Vol 11 No 1 2025 DOI : 10.24036/jppf.v11i1.1 Page : 72-81
JURNAL PENELITIAN PEMBELAJARAN FISIKA (JPPF)
Journal of Physics Learning Research
ISSN 2252-3014 (Print) | ISSN 2746-8445 (Electronic)

Improvement Ability Students' Science Literacy in Aspects Knowledge and Competence Using the PBL Model

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ARTICLE INFORMATION

Received : 2025-03-17
Revised : 2025-03-25
Accepted : 2025-03-26

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KEYWORDS :

Ability Science Literacy , Knowledge and Competence , PBL

ABSTRACT

Scientific Literacy is important in improving physics learning outcomes. looking at the situation in the field, student scientific literacy abbilities are still very low. The learningcarried out by students has mot simulated aspects of scientific literacy. the solutions given is to apply the PBL model. This research aims to find out whether there is an increase in students scientific literacy skill before and after carrying out learning using the PBL model. This research is a quantitative research with a pretest-posttest control group design. The population of this study was class X SMAN 1 Sungai Limau. The sampel is class X.3. the research Instruments used are teaching modules and stientific literacy tests. The data analysis techniques used are descriptive analisis techniques, normality tests, and hypothesis test. Based on the result of research hypothesis testing on students' scientific literacy abilities, a significance value of 0.000000004 was obtained at a significance value at significance 0.05. Therefore H_a is accepted and H_0 is rejected. This means that there is an increase in scientific literacy abbilities in the knowledge aspect and competency aspect after using the PBL model in class X at SMAN 1 Sungai Limau

INTRODUCTION

Literacy science is asked, find, or decide solution on questions sparked by interest in experience general. Literacy science show ability For explain , describe , and predict natural processes (Deta et al., 2025) . The ability to solve the problems of scientific literacy in everyday is known as scientific literacy (OECD, 2015). According to the OECD (2014), scientific literacy is the scientific knowledge and skills that a person has that are used to search for and discover new knowledge so that they can explain and draw conclusions about scientific phenomena. The main goal of physics education worldwide is the growth of scientific literacy (Sunarti et al., 2024) . Without scientific literacy skills, students will have difficulty in finding new knowledge related to education, social, and science encountered in everyday life (Glynn & Muth, 1994). Literacy skills science as a work tool is more developed in secondary schools because its stages are ready to interact and innovate (Subali et al., 2023) . Scientific literacy is one of the most important abilities to be tested as a benchmark for the success of curriculum implementation in Indonesia (Kemendikbud, 2017). Scientific

literacy capable in improve students' ability to learn and understand physics on concepts, principles and applications in physics learning and other fields science (I. Lestari et al., 2022) . then this can be concluded for organize, analyze, and understand the acquare abilities well, every people or student must have key skills, namely scientific literacy (Nilyani et al., 2023) .

Based on the result of study conducted by PISA *Program for International Student Assessment)* in 2022, Indonesia's reading literacy position was ranked 71 out of 81 countries participating in the test, science was ranked 67 out of 81 countries and Indonesian mathematics was ranked 70 out of 81 countries participating (Aliyana et al., 2021) . Ability literacy low science is form consequence from Several factors like selection of education systems, curriculum, methods, learning models, and teaching materials that are not right. Learning practices that tend not to give students the opportunity to understand everyday phenomena are a supporting factor for weak scientific literacy (Erna Muliastrini et al., 2019) . Implementation learning This will make student tend For No submit questions and arguments related the material he studied (Juriah & Zulfiani, 2019) . This is making student difficult in to communicate as well as connect the knowledge they have have with Topic science in progress they learn. One of part Topic learning that includes into the aspect from literacy science in PISA, namely Topic related Global Warming and Change climate. On the topic learning This student expected capable for analyze impact, causes, and method countermeasures from global warming and change climate in scale local, regional and global. However in the the practice student Still experience difficulty in control ability the because of learning literacy science nature abstract (Setianita et al., 2019) . Research conducted by (Susanti et al., 2023) show that ability literacy science high school students in the city field categorized low . Acquisition test ability literacy science show that Senior high school students in Padang received value 30.58 with category low (Susanti et al., 2023) .

This problem was also found in SMAN 1 Sungai Limau. From the results of observations conducted at SMAN 1 Sungai Limau, it was found that students did not have good science literacy skills. This was caused by the low motivation of students in carrying out literacy and was also supported by the selection of learning models. which is not appropriate and is also supported by the selection of learning models which is not in accordance with even its implementation is also not in accordance with the existing syntax, thus making the implementation of the learning model ineffective. This is also supported by the results of Nana Sutrisna's research in 2021 which showed that the low scientific literacy skills of students were caused by several factors, namely: low interest in reading, learning models that are not yet appropriate for scientific literacy, low teacher abilities related to students' scientific literacy in Indonesia (Sutrisna, 2021) . Solutions that can be used for increase Ability understanding literacy science student is with give proper learning (Fitriyana et al., 2020) .

Proper learning For overcome the problem of low ability literacy science student is by using a *PBL model* (Qomariyah et al., 2019) . *Problem-Based Learning* is a learning model that focuses on problems encounter in learning so that students are able to solve these problems using concepts that are in accordance with scientific literacy (Widiana, 2020). *Problem based learning model* where learning is carried out in groups or individually and learning through the process of understanding problem solutions (PD Lestari et al., 2024) . *Problem based learning* (PBL) can provide positive impact on student motivation, student learning perceptions, and performance. but, many teachers do not want to adopt PBL (Yang et al., 2021) . The *problem based learning model* is able to improve students' scientific literacy aspects through learning with analysis and investigation (Fauziah et al., 2019). By using the PBL learning model, students must be skilled in problem solving, creative thinking, and critical thinking (Sarnoko et al., 2024) . Focus in study This that is do improvement ability literacy

science students on aspects knowledge and competence with using *problem-based learning* model on the material global warming and change climate. So that obtained hypothesis in research This is a *problem-based learning* model increase ability literacy science students in class X of SMAN 1 Sungai Limau.

METHODS

Types of research used quqntitative research. According to Sugiyono (2018) , method study quantitative can interpreted as method research based on philosophy positivism, used in populations or sample certain in research . Samples in study this is taken with use technique *purposive cluster random sampling* with method determine population, then to be continued with select cluster from population that has determined. Next, we determine sample in a way random from the selected cluster. The samples obtained as place data collection in research This is Class X.3. Data collected in form numbers and interpreted through Hypothesis test results. Data collection in research This conducted in class X.3 SMAN 1 Sungai Limau with give pretest questions before done learning on October 3, 2024 and the provision of posttest questions after learning completed on November 14, 2024.

Questions and answers the made with follow indicator from aspect knowledge and competence from literacy science on matter global warming and change climate as well as has go through the trial process for ensure question the worthy used in the research. Result data answer student on this pretest-posttest question later will be tested using the paired t-test hypothesis test with standard significance 0.05. Paired t test was conducted for know whether results study This show results existence improvement ability literacy science students. Ability literacy science student will it is said increase If the results of the paired t test show mark level significance count lower from settings standard significance 0.05, but If hypothesis test results show results that mark level significance count bigger from 0.05 then results study show No happen improvement ability literacy science student.

The implementation of this research was carried out in three stages, the first stage was preparation stage, followed by implementation stage and the final stage was the hypothesis stage. Observation and preparation for analysis of research material are carried out. Observation was carried out at SMAN 1 Sungai Limau. Observation was carried out by observing the implementation of learning implementationquastionaire sheets. Observation were csrried out to find how learning in the field. So we could determine how the research would be carried out at SMAN 1 Sungai Limau.

The instrument used in this research is the teaching Modules. The module used in class experiment has through validation and practicality tests , where results validation shows an average of 91.84 while the average practicality students and teachers were 85.17 and 95.73 (Fitri & Amnah, 2024). Seventh, after the learning process end researcher continue with give posttest questions to students. At the stage final researcher analyze how much big improvement ability literacy science student from every indicator literacy science in aspects knowledge and competence as well as test data hypothesis what There is improvement ability literacy science student before with after given learning using the Problem Based Learning model.

RESULTS AND DISCUSSION

Results

Data that researchers serve is results ability literacy science student who is a researcher get through calculation score results implementation of student pretest-posttest on material global warming and climate change. apability data literacy science student this is what we share into 2 parts namely: based on aspect knowledge literacy science and based on aspect competence literacy science. Data collected with give test written essay type when not yet given his learning (*pretest)* and when has given learning (*posttest).* The data has been collected can seen as evaluation ability literacy science in aspects knowledge and aspects competence.

Below are presented the result of data analysis on increasing students scientific literacy knowledge aspect. This data was obtained by dividing each question into indicators for the scientific literacy knowledge aspect issued by PISA. Next the pretest and posttest scores were calculated for each question according to the indicators in scientific literacy knowledge aspect. So that we get the result of calculating students' scientific literacy abilities for each scientific literacy indikator in the knowledge aspect as shown in Table 1:

Table 1. Aspect Values Knowledge Science Literacy

Indicator	Mark		Improvement
	Pre-test	Posttest	
Content	366.6	431.7	65.1
Procedural	251.2	736.6	485.4
Epistemic	74.7	208.1	133.4
Mean	23.87	47.46	23.58

From Table 1 we can see analyzed that happen improvement ability literacy science aspect knowledge how evenly, where third aspect experience improvement. Improvement ability literacy the lowest science found on the indicator content , where in the indicator content only experience improvement of 65, while improvement the biggest occurred in the Procedural category which experienced improvement as big as 485.4. the increase in scientific literacy skills in the knowledge aspect evenly in each indicator shows that there is a balance in the function of PBL model and also the problem-based learning model which allows students to use all indicators related to scientific literacy in improving each indicator. Embedded in aspects of scientific literacy knowledge.

By obtaining Analysis results ability literacy science students on aspects knowledge, an analisis can be carried out on competence aspect using pretest posttest quastions. Analisis scientific litercy in competence aspect is carried by grouping the question according to the competence aspect indicators, so that the scores of students answer to these questions can be grouped according to the scientific literacy competence indicators. For more details see in **Table 2**:

Table 2. Value of Science Literacy Competency Aspect

Indicator	Mark		Improvement
	Pre-test	Posttest	
Explain Phenomenon Scientific	137.7	400.1	262.4
Evaluating and Designing Scientific Research	313.3	775.5	462.2
Interpreting Scientific Data and Evidence	241.5	200.8	-40.7
Mean	23.87	47.46	23.58

Based on Table 2 can be seen that there has been a quite large increase in the scientific research evaluation and design indicator, namely 462.2. At the same time there has been an increase in the decline in students' scientific literacy abilities in the indicator interpreting scientific data and evidence by -40.7. However it looks at the total score of student's scientific literacy abilities, it is known that there was an increase in students' scientific literacy abilities after being given treatment with an average of 23.58 point. If we calculate the total percentage increase, we can get an increase in scientific literacy skill with percentage of 49,7%. This shows that competency scientific literacy literacy skills can be improved by using a PBL model.

After knowing the results of increasing scientific literacy skills on each indicator from the knowledge and competency aspects, we will continue by conducting hypothesis testing. The hypothesis test used is the paired t-test with significance level of 0.05. This hypothesis test was carried out to determine whether ther effect of the PBL learning model was good enough in improving overall scientific literacy abilities in the aspects of competence. The result of this hypothesis test will later become the main reference for the results of this research regarding whether the PBL learning model has a very good influence in improving students scientific literacy skills in aspects of knowledge and competence in global warming and climate change,. To find out the result of the hypothesis test, see Table 3:

Table 3. Results of Hypothesis Testing of Science Literacy Ability

Indicator	Mark	
	Pre-test	Posttest
Average	23.87	47.46
Variant Value	66.56527094	245.903941
Amount of data	29	29
Pearson Correlation	0.341494932	
t Stat	-8.385610211	
Significance Level count	0.000000004	
Significance Level	0.05	

By looking at the result displayed in table 3, it can be seen that the results of the hypothesis test of student's scientific literacy abilities in the knowledge and competency aspects obtained a test significance value of 0,00000004. Which smaller than the fixed significance value is 0,00000004 which is smaller than the fixed significance level 0,05. Because the test significance value is lower than fixed significance value, H_a is accepted and H_0 is rejected. By accepting the H_a from the hypothesis test, it can be concluded that the PBL model can improve students' scientific literacy abilities very well in the aspects of knowledge and competence.

Discussion

The research began by carrying out a pre-test and ended posttest. Based on pretest and posttest results in class experiment prerequisite test conducted statistics. Statistical prerequisite tests are carried out is a normality test, where the results of the normality test obtained normally distributed data. Furthermore done here is the hypothesis test with dependent t test or more known with *Paired t* test term using Microsoft Excel with level significance 0.05 (Ruseffendi, 1998). The expected hypothesis testing is that the Problem Based Learning model can improve students' scientific literacy skills on global warming and climate change material. This hope is in accordance with the results of research conducted by Fathias Alatas and Laili Fauziah showing that the Problem Based Learning model has quite a high influence in improving students' scientific literacy skills in the aspects of knowledge and competence (Alatas & Fauziah, 2020) . Research conducted by Siti Juleha , Ikmanda Nugraha , and Selly Feranie get results that the *Problem Based Learning* model can increase ability literacy science student very well in all domains (Juleha et al., 2019) .

The use of ethnoscience-based teaching modules with a PBL approach also supports the improvement of students' scientific literacy skills in experimental classes . Ethnoscience teaching materials is A design creation environment learning that integrates culture and environment into the activity Study physics so that capable make student more easy understand material learning (Sukesti et al., 2019) . This is in accordance with results research conducted by Intan Putri Anggraini which states learning module based ethnoscience with PBL approach can push ability literacy science students on the material global warming (Anggraini, 2023) . The *Problem Based Learning model* encourages student For Study finish problem in a way gradual and structured.

Problem Based Learning Model consists of of 6 stages. Stage 1 introduction (beginning observation), students Can analyze problem the beginning given by the teacher. Stage 2 students expected capable take notes as well as compile problems that have been delivered by the teacher. Stage 3 students capable compile hypothesis or suspicion while. Stage 4 students can gather as well as take notes all information related hypothesis that has been arranged. Stage 5 students capable discuss and share related argument problems that have been solved. Stage 6 students capable compile conclusion from results discussions that have been conducted (Syamsidah, 2018). By connecting social scientific case studies with knowledge, problem-based learning models are more effective in improving students' scientific literacy (Rubini et al., 2019) .

The results of the research that has been done show that the problem-based learning model can increase ability literacy science student with Enough good in aspects knowledge and competence. In the results study known that happen improvement ability literacy science with improvement average score by 23.58 points in each aspect. Improvement ability

literacy science student This classified as in sufficient condition Good remember average percentage improvement ability literacy science students who get from posttest score against the pretest score is by 49.7%. For see achievement improvement ability literacy science the done here is the hypothesis test using the *paired t*- test, with level significance 0.05. after the test was carried out obtained results that level significance counts of 0.0000000040 which is smaller from 0.05. So, from hypothesis test results the can concluded that happen improvement ability literacy science student using the Problem Based Learning model.

Improvement ability literacy science students on aspects knowledge experience improvement in the indicator, the indicator content, procedural and epistemic literacy science experience quite an improvement significant. Increase the biggest is found in the procedural indicator, namely 485.4. This is because the *problem based learning* model can help students to study the material learning through investigation and analysis activities (Fauziah et al., 2019) . Improvement epistemic knowledge is in the order the biggest second of 133.4 and followed by with improvement knowledge content of 65.1. The problem-based learning model allows students to use all indicators related to scientific literacy. This results in increased scientific literacy skills in all aspects of knowledge . This supported by learning models based on the problem that gives chance to student For each other share ideas in finish problem in learning That (Juriah & Zulfiani, 2019) .

Ability literacy science students on aspects competence also experienced quite an improvement big. Increase the biggest found on the indicator evaluate and design study scientific as much as 462.2 then followed by an increase in the indicators explain phenomenon scientific by 262.4. Increase Ability literacy science on two indicators This happen because the problem-based learning model supports ability breakdown problems and capabilities think critically, in systematic ability This will push student for do to design investigation related the material studied and this also includes impact to ability student in increase trust participant educate in explain phenomena encountered during learning (Fauziah et al., 2019). However, in the indicators interpreting data and evidence scientific experience decline of -40.7. This is caused by style learning This Not yet Once they find in learning learning that has been they live it. Therefore, that student must adapt self with syntax of *the Problem Based Learning* model first before. This is making student No control ability good data interpretation so that in the syntax discussion student difficulty in do data interpretation (Maknuniyah et al., 2019).

Utilization of the Problem Based Learning (PBL) model in learning effective as well as in accordance for used together students. The problem based learning model consists of six steps: introducing the problem to students, organizing students for learning, teaching individuals and groups to conduct investigations, organizing student For do discussion results investigation , developing and presenting results, and evaluating the problem-solving process. (Handayani et al., 2024) . Learning that is carried out using the *Problem Based Learning* model will give contribution positive to ability literacy science student (Aliyana et al., 2021) . The influence provided by the *Problem Based Learning* model in increase ability literacy science students are very Good (Rubini et al., 2019). Lessons provided with the *Problem Based Learning* model has advantages that can be reliable in jack up ability literacy science student such as (a) students motivated For behave active in undergo learning , (b) learning presented by the teacher is accompanied by with existence problem authentic , so that student experience more learning meaning , (c) students can

merge knowledge gained in a way complex , (d) can push student For used to in solve problem , (e) can practice ability think level tall students , (f) can increase trust self as well as ability communication student in Work with the team (Aliyana et al., 2021) .

Implementation problem-based learning model which is conducted based on results study This able to improve ability literacy science student very well. Learning model This make students are accustomed to in problem solving and scientific processing related to natural phenomena in their environment. The scientific processing and problem solving skills offered by the PBL model can have a positive impact on scientific literacy and results Study student (Nurtanto et al., 2020) . This is in harmony with results research conducted by Fathias Alataz and Laili Fauziah who received results that Scientific literacy skills in terms of knowledge and competence can be significantly improved with problem-based learning models (Alatas & Fauziah, 2020) .

CONCLUSION

The Problem Based Learning (PBL) model is capable increase ability literacy science students on aspects knowledge and competence in a way good. Average improvement ability literacy science students on aspects knowledge and competence by 23.58. increase ability literacy science in aspects the greatest knowledge occurred in the Procedural indicator of 485.4 and an increase in the aspect the greatest skill occurs in aspects evaluate and design study that is of 462.2. increasing students' scientific literacy abilities can help students to learn learning material through investigation and analysis activities. In addition, the problem-based learning model also supports problem solving abilities and critical thinking abilities, systematically this ability will encourage students to do as well as designing investigations related to the material studied.

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