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The Effect of E-LKPD Based on Physics Toolbox Sensor Suite on Simple Harmonic Motion Material on High School Students' Understanding of Physics Concepts

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ABSTRACT
This research aims to determine the effect of Digital-Worksheet (E-LKPD) with the Physics Toolbox Sensor Suite on understanding physics concepts of high school students in South Lampung, Lampung. A total of 60 students were involved in this research and were divided into two classes, namely the experimental and control classes. Data were analyzed using n-gain, independent sample t-test, and effect size. The research results showed that the average N-gain in the experimental class was 0.73 in the high category, while it was 0.58 in the medium category in the control class. There was a significant difference in n-gain in understanding concepts (sig.2-tailed < 0.05) between the experimental and control classes. This result is also reinforced by the effect size, which is very high, namely 1.319. This shows that the E-LKPD with the Physics Toolbox Sensor Suite is able to improve understanding of physics concepts, especially regarding Vibration. E-LKPD with the Physics Toolbox Sensor Suite can help students understand concepts, improve work activities, and reduce misconceptions.

INTRODUCTION

Indonesia is in the period of revolution 4.0, as evidenced by the quick development of information and communication technology, which is reflected in the advent of the Internet of Things in many aspects of life that affect people's lives [1]. Educators are encouraged to use information and technology (IT) as a media source to support the learning process, one of which is scientific learning, as a result of the development of technology, communication, and information in Indonesia [2]. Because physics is a very fundamental subject and has a significant impact on technological progress, it cannot be separated from the principles of current technological advancements [3]. One of the goals of physics at the high school level is for these students to master the understanding of physics concepts and principles [4]. In learning physics the concepts studied are always related, the initial concepts learned will become the basis for the development of subsequent concepts [5].

Physics is a science that studies natural phenomena which are studied logically, systematically, and full of scientific attitude [6]. However, in general, problems occur when learning physics is considered a complicated calculation, but physics I,s a conceptual science [7]. Additionally, based on research conducted by Aseng et al [8] regarding students' understanding of the concept of physics in the simple harmonic motion material in class X SMA Negeri 1 Maumere, the results obtained were that students' understanding of the concept of the simple harmonic motion material was still low, and the learning methods used by teachers are less attractive to students, which causes them to get bored. A study by Wardani [9] on An analysis of student's concepts and understanding of simple harmonic motion: Study in vocational high schools found that specific misconceptions accounted for 14.6% of the results, followed by partial understanding with specific misconceptions at 23.9%, partial understanding at 36.8%, and appropriate understanding with an expert at 24.7% . This demonstrates the need to strengthen students' conceptual comprehension through the use of instructional media that may represent abstract ideas of straightforward harmonic motion.

Based on the results of observations with interviews with students and physics teachers in class X at SMA Negeri Lampung Selatan, where students said that physics was very challenging, difficult to understand, and uninteresting because there were too many formulas and calculations. According to the majority of students, however, the physics teacher for class X stated that many students did not meet the Minimum Completeness Criteria (KKM) on daily exams or tests because they relied primarily on memorization and did not comprehend the concepts of the physics material when faced with various questions. Therefore, students must comprehend concepts to be able to answer abstract and challenging physics issues. The answer to the difficulty of students comprehending topics is to have learning innovations by creating engaging displays and interactive teaching resources, which will increase students' attention and make learning physics easier.

There are several methods to help students For increase their understanding of concepts, which is using the appropriate model/method with characteristics material, and style Study students, teaching materials, and media. One of the common teaching materials used in learning is Electronic Student Worksheets (E-LKPD). Electronic LKPD is a worksheet that is arranged in an electronic form that is practical and can provide facilities used as a support for making learning activities appropriate with technological advances in the field of education making it easier for students to have good conceptual understanding skills [10]. Conceptual understanding, which is demonstrated by outlining a reading's main points or transforming data presented in one form into another, is the capacity of a person to comprehend or understand something after it has been known or remembered, including the capacity to understand the meaning of the material being studied [11]. Increased understanding of concepts in guided inquiry-oriented learning through data collection activities, making and interpreting graphs, tabulating research results, and presenting research results [12].

Physics learning is very closely related to practical activities. Practicum activities are very important in encouraging and facilitating students, including understanding concepts, proving concepts, concept accuracy, and process skills (scientific basic skills and students' affective skills) [13]. Teachers and students can both benefit from the usage of technology as a learning tool [14]. Therefore, using electronic teaching materials in the form of student worksheets (E-LKPD) with an experimental guide is one way that developments in information and communication technology are used in learning activities. One alternative to overcome the existing problems is by developing a learning tool in the form of an E-LKPD so that students can use the E-LKPD via a smartphone and do practical work using the Physics Toolbox Sensor Suite application on a smartphone so that students and teachers can use it at school at home independently flexible. This is consistent with Nuryantini's research, which found that using the Physics Toolbox Sensor Suite application is one of the learning media innovations that can be used as a physics experiment instrument [15].

The Physics Toolbox Sensor Suite application is a tool for carrying out physics practicum activities by utilizing various sensors in applications and smartphones. Experiments using the Physics Toolbox Sensor Suite can make it easier for students to do practicum because the data obtained is easily accessible and shared for further analysis [15]. The use of E-LKPD accompanied by the Physics

Toolbox Sensor Suite as a learning tool can be one of the solutions and innovations in physics learning media.

Based on the explanation above, the use of the Physics Toolbox Sensor Suite -based E-LKPD is an alternative learning solution and innovation to improve students' understanding of physics concepts, to ascertain the impact of applying the Physics Toolbox Sensor Suite E-LKPD on simple harmonic motion material on students' grasp of physics principles, the study was carried out.

METHOD

This research uses a static one group pretest-posttest design. This research involved 60 high school students in South Lampung as samples taken by random cluster sampling. Next, students were divided into 2 classes, namely experimental and control classes. experimental class using E-LKPD based on Physics Toolbox Sensor Suite with a learning model inquiry Guided and control class using printed worksheets with learning model inquiry Guided. The research design is shown in Table 1.

Table 1. Research Design

Class	Pretest	Treatment	Posttest
Experiment	O_1	X_1 (Treatment class using E-LKPD based on Physics Toolbox Sensor Suite with Guided Inquiry Learning Model)	O_2
Control	O_1	X_2 (Treatment class using printed worksheets with Guided Inquiry Learning Model)	O_2

O_1 = Pretest, O_2 = Posttest

This research uses a multiple choice test instrument consisting of 5 indicators of concept understanding, namely interpretation, giving examples, classification, summarizing, concluding, comparing and explaining [16]. Before use, the test instrument is tested for validity and reliability. The test result data was analyzed by carrying out a normality test to determine the type of statistical test that will be used, the n-gain test to determine the magnitude of the increase in conceptual understanding of each sample, the independent sample t-test to determine the difference in n-gain between the experimental and control classes, and the effect size to determine the magnitude of the influence of e-LKPD with the Physics Toolbox Sensor Suite.

RESULTS AND DISCUSSIONS

The pretest and posttest employed in this study are written test methodologies. The pretest is administered ahead of time, and the posttest is administered following the conclusion of the learning activities. This written exam was created to assess candidates' comprehension of physics concepts related to the pendulum's straightforward harmonic motion. The test consists of multiple-choice questions with a maximum total score of 20. The final score is calculated by dividing the total score by the maximum score and multiplying that result by 100. The following are research findings based on quantitative data that are shown in Table 2.

Table 2. Quantitative Data from Experimental and Control Group Research

Statistical Parameters	Experiment		Control	
	Pretest	Posttest	Pretest	Posttest
Number of Samples (N)	35	35	35	35
Lowest Value	25	70	20	50
The highest score	80	95	60	85
Maximum Value	100	100	100	100
Average Value	32,43	85.71	31,29	71,43

According to Table 2, the experimental class's average pretest score was 32.428, while the control class's was 31.285. Pre-test findings between the experimental and control groups did not differ significantly, sig. (2-tailed) > 0.05. This indicates that both sample groups had the same level of understanding of physics topics before treatment. Following treatment, the average posttest score in the experimental group was 85.714 while it was 71.428 in the control group for the two samples. The concept understanding indicator alludes to the indicators created by Anderson and Krathwohl, which include an explanation, classification, summarizing, concluding, presenting instances, and interpreting [17]. Table 3 displays the results of the pretest and posttest for each indicator in the experimental and control groups.

Table 3. Pretest and Posttest Results in each Indicator of Understanding Draft Physics

Indicator Understanding Draft	Group			
	Experiment		Control	
	Pretest	Posttest	Pretest	Posttest
Interpretation	38.09	96,19	25,71	71.85
Example	42.65	98.57	48,57	92.85
Classify	46,42	83,37	43,57	78,37
Summarizing	10.75	69,14	8,14	44,22
Conclude	37,14	75,27	41,42	77,14
Compare	43,71	87,44	42.85	68,42
Explain	8,27	90	8.77	67,14
Average	**32,43**	**85.71**	**31,29**	**71,43**

According to Table 3, the experimental group's average improvement in comprehension of each indicator's physics concept was quantitatively higher than that of the control group. This is because the use of the E-LKPD, which is based on the Physics Toolbox Sensor Suite and the guided inquiry learning model, makes students more engaged and capable of grasping the concepts in the simple harmonic motion material. The difference in post-test between the group experiment and control makes the difference in n-gain understanding of draft physics between the group experiment and control very significant, that is the n-gain of the group experiment 0.79 included category height and n-gain groups control 0.58 included category medium. Average n-gain understanding draft physics group experiment and control shown in Figure 1.

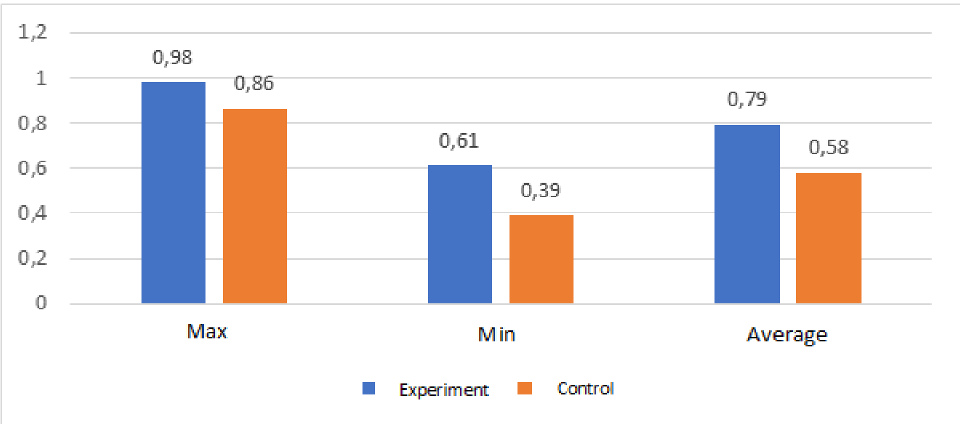


Fig 1. *Average N-gain Understanding of Physics Concepts*

The Kolmogorov-Smirnov test was used to conduct the group N-gain experiment and the control normalcy test. The results of the n-gain understanding test for the draft physics assignment for high school students are shown in Table 4.

Table 4. N-gain understanding normality test results draft physics high school students

Class	Kolmogorov Smirnov test			
	Statistics	**Df**	**Sig.**	**Interpretation**
Experiment	0.129	35	0.153	Normal
Control	0.097	35	0.200	Normal

Since the n-gain data for high school student's understanding of physics concepts are normally distributed and meet the criteria for continuing the Independent Sample T-test, Table 4's n-gain for the experimental group and the control group has a significance value of > 0.05. Table 5 displays the results of the Independent Sample T-Test.

Table 5. Independent Sample T-Test Results Ability to Understand Draft Physics high school students

		Levene's Test for Equality of Variances		t	df	Sig. (2-tailed)
		F	Sig.			
N-Gains	Equal variances assumed	11,593	0.001	5,487	68	0.000
	Equal variances not assumed			5,487	55,691	0.000

The Independent Sample Test T-Test yielded a Sig value (2-tailed) of 0.000, as shown in Table 5. Depending on the determining factor If the Sig value (2-tailed) is 0.000 0.05, then H 1 is accepted, and it can be concluded that deep experiment learning utilizing the Physics Toolbox Sensor Suite's E-LKPD platform differs from the control group's use of printed LKPD in terms of how well high school kids grasp draft physics. The Physics Toolbox Sensor Suite-based E-LKPD is more efficient and makes it simpler for students to comprehend subject topics when used directly on a personal computer (PC) or mobile device. According to Wati et al., the E-LKPD is a student work guide that is intended to help students understand the idea that study may be done effectively in an electronic setting with the use of a computer or mobile device [18]. Additionally, the adoption of E-LKPD can encourage students to participate actively in their learning [19].

E-LKPD-based Physics Toolbox Sensor Suite is designed teaching materials with utilize Android devices to be tool gauges that can use in test physics. With the use of an application, this student can test material motion harmonious simply like in an environment rea. Learning using E-LKPD based The Physics Toolbox Sensor Suite makes it possible for students can collect data through tests in a manner thorough and correct so that the data obtained is quite valid. In the initial stage, students are faced with the problem of swing shapes with varying pendulum sizes, as in Figure 2

a b

Fig 2. *a. Different pendulums; b. Modern Perpetual Motion Machine Newton's Pendulum*

There are 5 pendulums hanging close to each other, if pendulum C is swung, how will the other pendulums swing too? Most students gave the correct answer, that is, when one of the pendulums is swung and then collides with a stationary pendulum, the kinetic energy and momentum of the moving pendulum will be transferred to the stationary pendulum, so that the other pendulum moves. Next, students focused on the movement of the pendulum to find the relationship between frequency, periode and rope length. By using the Physics Toolbox Sensor Suite in LKPD the data obtained is very accurate, so it is easy to interpret, and it will be easy to prove the relationship between frequency and period, and string length. Inserted Physics Toolbox Sensor Suite in LKPD make student will more interested and enthusiastic in their study. This Because a student can connect material lesson physics with the use of familiar technology.

N-gain understanding draft physics on each good indicator in the group experiment nor control shown in Figure 3.

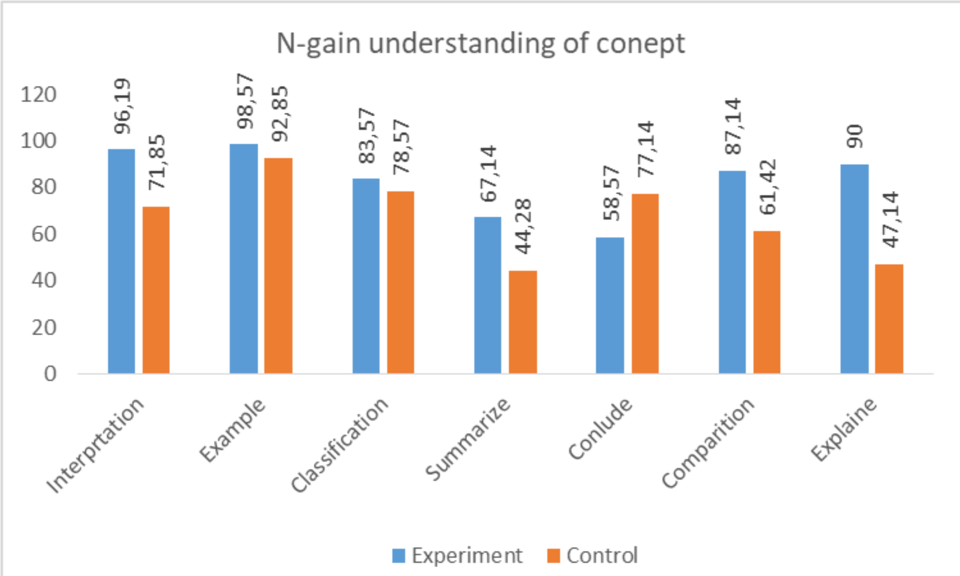
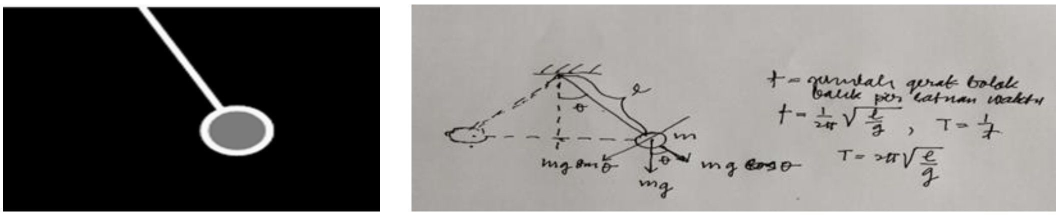


Fig 3. *Graph of Concept Understanding Indicator Achievements*

Between the experimental and control groups, there was a substantial difference in the average accomplishment of each metric. In the example of the providing indicator, both the experimental class and the control class experienced an increase in the highest concept understanding indicators. The n-gain in the experimental group was 0.98 while it was 0.86 in the control group. Although the ability to give an example is very good in group experiments Far more good data group control. Difference This caused Because students in groups experiment more motivated to learn and do tests with utilize the Embedded Physics Toolbox Sensor Suite in LKPD. The use of E-LKPD based The Physics Toolbox Sensor Suite makes it possible for students to Study physics through experience direct, and connect draft physics with the real world, so students in groups experiment Enough easy in look for example example motion harmonious simple in life real. The results of this research are supported by the research results of I Wayan District et al, namely that e-LKPD is able to increase high school students' understanding of concepts and digital literacy. The increase in conceptual understanding of all indicators in both the experimental and control classes was due to the influence of the inquiry model [20] [21] [22]. The highest understanding of the concept was found in the indicators of giving examples and interpretation in both the experimental and control classes, respectively 98.57 and 92.85. These results are in accordance with the findings of Distrik et al [23] in their research which applied digital worksheets in learning.

In learning taught students using E-LKPD based Physics Toolbox Sensor Suite is capable guide student in do motion interpretation harmonious simple. Students can explain the relationship between the concept of period (T) and frequency (f) in a pendulum through a simple pendulum circuit drawing (Figure 4)



a b

Fig 4. *a. Motion of Pendulum; b. Analysis of pendulum motion by students*

In addition, students are also able to interpret images of simple harmonic motion applications on pendulums in everyday life. According to research by Musdar, et al., the capacity to interpret the concept understanding indication falls into the high category with an average percentage of 77% [24]. While the indicator that experienced the lowest increase occurred in the concluding indicator, this was because many students had not been able to analyze with Good so that difficult conclude. Difficulty students in making conclusions are also expressed by Distrik et al [25]. According to District et al. The difficulty of students in making conclusions because students are not used to in interpret the data obtained through tests or observations understanding the draft holds a role important in physics. Good conceptual understanding is the basis for problem-solving [26]. Mastery of concepts is also the most basic thing in solving or solving problems in physics [27].

The E-LKPD, based on the Physics Toolbox Sensor Suite application, supports a thorough comprehension of the topics in this research. Teachers and students can both benefit from the usage of technology as a learning tool [14]. This aligns with Nuryantini's research that one of the learning media innovations as a physics experimental instrument is using the Physics Toolbox Sensor Suite application [15]. Putri et al's research state that smartphones can be used as a medium for learning physics through practical activities based on smartphone sensors [14]. In line with this research, applying smartphone sensors using the Physics Toolbox Sensor Suite application through simple harmonic motion experiments on student pendulums makes it easier to obtain experimental data because the experimental results can be read on the smartphone screen.

The influence of the E-LKPD-based Physics Toolbox Sensor Suite to ability understanding concepts also counts through the effect size test. Effect size test results can be seen in Table 6.

Table 6. Effect Size Test Results

Class	Means	Standard Deviation	Cohen's d
Experiment	73,87	13.97	1.319
Control	58.75	8,38	

Cohen's d value of 1.319 is obtained in the large category, this shows that the E-LKPD based on the Physics Toolbox Sensor Suite has a major influence on students' ability to understand physics concepts. This shows that the E-LKPD based on the Physics Toolbox Sensor Suite has a major influence on increasing students' understanding of physics concepts. To meet learning objectives, students can benefit from using E-LKPD to better understand the information that teachers are presenting to them [28]. Additionally, the utilization of electronic LKPD can entice students to take an active role in their education [19]. It has been demonstrated that using the E-LKPD as teaching material can help students comprehend physics subjects better. This statement is by Putri et al.'s research that E-LKPD can improve the mastery of physics concepts in high school students [14].

The study by Ariyansah et al. is in support of a study on the impact of the E-LKPD based on the Physics Toolbox Sensor Suite. With an N-gain value of 0.71 in the high category, his research findings demonstrate that the E-LKPD is a useful tool for improving students' knowledge of physics subjects [28]. Additionally, a study by Alma et al. revealed that students' conceptual understanding allowed them to achieve an N-gain value of 0.70 in the high category [6]. The Physics Toolbox Sensor Suite application, which is successfully used in educational activities, served as the foundation for the E-LKPD employed in this work. According to Nuryantini's research, using smartphone sensors in the Physics Toolbox Sensor Suite application is a different approach and a cutting-edge experimental technique to teach students the imprecise idea of simple harmonic motion. Results of research This is consistent with Ulhaq's research, which shows that media-guided inquiry based on simple harmonic motion learning is effectively used in learning activities with an average N-Gain of 0.66 and an effect size value of 1.68 in the high category [29]. The practicum uses smartphone sensors with the Physics Toolbox Sensor Suite.

CONCLUSION AND SUGGESTION

The use of Physics Toolbox Sensor Suite-based E-LKPD on Simple Harmonic Motion material has an influence Enough big on students' understanding of physics concepts shown by the different n-gain understanding of significant concepts between taught students with using E-LKPD based Physics Toolbox Sensor Suite and the students it teaches with using the usual printed LKPD used by students at school the. The highest understanding of physics concepts is on the giving indicator example with an n-gain of 0.98 and an understanding indicator draft lowest physics found in the concluding indicator with an n-gain of 0.61. Understanding indicators concept included category tall in learning that uses E-LPKD-based Physics Toolbox Sensor Suite, that is interpretation, give examples, explain, and compare while the indicator of understanding concept included in category medium, that is summarizing, classifying and concluding. The influence of E-LKPD-based Physics Toolbox Sensor Suite on the understanding concept is also shown with effect size test results, is 1.319 with large categories, p This show that the Physics Toolbox Sensor Suite-based E-LKPD on Simple Harmonic Motion material has enough influence big in improving students' understanding of physics concepts.

E-LKPD based on the Physics Toolbox Sensor Suite can be a new alternative solution for teachers as teaching materials that are more varied and interactive so that they can be used to increase students' understanding of physics concepts. The weakness of the Physics Toolbox Sensor Suite is that the sensors on mobile devices are not as accurate as laboratory sensors. Measurement results can be affected by factors, such as electronic interference, sometimes difficult to control environments that must be supported, and cannot be used to measure more complex physical variables.

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