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The Effectiveness of Integrated Scientific Literacy Student Worksheets for the Use of Physics Practical Kits on Temperature and Heat Materials on the Learning Outcomes of Grade XI Senior High School Students

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ABSTRACT

This study aims to determine the effectiveness of integrated student worksheets (LKPD) with scientific literacy on temperature and heat material in the independent curriculum. The method used in this study is a quasi-experimental with a posttest-only control group design, involving 2 classes in phase F, namely class XI F5 as the control class and class XI F6 as the experimental class. The instrument used in the knowledge aspect is a multiple-choice question and the instrument used in the skills aspect uses an assessment rubric. Data were analyzed using a normality test, a homogeneity test, and a hypothesis test in the form of a t-test. The results of the study indicate that the application of student worksheets (LKPD) containing scientific literacy significantly improves student learning outcomes, both in terms of knowledge and skills. This is evidenced by the average increase in the experimental class in the knowledge and skills aspects with the same value, namely 72.96 for the results of the hypothesis test or t-test conducted on student learning outcomes in two aspects: knowledge and skills. The results obtained for the knowledge aspect were 4.4>2.00 and the skills aspect was 5.5>2.00, so it was stated that t count>t table, so H1 was accepted and H0 was rejected..

Keywords: Scientific literacy LKPD; lab work kit; temperature and heat; physics learning outcomes; guided inquiry; independent curriculum;

I. INTRODUCTION

Learning can be defined as the process of creating a supportive learning environment, thereby enabling behavioral change in students. One interesting aspect of learning is the use of video-based learning environments at various levels of education, from elementary school to higher education [1]. Physics is a field of science that explains and predicts natural phenomena, with a scope limited to the empirical world, that is, things within the scope of human experience. Nature becomes the object of learning in Physics. Through learning Physics, students can gain direct experience to strengthen their ability to absorb, retain, and apply the knowledge they have acquired. [2]The Independent Curriculum gives students the freedom to participate in learning more flexibly. They can choose subjects according to their interests and complete projects that produce marketable work [3]. The Independent Curriculum is a curriculum that gives all educational units the freedom to utilize various learning tools, such as literacy assessments, learning modules, textbooks, and others. [4].]. The guided inquiry model can be implemented in schools with the help of practical KIT on physics material to improve student learning outcomes[5].

Learning Outcomes (CP), Learning Objective Flow (ATP), teaching modules, teaching materials, and Learning Objective Completion (KTP) are learning resources used in the independent curriculum [6].The inquiry learning model is a learning model that can train students to think critically and analytically to seek and find definitive answers to problems given by the teacher [7]. Inquiry learning is a learning model that focuses on finding solutions to problems or answers to various questions within clear procedures and group structure [8]. The government provides textbooks and non-textbooks, such as teaching modules, student worksheets, and others, as teaching materials for an independent curriculum. Meanwhile, teachers act as guides to keep students on the right track [9].In addition to improving their learning outcomes by becoming more systematic, logical,

critical, and analytical, students are said to be able to understand and remember the material they learn better with this learning paradigm [10].

Laboratory equipment (KIT) is a set of laboratory equipment that can be used in learning [11]. KIT is a set of practical tools made and packaged in a teaching unit box containing tools useful for specific subjects [12]. KIT is a collection of components in a box that can be arranged in a coordinated manner to support various real-world activity problems or function as a teaching tool for various subjects [13] Scientific literacy encompasses students' understanding of scientific ideas and procedures and their critical application of this information in everyday life, creatively, and responsibly. Scientific literacy is one way to address the challenges of addressing the shifting educational paradigm and preparing students to achieve desired competencies. [14]. The decline in PISA 2022 scientific literacy scores raises many questions regarding the underlying factors, one of which is the impact of the pandemic, which has affected learning processes in various countries. [15]. Scientific literacy is a person's ability to use their scientific knowledge to solve various everyday problems [16].

Student Worksheets (LKPD) are printed teaching materials in the form of sheets containing the main points of learning material accompanied by instructions for carrying out learning tasks that must be completed by students [17]. LKPDs include activities that engage students and can encourage students to actively participate in their education. [18]. Low levels of learning processes in the laboratory are caused by inadequate laboratory equipment, insufficient time, and a lack of student creativity. [19] The LKPD created by the previous researcher had not yet undergone an effectiveness test, so the researcher wanted to continue with that stage.The use of an inquiry-based learning model, one of the learning models recommended by the autonomous curriculum [20]. The national education system uses Benjamin Bloom's classification of learning outcomes, which broadly divides them into three domains: cognitive, affective, and psychomotor, to formulate educational objectives, both curricular and instructional [21]. The knowledge aspect is an aspect that includes mental (brain) activities. All efforts that involve brain activity are within the realm of knowledge. The skills aspect is an aspect that relates to skills or the ability to act after someone receives a certain learning experience [22].

Based on observations at SMAN 2 Lubuk Sikaping, guided inquiry has not been fully implemented in schools due to a lack of adequate supporting teaching materials. Interviews with physics teachers at SMAN 2 Lubuk Sikaping revealed that physics students still experience difficulties in understanding physics concepts due to the lack of teaching materials for guided inquiry-based learning. Therefore, effective teaching materials are needed to actively engage students in exploration and knowledge discovery.Although laboratory equipment for conducting experiments is available at school, its utilization tends to be suboptimal due to the lack of clear and easy-to-understand instructions. Unclear instructions in the student worksheet (LKPD) make it difficult for teachers and students to use the equipment effectively. As a result, the learning potential of laboratory experiments is hampered, and students miss out on opportunities for hands-on experience. In addition, because the learning carried out is not optimal, it causes the learning outcomes obtained from students to be still relatively low, so researchers conducted research using integrated scientific literacy LKPD from previous researchers who had not yet reached the stage of testing effectiveness to see the level of effectiveness of the LKPD on student learning outcomes. Conditions found in the field during observations, where during learning activities the teacher only used PPT and printed books, resulting in poor understanding of student concepts, and when assessing student learning outcomes, this was proven by the results of the odd semester final exam as follows:

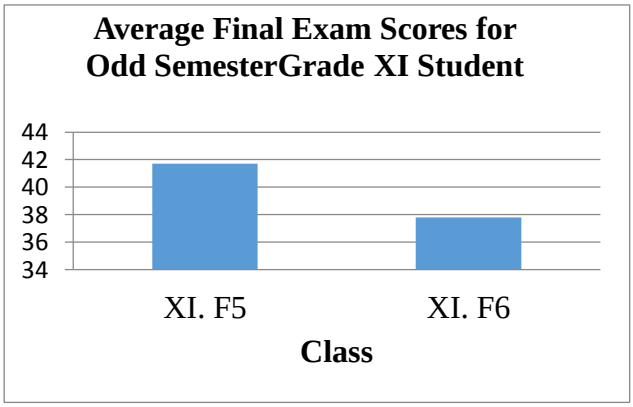

Fig. 1. Graph of Average Final Exam Scores for Odd Semester Students of Grade XI"

Figure 1 shows that students in the physics class at SMAN 2 Lubuk Sikaping continue to have relatively low results; the average score for each class falls short of the school's KKM of 70. Among other factors, the usage of instructional materials that are still deficient can contribute to these students' low scores by making it difficult for them to comprehend numerous physics topics. Based on the description above, the author conducted a study entitled "The Effectiveness of Integrated Science Literacy Student Worksheets with the Use of Physics Practical Equipment on Temperature and Heat Material on the Learning Outcomes of Grade XI Senior High School Students". It is hoped that with this study, students can improve their learning outcomes in mastering temperature and heat material.

II. METHOD

This study employed a quasi-experimental research design. Despite having a control group, this design is unable to completely control outside factors that could influence how the experiment is carried out. A posttest-only control design is the research methodology employed. Two classes were used in this study a control class and an experimental class. The experimental class used a physics worksheet containing scientific literacy from researchers that had been validated previously, while the control class used a worksheet commonly used in schools. Both classes used a guided inquiry learning model. According to [22] the posttest-only control design is illustrated in the table below:

Table 1. Post-Test Only Control Design

Group	Treatment	Post-test
Experiment	X	O
Control	-	O

(Source: Ref [22])

Information:

X = The experimental class received instruction utilizing student worksheets that included scientific literacy in order to understand the content. Heat and Temperature.

O = Final test conducted in the experimental and control classes.

A. Population

[22] A population is a broad category made up of items or people with particular attributes and traits that the researcher has chosen to study in order to draw conclusions. Class XI pupils enrolled in the second semester at SMAN 2 Lubuk Sikaping served as the study's population

Table 2. Students of Class XI of SMAN 2 Lubuk Sikaping

NO	Class	Number of students
1	XI F 5	31 students
2	XI F 6	28 students

B. Sample

Sample a subset of the population. Two classes form the sample, based on the problem: an experimental class and a control class. Saturated sampling, also known as total sampling, is used to select the sample classes. When every member of the population is used as a sample, the total sampling technique is used [22]. To determine whether the two samples have equal ability, a test of equality of means is conducted after first conducting a normality test and a homogeneity test.

This research was conducted with the following preparation and implementation stages:

1. Preparation Stage

The activities carried out in the preparation stage are as follows:

a. Determining the location and schedule of the research.

b. Preparing documents related to the research.

c. Determining the sample and population used in the research.

d. Preparing learning materials.

e. Creating an exam question framework based on the previously created framework.

f. Preparation of research instruments, such as final exam questions for the knowledge and skills domains, is obtained through an assessment rubric by assessing student performance.

C. Learning Outcome Instruments for Knowledge Competencies

The research instruments used are appropriate for the research variables from which the data will be collected. The instrument used for knowledge competencies is a written test on temperature and heat, consisting of 20 multiple-choice questions and referring to competency achievement indicators. The instrument for knowledge competencies is a written test administered at the end of the study.

D. Learning Outcome Instrument for Skills Competencies

Skills assessment is conducted while students are engaged in practical activities on the physics material on temperature and heat being taught. The instrument used is a scoring rubric.

E. Data analysis procedures

Data analysis techniques are crucial because they are the basis for drawing conclusions based on the formulated hypotheses. The purpose of data analysis in research is to test the validity of the proposed hypotheses.

1. Normality Test

The normality test is conducted to determine whether the sample comes from a normally distributed population. The Lilliefors test is used to test for normality.

2. Homogeneity Test

The homogeneity test is a method used to determine whether two samples have uniform variances. This test aims to ensure that two or more groups of sample data come from populations with the same level of variation. In research, the homogeneity test is conducted on post-test data from the experimental and control groups to determine the equality of variance between the two samples. This test is conducted using the F test.

3. Hypothesis Test (t-Test)

There are two types of t-test formulas that can be used to test comparative hypotheses on two independent samples when the data used are in ratio or interval form. The significance level for the t-test is $\alpha = 0.05$. If $\alpha < 0.05$, H0 is accepted and H1 is rejected.

III. RESULTS AND DISCUSSION

Result

This research was conducted at SMAN 2 Lubuk Sikaping from May 5, 2025, to May 31, 2025. The research data obtained included knowledge and skills learning outcomes. Knowledge data were obtained from student answer sheets in the multiple-choice final test. Skill data were obtained from the assessment rubric. The description of student learning outcomes in the knowledge and skills subjects is as follows:

1. Description of Knowledge Competency Data

A written test consisting of 20 multiple-choice questions that had completed validation, reliability, and difficulty testing was used to collect knowledge competency data at the conclusion of the study. In terms of statistics, Table 5 displays the mean, standard deviation, and variance data for the experimental and control classes:

Table 3. Average, Highest, Lowest, and Standard Deviation of Both Classes for Knowledge Competence

Class	N	The tallest	Lowest	$\overline{X}$	S^2	S
Control	31	80	30	54.68	231.55	15.21
Experiment	27	95	50	72.96	265.88	16,306

Table 5 shows that students in the experimental class achieved better learning outcomes on average than those in the control group, so it can be seen that the class that used the physics LKPD containing scientific

literacy had higher scores than the class that did not use the physics LKPD containing scientific literacy in the knowledge aspect.

2. Description of Skill Competency Data

Skill competency data is obtained during the learning process. Research data on skill competency is obtained during practice or experiments. Aspects assessed include the ability to identify learning-related problems, ask questions, prepare experiments, conduct experiments, draw conclusions, and present results.

Table 4. Average Score, Highest Score, Lowest Score, and Average of Both Classes in the Skills Competency Aspect

Class	N	The tallest	Lowest	$\overline{X}$	S^2	S
Control	31	81	35	59.23	101,114	10.05
Experiment	27	87	57	72.96	73,422	8,569

It can be seen that the average student learning outcomes in the skills aspect obtained by students in classes that use physics LKPD containing scientific literacy have higher scores than classes that do not use physics LKPD containing scientific literacy.

Discussion

As demonstrated by an increase in learning outcomes following the use of scientific literacy-based physics worksheets, the study's findings demonstrated the impact of these resources on student learning outcomes. As stated by [23], this analysis found that scientific literacy is effective in training students' literacy skills, improving scientific thinking skills, and improving student learning outcomes. In addition to improving scientific thinking skills, the scientific approach can also improve science process skills.

The knowledge and skills results of this study also showed that the experimental class's average score was greater than the control class's average score. This is due to the difference in treatment where the experimental class implemented LKPD containing scientific literacy during the learning process while the control class only used LKPD provided by the school, even though both classes used teaching materials in the form of LKPD and the same learning model, but it turned out that the results obtained were that the class using physics LKPD containing scientific literacy had a higher score than the class using LKPD from the school.

The scientific literacy used in the experimental class's worksheets was the reason for the disparity in learning outcomes between the two courses. This is consistent with study by [24], which discovered that learning results were much enhanced by the use of a guided inquiry learning methodology supported with science-based worksheets. Stated differently, students' learning outcomes were impacted by the guided inquiry learning model with the help of science-based worksheets because they actively participated in learning activities that involved measurement, data collection, and observation. These activities could be completed individually or in groups using science-based worksheets. The science-based worksheets used in this study included experiential learning components, including observation, asking questions, gathering information, reasoning, and communicating, which helped students draw conclusions, thereby improving physics learning outcomes.

Guided inquiry is a highly effective learning approach for improving student learning outcomes. In this approach, teachers provide initial direction or guidance in the form of questions, step-by-step instructions, or sources of information, while still allowing students space to find answers or draw their own conclusions. This process actively engages students in learning, not only receiving information but also experiencing the scientific thinking process through exploration and discovery. This is in line with research findings [25]. This suggests that the guided inquiry learning approach works well for teaching physics. Physics learning is implemented using a science-based approach, adopting scientific steps through the scientific method, which includes observing, asking questions, experimenting, reasoning, and communicating. This approach facilitates broader student learning by utilizing available facilities, both in the classroom and through interaction with the natural environment.

Student Worksheets (LKPD) are learning tools designed to guide students to be active in learning activities, both individually and in groups. LKPD usually contains instructions, questions, activities, and space to write results or conclusions. Furthermore, LKPD can improve student learning outcomes, even using different learning models. This is in line with research conducted [26], which found that science-based LKPD with a Discovery Learning approach had an effect on science learning outcomes of class VIII students at SMPN 30 Padang in terms of knowledge and skills, as evidenced by better scores for the experimental class compared to the control class.

Student Worksheets (LKPD) are the most effective and relevant teaching materials for science literacy-based learning to improve learning outcomes due to their ability to integrate various scientific thinking processes

into student learning activities. In LKPD, students are not only asked to receive information passively but are encouraged to experience the scientific process themselves through observation, asking questions, collecting data, analyzing information, and drawing conclusions based on evidence. This is in line with the results of research [4] that from the analysis results obtained four types of teaching materials contained in the article, namely integrated science teaching materials, student worksheets (LKS), books, and modules. Based on these four types of teaching materials, LKS has a high effect size value of 2.03, meaning that LKS containing literacy is effective in improving student learning outcomes.

Based on the explanation that has been presented, the use of Physics LKPD containing scientific literacy on the material of temperature and heat in the independent curriculum is effective on student learning outcomes in physics learning at SMAN 2 Lubuk Sikaping class XI phase F. In addition to being seen in terms of different learning outcomes where the experimental class has higher scores than the control class both in terms of knowledge and skills, this is also supported by other opinions that say that physics LKPD containing scientific literacy has an effect and can improve student learning outcomes. Therefore, researchers recommend that physics LKPD containing scientific literacy can be a learning resource for teachers and students in the process of learning activities at school

IV. CONCLUSION

Based on the analyzed research results, it can be concluded that the use of scientific literacy-based physics worksheets is effective for student learning outcomes on temperature and heat material in the independent curriculum of class XI of SMAN 2 Lubuk Sikaping. This is proven before using scientific literacy-based physics worksheets, the learning outcomes of class XI phase F students were relatively low. After the application of scientific literacy-based physics worksheets, the learning outcomes of class XI phase F students experienced an increase, as evidenced by two aspects, namely the knowledge aspect and the skills aspect. In the knowledge aspect, it increased from the previous average of 37.79 to 72.96 and in the skills aspect, it increased from 57 to 72.96 so that an increase in learning outcomes was seen after using scientific literacy-integrated worksheets.

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