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# The Effect of Scientific Literacy Approach with Discovery Learning Model toward Physics Concepts Understanding

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***Abstract*** *– Scientific literacy is essential in our modern society today due to many problems related to science and technology. This study aims to determine the effect of the scientific literacy approach using the discovery learning model on students' understanding of physics concepts. The method of this research is a true experimental research using post-tests only control group design. This research was conducted at SMA Negeri 1 Watubangga. The sample of this study consisted of two classes, namely the experimental class, which was taught with scientific literacy approach using the discovery learning model, and the control class which was taught by using the direct learning model. Sampling was carried out using a random sampling technique so that class $X_1$ was chosen as the experimental class and $X_2$ as the control class. The data analysis technique used was descriptive and inferential analysis. The results showed that students' understanding of physics concepts in the experimental class is in a good category while in the control class is in the medium category. The inferential test shows t-count > t-table (6.85 > 1.98). This means that there is a significant difference in understanding of physics concept between the experimental and control group. This study concludes that the use of a scientific literacy approach with a discovery learning model has an effect on students' understanding of physics concepts.*

***Keywords:*** *discovery learning model; physics concepts understanding; scientific literacy approach*



## I. INTRODUCTION

Scientific literacy skill plays a crucial role for students in learning physics, especially in understanding concepts. It is a skill to utilize knowledge, identify questions, and draw a conclusion based on evidences in order to understand and make a decision about nature and changes done to nature by human activities (Kristyowati & Purwanto, 2019). Scientific literacy has been important in our modern society due to many problems related to science and technology (Turiman et al., 2012). Scientific literacy refers to the ability to use scientific knowledge and skills

based on empirical evidence creatively in order to solve problems and make socio-scientific decisions (Masfufah & Ellianawati, 2020). Through scientific literacy skills, students are expected to be able to develop inductive and deductive analytical thinking skills in solving problems related to natural events in their surroundings.

Referring to the literacy ability of students in Indonesia, a research conducted by the Program for International Student Assessment (PISA) 2018 on the scientific literacy abilities of students shows that Indonesia is still listed below several countries in the world, even in Asia (Schleicher, 2019). This indicates that the scientific ability of students in Indonesia is below the average scientific ability of other countries in the world. This problem also occurs at SMA Negeri 1 Watubangga where students' literacy skills are still low. Therefore, serious efforts are needed to improve the educational process in order to improve students' science learning outcomes through a literacy approach (Argina et al., 2017; Perwitasari et al., 2016).

The ability to master literacy is also in line with the current era of very rapid development of science and technology. The development of science and technology requires humans to be able to continue to adapt and master various sciences and information technology (Sukariasih et al., 2019). Otherwise, one would be left behind and lost in the competition in various fields. One way to adapt and master the development of science and technology is to maximize the ability to master literacy. Therefore, mastery of literacy is an important indicator to improving the achievements of the younger generation in achieving success. Planting literacy as early as possible must be realized because it is the main capital in realizing an intelligent and cultured nation (Irianto & Febrianti, 2017).

In addition to the selection of a scientific literacy approach, the selection of the right learning model also supports the successful understanding of students' physics concepts (Bancong & Putra, 2015). This relates to the competence of teachers in designing learning as an external factor that also determines student learning outcomes. Physics concepts require the ability to practice thinking and reasoning so that one's reasoning abilities can develop. The ability to reason is one of the skills in scientific literacy that must be possessed to survive in the 21st-century life (Prihatiningtyas & Sholihah, 2020).

One of the efforts that can be carried out in learning physics to generate students' critical reasoning abilities is to use the discovery learning model. Learning and teaching activities using the discovery learning model require teachers to be more creative in creating situations that can make students learn actively to find their own knowledge (Hunaidah et al., 2019). The application of the discovery learning model can also improve students' science process

skills and students' understanding of physics concepts (Sukariasih et al., 2019). Besides, the discovery learning model is more effective for increasing learning competence in the form of mastery of concepts and critical thinking skills of students (Ramadhani et al., 2022; Landa et al., 2021).

Discovery learning begins with problems posed by the teacher that cannot be explained easily or cannot be explained quickly. Then students make observations to draw a conclusion. However, the teacher controls the questions that students express, the hypotheses the students make, and the things students observe. The inhibiting factor is that the application of discovery learning models requires much time, students' characteristics, and teacher consistency in applying the discovery learning model (Sudirman et al., 2020).

From several previous studies, the novelty in this research is the combination of the discovery learning model with a scientific literacy approach in looking into students' understanding of physics concepts. So far, the research conducted to see students' conceptual understanding tends to be analyzed in separate studies, using both discovery model and scientific literacy approach. In addition, many studies also only examine the effect of learning on literacy skills.

Based on these conditions and problems, this study aims to determine the effect of the scientific literacy approach using the discovery learning model on students' understanding of physics concepts. The research questions in this study are (1) how is the physics concepts understanding of students who are taught using the discovery learning model with scientific literacy approach and students who are taught by direct learning model? (2) is there any significant difference in students' understanding of physics concepts between the two models?

## II. METHODS

This research is a true experimental research with post-tests only control group design. The experimental and control classes were determined using random sampling technique. The posttest-only control group design model (Sung et al., 2017) can be seen as follows:

| | | |
|---|---|---|
| $R_1$ | $X_1$ | $O_1$ |
| $R_2$ | $X_2$ | $O_2$ |

**Figure 1**. The posttest-only control group design

Explanation:

$X_1$ : Experimental class

$X_2$ : Control class

$O_1$, $O_2$ : The final test (post-test)

The population in this study were all students of class X SMA Negeri 1 Watubangga in the academic year of 2020/2021, which consisted of 5 classes.

Each class consisted of 21 students, so the total was 105 students. The sample in this study was two classes, namely the experimental class (X1) and the control class (X2). The experimental class (X1) applied a discovery learning model with a scientific literacy approach and the control class (X2) applied the direct teaching model commonly used by teachers at the school.

This research was conducted in three stages:

1. First stage

This stage is the initial stage carried out by the researcher before giving treatment to each sample group that has been obtained. This stage include (a) making research instruments; (b) validating the instruments; (3) sampling. The research instrument was arranged according to the variables studied, the instrument was a test for understanding the concept of physics and an observation sheet for gaining a clear picture of the students' learning process. In this step of validating the instruments, the content validation was conducted by two experts using Gregory model analysis on physics concept understanding test (HL et al., 2020). The sampling step was done to determine the experimental class and control class from the population by using random sampling technique.

2. Second stage

This stage is the stage of research implementation. At this stage, class X1 was given treatment using the discovery learning model with scientific literacy approach and class X2 was given treatment using direct learning model with conventional method.

3. Third stage

This stage is the final stage of this research. At this stage, students taught using the discovery learning model with scientific literacy approach and students taught using the direct learning model with the conventional method were given a post-test. The instruments of understanding the concept of physics in the form of multiple-choice questions. Figure 2 shows the research procedures in this study.

The data collection instruments in this research were physics concept understanding test and learning observation sheets (Sari et al., 2022). The data were analyzed quantitatively by using descriptive and inferential analyses using t-test (Akhfar & Saputra, 2020; Amaluddin et al., 2019). The hypothesis in this study used a two-party test, using a two-sample t-test independently. The hypothesis is: "There is a significant difference in understanding the concept of physics between the groups taught using scientific literacy approach with discovery learning model and using conventional approach with direct learning model".

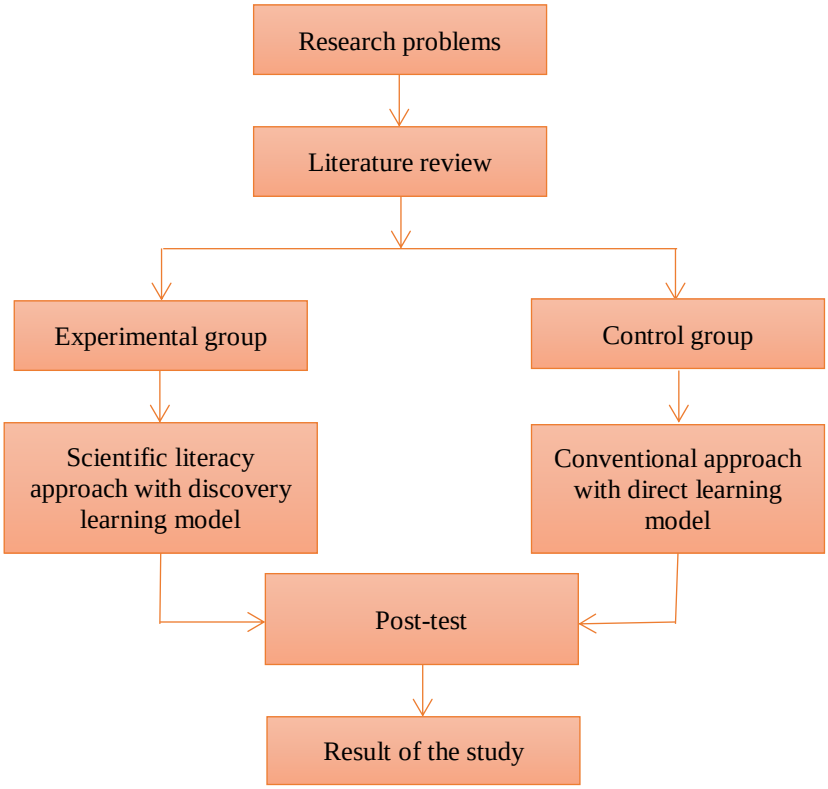


**Figure 2**. Flowchart of research procedure

## III. RESULTS AND DISCUSSION

The results of the descriptive analysis of students' understanding of physics concepts were obtained based on the post-test given at the end of the treatment in each experimental and control class. An overview of the understanding of physics concepts in the experimental class and control class can be seen in the Table 1. As can be seen, the average score in the experimental class (29.68) was higher than that in the control class (22.25). Likewise, the maximum score obtained by students in the experimental class (34.00) is higher than that obtained by students in the control class (30.00). This indicates that the use of discovery learning model with scientific literacy approach is more effective in improving understanding of physics concepts compared to direct learning model with conventional approach.

**Table 1**. The scores of physics concept understanding in experimental and control class

| No | Items | Scores | |
|---|---|---|---|
| | | Experimental class | Control class |
| 1 | Number of samples | 21 | 21 |
| 2 | Average | 29.68 | 22.25 |
| 3 | Standard deviation | 2.42 | 2.65 |
| 4 | Maximum score | 34.00 | 30.00 |
| 5 | Minimum score | 23.00 | 18.00 |

Furthermore, the data on the frequency distribution of categorization scores for understanding physics concepts in the

experimental class and the control class can be seen in the following categorization histogram. As we can see in Figure 2, none of the students in the control class scored in the very good category, while in the experimental class there was 1 student. In the good category, the number of students in the experimental class who obtained this category was 19 students, while in the control class there were only 4 students. Most of the students' scores in the control class were in the medium category with a total of 17 students. Fortunately, none of the students in the two classes were in the less and poor categories.

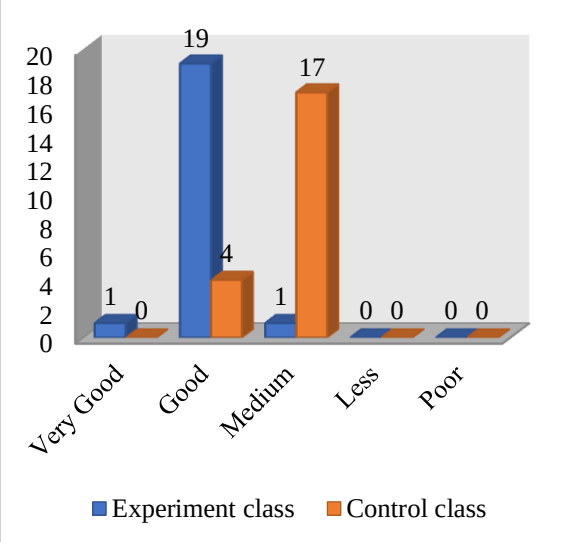


**Figure 2**. Histogram of scores of physics concepts understanding

After calculating the prerequisite test, and the data was proven to be normal and homogeneous, hypothesis testing was then carried out to prove the proposed hypotheses. The results of the t test showed that t-count > t-table (6.85 > 1.98). Thus, $H_0$ was rejected and $H_1$ was accepted. This means that there is a significant difference in understanding the concept of physics between the groups taught using scientific literacy approach with the discovery model and using conventional approach using direct learning model. The use of a discovery learning model with scientific literacy approach is more effective in improving the understanding of physics concepts compared to a direct learning model with a conventional approach.

In line with that, Warlinda and Yerimadesi (2020) revealed that the application of guided discovery learning model-assisted literacy strategies has a significant effect on students' learning outcomes. Furthermore, Tisarna (2019) also suggested that applying the discovery learning model through a digital-based science literacy strategy had a significant influence on improving students' physics learning outcomes compared to the discovery learning model without literacy reinforcement. Another finding in increasing students' understanding of physics concepts through scientific literacy states that the use of integrated science teaching materials with literacy has a significant effect on science learning outcomes with an effect size of 4.41, namely the high category (Agustin, 2021). These results further support the results found in this study.

In addition, the discovery model also has a significant positive impact on students' understanding of physics concepts. This is in accordance with research conducted by

Zandvakili et al. (2018), which states that the concept mastery and the critical thinking of students who learn by using discovery learning is higher than in conventional learning. Astuti (2014) also explains that the low mastery of students' concepts and the weak aspects of student process skills are the demands for the current curriculum, which emphasizes the active participation of students in learning. Thus, it is necessary to have a learning model that facilitates students' active involvement in learning; one of which is a discovery learning-based learning model because this model develops cognitive aspects of students' conceptual understanding.

This study is also in line with the results of research by Rahmawati et al. (2021), which states that the discovery learning model is able to provide better qualifications than conventional learning models. The results show that there is a significant effect of the discovery learning model on the variables of understanding concepts and science process skills. That is, understanding the concepts and skills of the science process together shows a significant difference in the discovery learning model that is carried out. Furthermore, there are differences in understanding physical concepts between students taught using the discovery method (Arafah, 2020). From some of the results of the previous studies and the results obtained in this study, it is known that most students' understanding of physics concepts can be improved by using a discovery learning model, which will be more optimum if it is carried out using a scientific literacy approach.

## IV. CONCLUSION AND SUGGESTION

From the results of data collection and analysis, it can be concluded that students' understanding of physics concepts after being taught using the discovery learning model with a scientific literacy approach is in a good category, while students who are taught using conventional approach with direct learning model is in the medium category. Therefore, there is a significant difference between students' understanding of physics concepts in a group taught with the discovery learning model using a scientific literacy approach and a group taught with a conventional approach with direct learning models.

The limitation of this study lies in the limited number of classes. This study only compares one experimental class and one control class. Therefore, it is recommended for further researchers to examine the effectiveness of using the discovery teaching model with a scientific literacy approach in a wider scope. In addition, this study also suggests teachers to apply the discovery model with a scientific literacy approach to further improve students' understanding of physics concepts.

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