined as follows:

Table 1. Research Design

Sample Class	Treatment	Final Test
Experimental class	X	T
Control class	-	T

Information:
X : The treatment given is in the form of a guided inquiry model assisted by LKPD.

The study population consisted of 134 students in grade XI Phase F, all of whom selected physics as a subject at SMAN 2 Pariaman, distributed across four classes. Purposive sampling was employed, which selects samples based on predetermined criteria and objectives [19]. The criteria included classes taught by the same teachers, with adjacent study hour schedules, and having similar average UAS scores. Based on these criteria, class XI F2 was selected as the experimental class, and class XI F6 was chosen as the control class.

The data required for this study includes both primary and secondary data. The primary data consists of information on students' understanding of concepts, gathered through a final test using multiple-choice questions, while the secondary data is the final semester exam (UAS) scores of students before the research obtained from physics teachers of SMAN 2 Pariaman.

The normality test used in this study is the Lilliefors test. The Lilliefors test, a modified version of the Kolmogorov-Smirnov test, is used to determine if the data follows a normal distribution. The F-test is employed in this study to assess homogeneity, and hypothesis testing is conducted using a t-test with the specified formula.

$$t = \frac{\overline{X_1} - \overline{X_2}}{S\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}} \text{ dengan } S^2 = \frac{(n_1 - 1){S_1}^2 + (n_2 - 1){S_2}^2}{n_1 + n_2 - 2} \quad (1)$$

Keterangan:
$\overline{X_1}$ = average score of the experimental class
$\overline{X_2}$ = average score of the control class
${S_1}^2$ = variance of the experimental class

$S_2{}^2$ = variance of the control class
S^2 = combined variance
n_1 = number of students in the experimental class
n_2 = number of students in the control class

The test criteria if $t_{counts} > t_{table}$ means H_0 is rejected, if $t_{counts} < t_{table}$ means H_0 is accepted where $t_{table} = t_{1-a}$ at a significance level of 5%.

III. RESULTS AND DISCUSSION

This study took place at SMAN 2 Pariaman and involved two sample classes: one designated as the experimental class and the other as the control class. The sample consisted of 64 students, with 31 in the experimental class and 33 in the control class. The experimental class received instruction through a guided inquiry learning model assisted by LKPD, while the control class followed a direct learning model. The material covered in this study included sound and light waves for classes XI F2 and XI F6 at SMAN 2 Pariaman. Upon completing the research process, data on students' understanding of physics concepts was collected. The description of the final results from the concept comprehension test is as follows.

Data Description

The researcher collected data on students' grasp of concepts through a final test administered in both the experimental and control classes at the conclusion of the study. A written test instrument comprising 20 multiple-choice questions was employed. Details of the research data outcomes for both the experimental and control classes are presented in Table 2.

Table 2. Data on the Results of the Final Test of the Experimental Class and Control Class at SMAN 2 Pariaman

Class	N	Value		$\bar{X}$	S^2	S
		Highest	Lowest			
Experiment	31	90	45	76,29	116,613	10,79
Control	33	85	30	59,54	206,818	14,38

Sumber: Hasil penelitian di SMAN 2 Pariaman, 2024

Table 2 displays statistically obtained data from the final test results of learners in both the experimental and control classes. It includes the number of students (N), average score ($\bar{x}$), standard deviation (S), and variance (S^2). The table reveals that the average concept understanding score in the experimental class surpasses that of the control class. Further details regarding concept understanding scores can be found in the appendix.

The subsequent graph illustrates the average final test scores of learners in the experimental and control classes, focusing on sound and light wave material. It contrasts the outcomes of LKPD-assisted guided inquiry learning models and direct learning models.

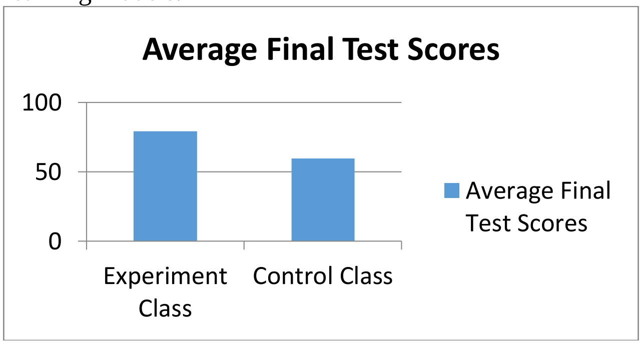

Fig. 1. Average Final Test Scores of the Experimental Class and Control Class

Figure 1 demonstrates that the experimental class exhibits a more substantial enhancement in average scores in comparison to the control class. This is evident in the calculations, where the average final test score for students in the experimental class is 76.29, whereas it is 59.54 for the control class. Thus, it can be inferred that the LKPD-assisted guided inquiry learning model influences students' understanding of concepts pertaining to sound and light wave materials.

Data Analysis

Data analysis was undertaken to assess the significance of the average disparity between the two sample classes. Before interpreting the study findings, statistical hypothesis testing was conducted to determine whether the hypothesis could be accepted or rejected. This test primarily investigates the resemblance of two averages. Preceding the hypothesis test, normality and homogeneity tests were administered for both samples. The description of the analysis of each concept understanding can be seen as follows.

Final Test Normality Test

The Lilliefors test was employed for the normality test. This test aimed to determine whether each sample originated from a population with a normal distribution. The outcomes of the normality test, including the L_0 and L_{table} values at the significance level of 0.05, are presented in Table 3.

Table 3. Results of the Normality Test of Understanding the Concept of the Experimental Class and Control Class

Class	N	α	L_0	L_t	Information
Experiment	31	0,05	0,11	0,16	Normal
Control	33	0,05	0,12	0,15	Normal

Table 3 indicates that both sample classes exhibit L_0 values lower than L_t at a significance level of 0.05. This implies that the data derived from the final test results of the two sample classes regarding concept understanding originate from populations with normal distributions.

Final Test Homogeneity Test

The F-test was employed for the homogeneity test. This test aimed to determine whether both sample classes originated from populations with homogeneous variances. Following calculations on both sample classes, the results are presented in Table 4.

Table 4. Test Results of Homogeneity Understanding of the Concepts of Experimental Class and Control Class

Class	N	S^2	Fh	Ft	Information
Experiment	31	116,613	1,77	1,83	Homogeneous
Control	33	206,818			

Table 4 displays the outcomes of the homogeneity test conducted on the final test data of the two sample classes. The obtained F_h value is 1.77, while F_t with a significance level of 0.05, having 30 as the numerator and 32 as the denominator, is 1.83. The results indicate that F_h is less than $F_{(0.05),(30:32)}$. This suggests that the data from both sample classes originate from populations with homogeneous variances.

Hypothesis Test (Similarity Test of Two Averages)

After conducting normality and homogeneity tests on the final test data from both sample classes, it was established that the data from both samples exhibited normal distribution and uniform variances. To assess the research hypothesis, a two-sample average similarity test was performed using t-test statistics. The outcomes of this similarity test for the two averages of both sample classes are depicted in Table 5.

Table 5. Test Results t Understanding the Concepts of Experimental Class and Control Class

Class	N	$\bar{X}$	S^2	t_{count}	t_{table}
Experiment	31	76,29	116,613	5,24	1,99
Control	33	59,54	206,818		

Table 5 indicates that at the significance level α = 0.05 and with degrees of freedom dk = 62, the distributed t-value is obtained as $t_{0.975:62}$ = 1.99. With the real level of α = 0.05, t_t = 1.99 and t_h = 5.24 were obtained. Acceptance criteria H_0 if $-t_{1-1/2.\alpha} < t < t_{1-1/2.\alpha}$, the price of t_h = 5.24 is outside the H_0 revenue area. Therefore, the null hypothesis (H_0) is rejected, and the alternative hypothesis (H_1) is accepted. Consequently, it can be inferred that there is a significant impact of employing the LKPD-assisted guided inquiry learning model on concept understanding at SMAN 2 Pariaman.

Based on the description and analysis of the conducted data, there emerges a distinction in the conceptual comprehension between students utilizing the LKPD-assisted guided inquiry learning model and those employing the direct learning model. This indicates that employing the LKPD-assisted guided inquiry model for sound and light wave materials can enhance students' grasp of concepts. The evaluation of concept comprehension was conducted through a concluding test administered to both the experimental class (class XI F2) utilizing the LKPD-assisted guided inquiry learning model and the control class (class XI F6) employing the direct learning model.

Before administering the final test, the questions intended for it undergo a trial run in classes other than the sample class. Following the question trial, statistical tests are conducted to evaluate the questions, ensuring their validity and feasibility for the final test. The final test outcomes show that the experimental class attained an average concept comprehension score of 76.29, whereas the control class achieved 59.54. Following this, normality and homogeneity tests were conducted on both sample classes at a significance level of 0.05, indicating that both samples exhibit normal distribution and homogeneous variances. Hypothesis testing is then conducted using a t-test, yielding a t_{count} of 5.24, which exceeds the t_{table} value of 1.99. The criteria for acceptance stipulate that if the t_{count} falls between the t_{table} values, the null hypothesis (H_0) is retained; otherwise, it is rejected. As the t_{count} surpasses the t_{table}, The null hypothesis (H0) is discarded, and the alternative hypothesis (H1) is embraced, indicating a notable influence of the LKPD-assisted guided inquiry learning model on students' grasp of physics concepts at SMAN 2 Pariaman.

There is an increase in students' understanding of concepts in the use of the guided inquiry model because the LKPD assistance makes students more directed to find physics concepts and tend to be more active in learning process activities. This reason is in accordance with Apriliani et al. [20] who stated that the use of a guided inquiry model can change the state of passive learning to active and creative. In addition, the use of LKPD makes students independent and easier to find the concepts they learn on their own. In addition, the Ministry of National Education in Umbaryati [21] having worksheets benefits students by fostering independent learning, promoting comprehension, and facilitating written tasks. The instructional materials utilized should align with the syntax of the chosen learning model, thereby enhancing students' conceptual understanding.

The observations on student engagement during the learning process revealed a stark contrast between the experimental and control classes. Generally, students in the experimental class demonstrated superior levels of participation and enthusiasm compared to their counterparts in the control class. Their demeanor reflected eagerness and involvement, evident in their cheerful expressions and relaxed demeanor throughout the lessons. This positive atmosphere contributed to a conducive learning environment, fostering effective student-teacher interaction. Moreover, the completion of LKPD by students in the experimental class indicated a meticulous understanding of the concepts related to sound and light waves, following the structured procedures outlined in the LKPD. Additionally, there was a noticeable enhancement in students' practical skills within the experimental class, surpassing those in the control class.

LKPD is crafted to streamline students' learning process and task completion. It is supplemented with focused questions to enhance concentration, QR codes featuring tutorial videos for experiments, and other resources aimed at engaging and stimulating students, facilitating adherence to procedural guidelines. Subsequently, this LKPD is integrated into the learning process, aligning with the guided inquiry model's syntax. The syntax of this guided inquiry model makes students discover for themselves the concepts they learn. According to Erawati [22], the guided inquiry model is a mental process in which students assimilate the concepts and principles they learn. Furthermore, the guided inquiry model facilitates effective, efficient, and enjoyable learning experiences for students by stimulating their intellectual curiosity.

LKPD also makes it easier for students to absorb the information received. According to Pradianti et al. [23] Within the guided inquiry model framework, teachers offer guidance, motivation, examples, and keywords to encourage students toward independent learning. This approach fosters a deeper understanding of the subject matter and facilitates easy recall. The creation of LKPD involves utilizing textbooks and various information sources to ensure its efficacy in enhancing students' conceptual understanding. Besides LKPD, several other factors influence students' comprehension of concepts, including teacher input and environmental factors such as parental support, peer interactions, and the overall learning environment, which are beyond the teacher's control.

IV. CONCLUSION

Following the research and statistical analysis, it was evident that the t_{count} exceeded the t_{table} value. Consequently, the null hypothesis (H_0) was rejected, and the alternative hypothesis (H_1) was accepted. Thus, it can be deduced that employing the LKPD-assisted guided inquiry model for sound and light wave materials significantly impacts students' comprehension of physics concepts at SMAN 2 Pariaman. In addition, there was an increase in learning outcomes which was marked by the average score of students' concept understanding, which was 76.29 in the experimental class and 59.54 in the control class.

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