THE INFLUENCE OF PROBLEM-BASED LEARNING ON SCIENCE LITERACY ABILITY OF PHYSICS STUDENTS

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Abstract
This study aims to determine the effect of problem-based learning on the ability of physics science literacy at SMAN 4 Bengkulu City. The research was conducted in class XI IPA 2. The method used was a pre-experiment with a one group pretest-posttest design. The first stage is the assessment of the test in the form of a pretest (initial test) after which it is given the learning treatment using the problem-based learning model. The last step is given a final test in the form of a posttest. There is an influence on the results of hypothesis testing and the results of students' scientific literacy ability tests before being given treatment and after being given treatment. The test results were hypothesized using the help of SPSS software version 25 obtained $H_0$ was rejected and $H_1$ was accepted, using the problem based learning learning model on students' scientific literacy skills on the concept of material Elasticity and Hooke's Law seen from the test results which showed an average posttest result of 80.19% higher than the pretest average (48.52%). Based on the results of the hypothesis test, there is an effect of problem-based learning on the scientific literacy abilities of physics students at SMAN 4 Bengkulu City.

Keywords: Scientific Literacy Skills, Problem Based Learning, Pre-Experiments

INTRODUCTION
Curriculum development in Indonesia gave birth to a new curriculum, namely the 2013 curriculum which is believed to bring the direction of Indonesian education in a better direction, namely to face future challenges related to environmental issues, the influence and impact of technoscience, as well as PISA material and other evaluation programs that contain information about scientific literacy. These challenges must be faced to meet future competencies that require students to be able to communicate, think rationally, critically, morally, and have a sense of responsibility towards the environment, therefore it is important to shape the character of students who
must be prepared through education at this stage of the learning process in School/Madrasah (Sy’a’ban & Wilujeng, 2016)

A series of developing a learning process is carried out continuously by educators/school teachers. A development plan carried out by educators (school teachers/teaching staff) starts from a learning process. The planning is based on the regulation of the Minister of National Education of the Republic of Indonesia No. 16 of 2022 concerning process standards in early childhood education, basic education levels and secondary education levels which include effective and efficient learning processes so that they can optimally develop the potential, abilities and independence of each individual student. An educator (school teacher/teaching staff who is able to develop the learning process well is a characteristic of a professional educator.

The 2013 curriculum places great emphasis on forming students’ mindsets, especially critical thinking in particular and high-level thinking in general (Siswa et al., 2018). Higher-order thinking skills are very important for students in analyzing all the problems they face. Students with high-order thinking skills will easily find ways to solve the problems they face. This high-level thinking can encourage students to do problem solving according to phenomena that occur in real life which are obtained from several facts which can later be drawn conclusions and also apply some scientific concept abilities in everyday life which is also called scientific literacy skills.

Sulislawati et al. (2017) added that the challenges of the 21st century demand innovative thoughts based on scientific thinking and scientific discoveries. Society needs a generation that can create new technologies that can become the basis for facing economic, social and environmental challenges. Education should produce a generation that has the basic ideas and innovative scientific discoveries to sustain Indonesia's competitiveness on the world stage, without forgetting the social impact aspects it creates. Therefore, in order to be able to remain competitive in facing global opportunities and challenges in the future, every individual is required to have adequate thinking including knowledge of science, science process skills and scientific attitude.

According to PISA (programmer for international student assessment) scientific literacy can be interpreted in terms of capacity requiring scientific knowledge, identifying questions, and drawing conclusions based on facts as a form of studying the universe and the changes that occur due to human activities (Hayat & Yusuf 2015). Scientific literacy has many meanings, one of which is that it can be said to be basic knowledge, the basis of critical thinking skills or the application of these two basic things (knowledge and skills) to make decisions in everyday life (Crowell & Schunn, 2016). By using scientific knowledge, identifying questions and drawing conclusions based on evidence, to understand and be able to make decisions related to nature and the changes that nature causes through human activities.

Kemendikbud (2017) Scientific literacy helps students to form mindsets, behaviors and attitudes that
are responsible for themselves, society and the universe, as well as the problems faced by modern society which is very dependent on technology. Scientific literacy as knowledge and understanding of events and happenings in the environment (Adolphus et al., 2012).

Based on the results of the 2006 PISA study, Indonesia was ranked 50th out of 57 countries with a score of 393. Indonesia's scientific literacy achievements in 2009 PISA were in the bottom 10 of 65 countries. In PISA 2012 it was found that Indonesia's scientific literacy had decreased from rank 54 to position 64 out of 45 countries with a score of 382. Meanwhile the results of the latest survey from PISA in 2015 placed Indonesia in 62nd position out of 70 countries with a score of 403 (OECD 2013) in (Kimianti & Prasetyo, 2019).

Sya’ban & Wilujeng (2016) states that scientific literacy is the ability of students to recognize concepts, understand, explain, communicate science, apply science in everyday life both in class, madrasah and the environment around where they live to solve everyday problems related to the material that has been studied, so that they have an attitude positive and good sensitivity to self and environment (interaction). Scientific literacy includes (1) context, namely the scope to be studied in the form of the surrounding environment, (2) content/knowledge, namely the understanding of scientific concepts and facts in the context of a special or typical surrounding environment (local excellence), (3) competence, namely the ability to use knowledge, understanding, scientific skills, and attitudes, (4) attitude, namely the attitude of caring for oneself and the surrounding environment.

However, the results of international research show that the literacy level of Indonesian students is in the low category (Rohman et al., 2017) means the level of understanding of students regarding the concept of material so that it is difficult to implement it in everyday life. In addition, the cause of students' low scientific literacy can be caused by the learning methods and teaching materials used by the teacher (Alatas & Fauziah, 2020) in (Kurnia et al., 2014) added that the low ability of Indonesian students' scientific literacy was caused by many things, namely the education system, curriculum, learning models and methods, learning resources, and teaching materials that did not support improving scientific literacy skills. This makes it difficult for students to associate or connect the concepts of science material in everyday life.

Yuyu (2017) states that one alternative that can be done in solving problems is to apply science learning which does not only emphasize mastery of concepts but also pays attention to other aspects. The application of science in everyday life can be an alternative for students to solve problems.

Scientific literacy indicators consist of: (1) explaining phenomena scientifically. (2) designing and evaluating scientific investigations, data obtained through observation and experimentation both in the laboratory and in the field. (3) interpret data and scientific evidence (OECD, 2017).

From the results of research conducted by Amalia & Yulianti, (2018) with the title "Identification of Scientific Literacy Ability in Straight
Motion X MIPA High School at SMAN Rambipuji" gets the average results of students' scientific literacy achievement in the low category. In line with research conducted by Mukharomah et al. (2021) entitled "Analysis of high school physics science literacy skills in straight motion kinematics material during the Covid-19 pandemic" that high school students' physics science literacy skills in straight motion kinematics material are still in the low category.

From these problems the basis for this research was carried out where students' abilities and understanding of scientific literacy skills were still very limited, especially in physics learning and also the lack of student involvement. In this study using learning models supported by the 2013 curriculum, one of which is the problem-based learning model.

The PBL learning model is a learning model that focuses on problems and questions so that it can help students solve problems by using appropriate concepts and principles and not far from scientific literacy which helps students solve problems. Measurement of students' scientific literacy reads to get solutions, so that without realizing it students are trained in solving problems which in turn indirectly shape scientific literacy skills (Widiana et al., 2020) and the application of scientific literacy to problem based learning is also expected that students can respond well to the problems related to the environment they face so that students can be wiser about the environment (Paramitha et al., 2019).

The effectiveness of the problem-based learning model is also demonstrated by the process of implementing this learning, which directly encourages students to investigate more complex issues related to the material, conduct research in groups and individually, which directly provides an overview and experience of scientific literacy. The context of scientific literacy emphasizes the importance of knowing and understanding the context in which science is applied and being able to apply science to solve real-world problems (Parwasi & Warouw, 2020).

Hosnan (2014) states that the application of a problem-based learning model consists of five main steps, (1) student orientation to the problem, (2) organizing students to learn, (3) guide individual and group investigations, (4) develop and present appropriate work, such as reports or videos, (5) analyze and evaluate the problem-solving process and end with a presentation of student work analysis.

The steps of the problem-based learning model are orienting students to problems, organizing students to learn, guiding individual and group investigations or experiences, developing and presenting work and analyzing and evaluating problem-solving processes (Kimianti & Prasetyo, 2019) These steps can later make students solve problems in everyday life. From the results of D. Ardianto's research, he said that the problem-based learning model can be used to improve the competency aspects of students' scientific literacy, where learning activities using the problem-based learning model make a positive contribution to students' ability to identify scientific issues, explain scientific phenomena, and use scientific evidence. because learning using the problem-based learning
model is designed by prioritizing independent learning (Ardianto, 2016).

Based on the results of interviews conducted on Friday, 19 July 2022 and 23 July 2022, the physics teacher at SMA Negeri 4 Bengkulu City obtained several things; (1) the teacher is still the center of the learning model, a stimulus for students in the interaction of learning activities. (2) students are expected to be able to understand the material well and apply learning concepts. (3) achievement of basic concepts after learning to students. (4) when faced with a problem, students have not been able to solve the problem. (5) student responses regarding learning are only students who like physics subjects who are active in the learning process and student responses when faced with a problem still easily give up before trying. (6) students are still confused in applying or concluding in everyday life so they are still guided by the teacher. Curiosity, motivation and interest of students in learning physics are still lacking, because students still find learning physics difficult and seem boring, causing a feeling of laziness to find out the solution to a scientific problem that must be solved.

Based on the problems above, a study was carried out which aimed to determine the effect of problem-based learning on the ability of physics science literacy at SMAN 4 Bengkulu City.

METHODS

The type of research used in this research is pre-experimental. Experimental research is carried out by giving treatment to the subjects to be studied and then comparing the results and seeing the effect. (Sugiyono, 2019)

The research design used was a pre-experimental design with a one group pretest – posttest design. This design is used based on the objectives to be achieved, namely to determine the effect of problem-based learning on the ability of physics science literacy at SMAN 4 Bengkulu City. The research design contained a pretest before being given treatment, thus the results of the treatment can be known more accurately because they can be compared with the conditions before and after being given treatment. This design can be described in table 1.

Table 1. Design one group pretest – posttest

<table>
<thead>
<tr>
<th>Prettest</th>
<th>Treatment</th>
<th>Posttest</th>
</tr>
</thead>
<tbody>
<tr>
<td>O₁</td>
<td>X</td>
<td>O₂</td>
</tr>
</tbody>
</table>

Annotation:
O₁ = pretest value before being given treatment (treatment)
O₂ = posttest value after being given treatment (treatment)
X = treatment by applying the problem-based learning process

The research was carried out based on the schematic picture above where there is a background of the problem which will be formulated with a theoretical basis to produce a hypothesis using an experimental design and a population and a sample so that the results of analyzing the data can be drawn conclusions.

This research was conducted at SMAN 4 Bengkulu City which was carried out in the 1st (odd) semester of the 2022/2023 school year. The population in this study were students...
of class XI IPA. The sample used was students of class XI IPA 4. Sampling was carried out by simple random sampling technique, where students in class positions were applied randomly without looking at grades, student groups and student gender, so that students were randomly distributed, having a number of students in classes and get the same curriculum.

Figure 1. Research components and processes (in Bahasa)

Source: Sugiyono (2019)

Data collection was carried out by interviewing the physics teacher and then determining the class to be carried out with the experiment. The experimental class used with 36 students carried out an initial test (pretest) in the form of 15 questions for 45 minutes for the processing time. The next day they were given treatment in the form of problem-based learning. About 45 minutes, the final test (posttest) was carried out with the same questions. To analyze the data using the data normality test to determine whether the data obtained is normally distributed or not. To test the normality of the data, you can use the kloogorov-smirnov test with the condition that Asymp. > 0.05, the data is normally distributed, in testing the data used are pretest and posttest data.

Testing the normality of the data in this study used Software Statistical Product and Service Solution (SPSS) version 25 with the criterion if the significance value < 0.05 then the data distribution is normal. After that, a homogeneity test was carried out to find out whether the samples taken from the same population were uniform or not (pretest and posttest).

Hypothesis testing is carried out after testing the prerequisites are met, data analysis from the pretest and posttest values are used to determine the abilities of students before and after being given treatment. The analysis used is parametric statistical paired sample t-test. With the following formula equation:

$$t_{count} = \frac{x_1 - x_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}} \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

(1)

Annotation:

- $r$ = correlation value $x_1$ with $x_2$
- $n_1$ and $n_2$ = number of samples
- $x_{1}$ = 1st sample mean
- $x_{2}$ = 2nd sample mean
- $S_{1}$ = standard deviation of the 1st sample
S_2 = standard deviation of the 2nd sample
〖S_1〗^2 = 1st sample variance
〖S_2〗^2 = 2nd sample variance

To simplify the calculations, the researchers conducted a t test using the SPSS 25 for windows computer program, with the following testing criteria:

\[ H_0: \mu_0 = \mu_1 \]
\[ H_1: \mu_0 \neq \mu_1 \]

H_0 = there is no effect of the problem-based learning model on students' scientific literacy abilities
H_1 = there is an influence of the problem-based learning model on students' scientific literacy abilities

\[ \mu_1 = \text{average physics literacy ability of students in the experimental class} \]

To determine the level of student ability based on scientific literacy abilities, each indicator item in the question is given a score of 0-4 as well as scoring the answers to student worksheets (LKPD) and then looking for the percentage of each of the indicators that appear. According to Purwanto (2010) states that the percentage value can be found by using the equation:

\[ NP = \frac{R}{SM} \times 100 \quad (2) \]

Annotation:
NP = Percent value to be searched for
R = Scores obtained by students
SM = Maximum score
100 = Fixed number

<table>
<thead>
<tr>
<th>Score (%)</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>81 – 100</td>
<td>Very good</td>
</tr>
<tr>
<td>61-81</td>
<td>Good</td>
</tr>
<tr>
<td>41-60</td>
<td>Enough</td>
</tr>
<tr>
<td>21-40</td>
<td>Not enough</td>
</tr>
<tr>
<td>0-20</td>
<td>Very less</td>
</tr>
</tbody>
</table>

Source: Purwanto (2010)

The instrument used in this research is test. The scientific literacy test which is aimed at physics learning takes place using student worksheet related to the material being studied, the test grid is in the form of content, context, and competency aspects of students’ scientific literacy abilities.

RESULT AND DISCUSSION

Based on the research that has been done to find out whether the data obtained is normally distributed or not, a data normality test is performed. The meaning of normal in this test is the same distribution of data, so the population used comes from the same population or can be said to be normal. The pretest and posttest data obtained were then tested using the Kolmogorov Smirnov test using SPSS software version 25. The data can be said to be normally distributed if sig > \( \alpha \), where the value of \( \alpha \) = 0.05.

Apart from using SPSS version 25, the data is normally distributed or
not, it can be determined by comparing the value of \( D_0 \) (the results of calculations with \( D_{\text{table}} \) based on the number of samples and the level of confidence used. The results obtained are if the value of \( D(0) < D_{\text{table}} \), then the data is normally distributed. The test results the normality of the pretest and posttest data met the statistical criteria used, with \( \text{sig} > (0.05) \) and \( D_0 < D_{\text{table}} \). This shows that the pretest and posttest data were good in the experimental class.

The pretest and posttest data were obtained based on the normal distribution normality test. The next step is to test the homogeneity of the pretest and posttest data obtained. Homogeneity test is used to determine whether the data is consistent with the variance of samples taken from the same population. Homogeneity testing in this study used the Lavene test with SPSS version 25 software. Data can be said to be homogeneous if it meets the criteria \( \text{sig} > \alpha(0.05) \).

After the tests were carried out on the normality and homogeneity tests, the next step was to test the hypothesis using the paired sample t-test on SPSS software version 25. This test was conducted to determine whether there was an effect of the PBL (problem-based learning) learning model on students' scientific literacy abilities. In the tests that have been carried out in the hypothesis testing, the following hypotheses are proposed:

\[
\begin{align*}
\text{H}_0 &= \text{there is no effect of the problem-based learning model on students' scientific literacy skills} \\
\text{H}_1 &= \text{there are problem-based learning caregivers on students' scientific literacy skills}
\end{align*}
\]

The t-test was carried out on the pretest and posttest data to find out the difference in the average scientific literacy ability of students after being given treatment. Based on the results of data analysis in the table above, the pretest and posttest t-test table obtained \( \text{sig} < \alpha \), namely 0.000 < 0.05 so that the hypothesis testing that was carried out in the experimental class showed that there was an effect of problem-based learning on students' scientific literacy abilities in class experiment.

According to Rerung et al. (2017) states the advantages of the Problem Based Learning (PBL) learning model include: (1) students are trained to have the ability to solve problems in real situations, (2) have the ability to build their own knowledge through learning activities, (3) learning focuses on problems so that the material nothing to do not need to be learned by students. This reduces the burden on students by memorizing or storing information, (4) scientific activities occur in students through group work, (5) students are used to using sources of knowledge, both from libraries, the internet, interviews and observations, (6) students have the ability to assess their own learning progress, (7) students have the ability to carry out scientific communication in discussion activities or presentations of their work, and (8) learning difficulties of individual students can be overcome through group work in the form of peer teaching.

According to Ilmi & Lagiono (2019) the weaknesses of the Problem Based Learning learning model: 1) academic learning outcomes of students involved in problem-based learning, 2) changes in the role of students in the learning process, 3)
changes in the teacher's role in the learning process, 4) formulation appropriate problems, 5) a valid assessment of the program and student problems.

In learning the teacher should apply a variety of learning, the goal is that students are not bored and bored in learning (Kemdikbud, 2022). This research was conducted with the aim of knowing the effect of the problem-based learning (PBL) learning model on students' scientific literacy abilities in the material of elasticity and Hooke's law. In this study only used one class, namely the experimental class.

The research was carried out with prerequisite tests on pretest data and prerequisite analysis tests on posttest from the experimental class. The results obtained show that the pretest and posttest data come from the experimental class and are normally distributed as well as homogeneous. That way it indicates that the data obtained comes from a normal population that also has the same variation in data. After the prerequisite tests were met, the final step in this study was to test the hypothesis to find out whether the problem-based learning (PBL) model had an influence or not on students' scientific literacy abilities.

This hypothesis test was carried out on the experimental class pretest and posttest data, from the results of the hypothesis test data it showed that H_0 was accepted. This means that there is a significant difference between the pretest and posttest data on students' scientific literacy abilities.

Data from the pretest and posttest results in the experimental class were obtained using a test instrument of 15 items which included indicators on scientific literacy. The research data obtained from the experimental class are as follows, data from the pretest and posttest results of the experimental class can be seen in table 3.

<table>
<thead>
<tr>
<th>Table 3. Pretest and posttest results of the experimental class</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Data</strong></td>
</tr>
<tr>
<td>The number of students</td>
</tr>
<tr>
<td>The highest score</td>
</tr>
<tr>
<td>Lowest value</td>
</tr>
<tr>
<td><strong>Average</strong></td>
</tr>
</tbody>
</table>

In table 3 it can be seen that the pretest average value in the experimental class was 48.52 with the highest score being 80 and the lowest score being 13.33. Meanwhile, the posttest average score was 80.19 with the highest score in the experimental class being 100 and the lowest score being 53.33. Overall after being given treatment there is a significant difference which is indicated by the average of the pretest and posttest scores obtained in the experimental class indicating that the posttest score is higher than the pretest value. This difference indicates that the learning outcomes that apply the problem-based learning (PBL) learning model are better than applying learning that does not use problem based learning (PBL).

The increase in student learning outcomes is in line with the increase in students' scientific literacy towards the increase in students' scientific literacy...
in the concepts studied. In the data from the pretest and posttest hypothesis testing results show that \( H_1 \) is accepted and \( H_0 \) is rejected, it can be said that students' scientific literacy in the experimental class. With this problem-based learning (PBL) learning model affects students' scientific literacy abilities.

Learning using the PBL model begins by showing an illustration video as a first step which aims to introduce the problem to be studied related to the concept of elasticity of an object which later students will find problems through learning. After being given a learning video, in this second step students are given student worksheets (LKPD) which have been adapted to the stages of the PBL learning model, learning activities are carried out in groups, students observe the teacher's directions and try to re-understand the problem, and ask group mates if there is none who understand, besides that students also ask the teacher if there is something that is not understood in understanding the problem. According to Haji et al. (2018) understanding the concept of physics through phenomena displayed by the teacher in the form of animations, then students find examples in everyday life. Students enthusiastically hypothesize questions and problems posed by the teacher, and find answers easily after the animation displays and provide the right solutions to problems.

The third step, guiding group/individual experiences; students carry out experiments based on the LKPD that has been given, pay close attention to the directions given by the teacher and continue to try to carry out problem-solving activities, discussing the results of work with group mates. Fourth step; developing and presenting the work, in its implementation students discuss and describe the observed data obtained. And the last step of learning this PBL model is to analyze the learning and evaluate the problem-solving process, students present the results of the discussion activities in front of the class as group representatives, after that the teacher reviews the problem solving of explaining the correct concept.

Students become more independent when learning with this PBL model in building on the knowledge gained. This condition is because since the beginning of learning students have been presented with problems. Work in groups with friends. Students are also encouraged to look for information related to the problems they face which are provided online from various sources such as books and. In addition, the learning environment in problem-based learning emphasizes the central role of students, not teachers (Rusman, 2016). So that it can make students play a more active role than the teacher with this student being the center of learning.

Based on the results of the experimental group data, it gave more results in the application of a problem-based learning model that occurs when in the learning process, students become more engaged and motivated. This is consistent with the theory that problem-based learning is student knowledge and interests and motivation (Toharudin et al., 2011). During learning, students participate in various activities in a group. Students explain, discuss, and exchange ideas to help each other solve the questions given by the teacher. Such learning
facilitates understanding when students have difficulty with material they do not understand. Problems that exist in learning are problems that exist in everyday life. This motivates and inspires students to learn and explore knowledge independently in order to solve the problems presented as well as possible. In addition to presenting learning materials that contain problems related to life, when students are involved in learning, they will have solutions to solve problems presented as well as possible. In addition to presenting learning materials that contain problems related to life, when students are involved in learning, they will have solutions to solve these problems so that they have challenges to solve them. This increases students' motivation to learn.

Table 4. Percentage of each indicator of scientific literacy

<table>
<thead>
<tr>
<th>No</th>
<th>Scientific Literacy Indicator</th>
<th>Percentage of Pretest</th>
<th>Percentage of Posttest</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Explain scientific phenomena</td>
<td>53%</td>
<td>92%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>92%</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td><strong>Indicator average</strong></td>
<td><strong>72%</strong></td>
<td><strong>96%</strong></td>
</tr>
<tr>
<td>2.</td>
<td>Designing and evaluating scientific investigations</td>
<td>50%</td>
<td>92%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>39%</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>53%</td>
<td>97%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>47%</td>
<td>86%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>78%</td>
<td>83%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>19%</td>
<td>42%</td>
</tr>
<tr>
<td></td>
<td><strong>Indicator average</strong></td>
<td><strong>48%</strong></td>
<td><strong>83%</strong></td>
</tr>
<tr>
<td>3.</td>
<td>Interpret scientific data and evidence</td>
<td>56%</td>
<td>94%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>31%</td>
<td>39%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>36%</td>
<td>64%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>44%</td>
<td>92%</td>
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<td></td>
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<td>22%</td>
<td>78%</td>
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<td></td>
<td></td>
<td>42%</td>
<td>86%</td>
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<tr>
<td></td>
<td></td>
<td>67%</td>
<td>47%</td>
</tr>
<tr>
<td></td>
<td><strong>Indicator average</strong></td>
<td><strong>42%</strong></td>
<td><strong>71%</strong></td>
</tr>
</tbody>
</table>

Table 4 shows the percentage of achievement for each indicator of students' scientific literacy abilities in the experimental class. There are 15 questions about the pretest and posttest. For the first scientific literacy indicator, namely explaining scientific phenomena, it consists of 2 questions, the second indicator of designing and evaluating scientific investigations of 6 pieces and the third indicator of scientific literacy indicators of 7 pieces. From the questions that have been given, it is obtained that the average pretest indicator of scientific literacy ability is 49% while for the posttest average of students' scientific literacy indicator is 80%. If you look at the average scientific literacy indicators, of the three indicators the highest indicator is explaining phenomena scientifically and the lowest indicator is interpreting data and scientific evidence.
The percentage of each indicator of scientific literacy is shown in table 4, where the highest percentage of indicators of scientific literacy both in the pretest and posttest results, namely the indicator explaining scientific phenomena is 96% for the posttest results with very good category and for the pretest results by 72%, meanwhile the indicators that has the lowest percentage, namely interpreting data and evidence by 71% for the posttest data in the good category, while the pretest percentage is 42% in the less category.

Based on table 4, it can be seen that the results of the posttest are greater than the results of the pretest for each indicator of scientific competence. This is because in problem-based learning, students go through several stages of learning and develop three indicators. In problem-based learning there are phases. There are five phases, namely orienting students to problems, organizing students to learn, guiding investigations or experiences individually or in groups, developing and presenting work and analyzing and evaluating problem-solving processes (Kimianti & Prasetyo, 2019)

The low achievement of this indicator on the results of the pretest is because students do not yet have sufficient understanding of the material on elasticity and Hooke's law, so that certain phenomena cannot be explained scientifically. Students lack practice in dealing with problems related to different sources of information and related to different life situations so that they require sufficient knowledge and understanding.

The percentage of indicators for designing and evaluating scientific investigations on the pretest results shows a percentage of 48% while the percentage for the posttest results is 83%. This is because, it is found that students individually are only given experimental videos, and independently carry out experiments based on the given LKPD. LKPD contains questions that can train students' scientific literacy skills, so that students in class can design and evaluate scientific investigations properly.

The indicators for interpreting data and scientific evidence show that the posttest percentage is 71% in the good category and the pretest percentage is 42%. This happens because during learning in developing, presenting the work, analyzing and also evaluating the problem-solving process. When students develop and present their work, students are directly involved in the knowledge they do. Students also write practical reports in groups. In producing the report, students include evidence in the form of data that is processed into other forms such as making graphs or providing conclusions based on data before it is presented. This trains students to use and present evidence in the form of scientific data. Through problem-based learning, students are trained to reflect, debate, and communicate with other parties, and teachers are trained to understand students' thought processes (Rusman, 2012)

Data on student worksheet results (LKPD) is carried out by calculating the percentage of each indicator of scientific literacy ability that appears, which can be seen in table 5.
Table 5. Percentage (%) of achievement of students’ scientific literacy indicators on the results of student worksheets (LKPD)

<table>
<thead>
<tr>
<th>No</th>
<th>Indicator</th>
<th>Percentage</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Explain scientific phenomena</td>
<td>80%</td>
<td>Good</td>
</tr>
<tr>
<td>2</td>
<td>Designing and evaluating scientific investigations</td>
<td>84%</td>
<td>Very good</td>
</tr>
<tr>
<td>3</td>
<td>Interpret scientific data and evidence</td>
<td>83%</td>
<td>Very good</td>
</tr>
<tr>
<td></td>
<td>Average</td>
<td>82%</td>
<td>Very good</td>
</tr>
</tbody>
</table>

On the student worksheet (LKPD) there are 8 questions for each indicator of scientific literacy. The first scientific literacy indicator consists of 2 questions, the second indicator has 2 questions and the third indicator has 4 questions. On the results of the student worksheets (LKPD) indicators of scientific literacy are obtained, the percentage on the indicator explaining scientific phenomena is 80% which is the average result of 2 questions on the LKPD in the good category. While the percentage of achievement on indicators of designing and evaluating scientific investigations was obtained by 84% in the very good category and the percentage of achievement on indicators of interpreting data and scientific evidence was obtained by a percentage of 83% belonging to the very good category. The overall percentage obtained from the achievement of students' scientific literacy indicators in the LKPD is 82% in the very good category.

Learning using LKPD which is carried out in groups aims to make students able to work well together and also exchange opinions in solving problems. According to Susanti et al. (2019) Problem-based learning can provide opportunities for students to be directly involved in scientific activities and can also provide individual experiences regarding science learning so that concepts become easy to remember and easy to understand. In addition, problematic learning also provides more opportunities for students to be able to find independent concepts from various activities in the LKPD so that students gain new and more meaningful knowledge.

Research conducted by Anton (2022) in his research entitled "The Influence of Problem-Based Learning Models on Students' Scientific Literacy Ability in Ecosystem Material Class X SMA Negeri 3 Gowa" concluded that there was an influence on student learning outcomes in class by applying problem-based learning models, with This model can be used as an alternative for teachers to create teaching and learning to take place in order to get maximum learning value results and further research by Kurniawati & Hidayah (2021) "The Effect of Problem Based Learning on Scientific Literacy" concludes that the application of the problem based learning learning model can make students more focused in the group discussion process so that it makes it easier for students to receive knowledge and if students follow the stages properly and correctly.

Literacy research was also conducted Widiana et al. (2020) entitled "The Influence of Problem-Based Learning Learning Models on the Scientific Literacy Ability of High School Students" concluded that the application of PBL had an effect on students' scientific literacy abilities in...
the three domains of learning outcomes. The high ability of scientific literacy is due to the model that is applied to stimulate students to be active and critical in getting solutions to problems. The PBL model requires students to read to find solutions, so that without realizing it students are trained in solving problems which in turn indirectly forms scientific literacy skills.

From the description of the indicators of scientific literacy ability in the experimental class, it can be concluded that the student indicators after being given the treatment and also the posttest had higher results than before being given the treatment and the pretest. This happens because during learning students are used to getting problems in the form of cases or problems which are solved by steps of problem-based learning models that can strengthen science concepts so that the class has excellent scientific literacy skills.

CONCLUSION AND RECOMMENDATION

Based on the results of data analysis and previous discussion, it can be concluded that there is an influence of the problem-based learning (PBL) learning model on the scientific literacy abilities of physics students at SMAN 4 Bengkulu City. In this study, the material taken was material for grade 11 odd semester, namely Elasticity and Hooke's Law. This is based on the results of hypothesis testing and the results of students' scientific literacy ability tests before being given treatment. The results of hypothesis testing using the SPSS version 25 software were obtained sig <0.000 <0.05 with the condition that H_0 was rejected and H_1 was accepted.

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