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Scientific Literacy-Oriented Problem Based Learning Model on Improving Critical Thinking Skills

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ABSTRAK

Penelitian ini dilatarbelakangi oleh sulitnya materi larutan penyangga dan keterampilan berpikir kritis peserta didik yang masih tergolong rendah. Tujuan penelitian ini yaitu untuk menganalisis pengaruh implementasi model PBL berorientasi literasi sains terhadap peningkatan keterampilan berpikir kritis peserta didik dalam mempelajari materi larutan penyangga. Pendekatan kuantitatif yang digunakan dalam penelitian ini menggunakan metode pra eksperimental. Sasaran penelitian ini adalah 35 peserta didik SMA. Peningkatan keterampilan berpikir kritis peserta didik ditinjau dari ketuntasan klasikal dan uji hipotesis. Hasil penelitian menunjukkan bahwa ketuntasan klasikal dalam satu kelas mengalami peningkatan, pada pretest sebesar 0% dan pada posttest sebesar 91,42%. Uji hipotesis menggunakan uji Wilcoxon diperoleh nilai signifikansi sebesar 0,000 (signifikansi <0,05). Hal ini menunjukkan terdapat perbedaan yang signifikan antara nilai pretest dan posttest keterampilan berpikir kritis peserta didik sehingga dapat disimpulkan bahwa terdapat pengaruh implementasi model PBL berorientasi literasi sains terhadap keterampilan berpikir kritis peserta didik. Penelitian ini mempunyai implikasi bahwa guru dapat menggunakan model PBL berorientasi literasi sains untuk meningkatkan berpikir kritis peserta didik yang pelaksanaannya disesuaikan dengan konteks materi.

ABSTRACT

This research was motivated by the difficulty of the buffer solution material and students' critical thinking skills which were still relatively low. Aim of this research is to analyze the effect of implementing a scientific literacy-oriented PBL model on improving students' critical thinking skills in studying buffer solution material. Quantitative approach used in this research uses pre-experimental methods. The target of this research was 35 high school students. Improving students' critical thinking skills in terms of classical completion and hypothesis testing. The results of the research showed that classical mastery in one class had increased, in the pretest by 0% and in the posttest by 91.42%. Hypothesis testing using the Wilcoxon test obtained a significance value of 0.000 (significance <0.05). This shows that there is a significant difference between the pretest and posttest scores of students' critical thinking skills so it can be concluded that there is an influence of the implementation of the scientific literacy-oriented PBL model on students' critical thinking skills. This research has the implication that teachers can use a scientific literacy-oriented PBL model to improve students' critical thinking, the implementation of which is adapted to the material context.

1. INTRODUCTION

One of the lessons taught at school is chemistry. Buffer solutions are part of class XI chemistry material which is often considered by students to be material that is difficult to learn. This problem can be seen from the lack of students' understanding of the complex buffer solution material so that to learn it students are required to understand the underlying prerequisite concepts (Alighiri et al., 2018; Sariati et al., 2020). The low understanding of students' concepts in buffer solution material is proven by 45.53% understanding, 31.05% not understanding, 12.96% having misconceptions, and 10.46% not understanding the material. The application of the buffer solution concept is closely related to problems in everyday life. Many problems in everyday life can actually be solved using the concept of buffer solutions. One example of the problem is when someone runs, over time the body will feel weak and breathing becomes short, which

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causes a decrease in blood pH in the body. However, to return the body to a normal state, this can be done by consuming electrolyte drinks because electrolyte drinks contain a buffer solution which acts as a pH controller. Solving these problems uses more thinking skills such as interpreting, analyzing, inferring, explaining and evaluating (Facione, 2013; Lubis et al., 2021). Based on these examples, to solve problems in everyday life, it is known that it is very important to train students' critical thinking skills. Another reason it is very important to train critical thinking skills is that this is in accordance with what is mandated in Minister of Education and Culture Regulation Number 20 of 2016, where through a scientific approach students are expected to be able to have thinking and acting skills such as critical, creative, collaborative and communicative thinking (Andres & Hamid, 2023; Kwangmuang et al., 2021).

In fact, students' critical thinking skills in schools are still low. The low critical thinking skills of students can be seen from the average results of the students' critical thinking skills test which overall is 36.87% which is included in the categorylow (Setianingsih & Roshayanti, 2022). There is also research conducted that shows that the results of students' critical thinking skills tests which refer to indicators of interpretation, analysis, inference and evaluation, the overall average is 43.5%, which is also included in the low category (Ningrum & Ratman, 2021). The cause of students' low critical thinking skills is the lack of practice on questions related to indicators of critical thinking skills so that students are not used to working on questions like that. Apart from that, it can also be caused by students not having initial knowledge about a concept so it is difficult to relate knowledge of one concept to another (Asniar et al., 2022; Wilkin, 2017).

It is important to improve students' critical thinking skills, of course a suitable learning model is needed, one of which is the Problem Based Learning (PBL) model. The PBL model is a learning model that focuses students on solving a problem where in the process the teacher only acts as a mediator and facilitator to guide students in building their knowledge actively and independently (Andres & Hamid, 2023; Yulianti, E., & Gunawan, 2019). The PBL stages simply begin with providing a problem related to the subject matter, organizing students to learn, guiding individual and group investigations to gather information, developing and presenting results and carrying out analysis and evaluation of the results of problem solving.(Kurniawati, 2021; Mareti & Hadiyanti, 2021). The PBL model makes learning more meaningful and encourages students to think at a higher level and encourages students to optimize their metacognitive abilities.

The application of this PBL model can be used as an alternative in implementing learning, supported by previous research conducted states that PBL learning is effective in improving students' critical thinking skills compared to conventional learning (Arviani et al., 2023). Other study also stated that the application of the PBL model to redox and electrochemical material can improve students' critical thinking skills where from the results of his research it was found that students' critical thinking skills in providing explanations, making decisions, and drawing conclusions in the experimental class were significantly higher than in the control class (Rosid, 2019). Other study also stated that the application of the PBL model to acid-base material can improve students' critical thinking skills, which can be seen from the research results which show that the percentage of critical thinking skills indicators of interpretation, analysis, evaluation and inference obtained a high N-gain criteria score (Suci & Harun, 2018). PBL learning which aims to improve students' critical thinking skills, can be trained in the learning process through scientific literacy exercises. The components between scientific literacy and critical thinking are related. This connection is found in scientific literacy competencies which are related to indicators of critical thinking skills. Scientific literacy competency to explain phenomena scientifically is related to indicators of critical thinking skills of analysis, interpretation and explanation (Rochmatin & Muchlis, 2023; Zahroh & Yuliani, 2021). Scientific literacy directs students to use scientific information, identify questions, and make evidence-based conclusions to understand and make decisions about nature and human interactions with nature. Scientific literacy can improve students' critical thinking skills where by being scientifically literate students get various types of information that are used to solve a problem (Noviani et al., 2017; Prahastiwi & Saraswati, 2019). Scientific literacy can improve critical thinking skills, supported by previous research conducted by study found the results obtained were that almost all students were able to express the facts needed to solve problems, provide arguments, analyze arguments and explain problem solving from various points of view well (Lubis et al., 2021). Research conducted by other study also stated that scientific literacy can improve students' critical thinking skills as evidenced by an increase in the average score of critical thinking skills after scientific literacy learning (Taufiq & Chatib, 2018).

The existence of scientific literacy in PBL learning is used as an introduction to presenting problems found in everyday life and is also used as a step in solving problems through practicing scientific literacy questions. This is in line with research conducted who obtained the results that there was an increase in critical thinking skills after implementing scientific literacy-based PBL learning (Rubiyanti et al., 2020). In addition, research was carried out, also obtained were the results of increasing students' critical thinking with high and medium N-gain criteria after being given PBL and scientific literacy oriented learning

(Perdana et al., 2023; Rochmatin & Muchlis, 2023). Based on the explanation of the problems described above, the aim of this research is to describe the influence of the scientific literacy-oriented PBL model on improving students' critical thinking skills. Indicators of critical thinking skills measured in this research include interpretation, analysis and explanation. The novelty of this study is scientific literacy-oriented PBL model focus on improving critical thinking skills

2. METHOD

The approach used in this research is a quantitative approach with pre-experimental methods (Gopalan et al., 2020). This research was carried out in only one class and there was no comparison class. The research design used was one group pretest-posttest. The stages of this research activity begin with carrying out a pretest, implementing a scientific literacy-oriented PBL model, and ending with carrying out a posttest. The pretest and posttest data were analyzed to determine the effect of implementing the scientific literacy-oriented PBL model on improving students' critical thinking skills. The research was carried out in 2 meetings with a time allocation of 2×45 minutes for each meeting. The target of this research was 35 students at one of the high schools in Gresik Regency. Data collection method used is the test method. The instrument used in this research was a critical thinking skills test sheet consisting of pretest and posttest question sheets. The pretest is given to determine students' initial critical thinking abilities before implementing learning with a scientific literacy-oriented PBL model. The posttest was given to determine students' critical thinking abilities after implementing scientific literacy-oriented PBL learning. On the pretest and posttest question sheets, a reading of the phenomenon is presented which is then developed into five detailed questions. The pretest and posttest question sheets that had been prepared were then validated by 2 chemistry lecturers and 1 chemistry teacher at the research school. Data analysis used to measure the increase in students' critical thinking skills in this research includes classical completeness, normality testing and hypothesis testing. In this study, a class is said to be complete if at least 85% of students have achieved individual completeness, namely getting a score of ≥75 out of a maximum score of 100 (Afrita, 2021).

The normality test is a prerequisite test before conducting a hypothesis test. The Normality Test was carried out with the help of SPSS 25. The Normality Test used in the research was the Shapiro Wilk normality test because the amount of data was < 50. Data is said to be normally distributed if the significance value is > 0.05. Hypothesis testing is carried out by referring to the results of the normality test, if the data is normally distributed then the Paired Sample t-test is carried out and if the data is not normally distributed then the Wilcoxon Signed Rank test is carried out. Ha's hypothesis in this research is that there is a significant difference between the pretest and posttest scores of critical thinking skills of students who are given learning using a scientific literacy-oriented PBL model. Conclusions from hypothesis testing results are based on significance values. If the significance value is > 0.05, then Ha is rejected and if the significance value is < 0.05, then Ha is accepted.

3. RESULT AND DISCUSSION

Result

The following are some of the results of data analysis presented to determine the improvement in students' critical thinking skills. The data presented includes classical completeness to determine the learning completeness of students in one class, a normality test to find out whether the data is normal data or not and a hypothesis test to find out whether there is a significant difference between the pretest and posttest scores after implementing the scientific literacy-oriented PBL model. Students' pretest and posttest results is show in Figure 1.

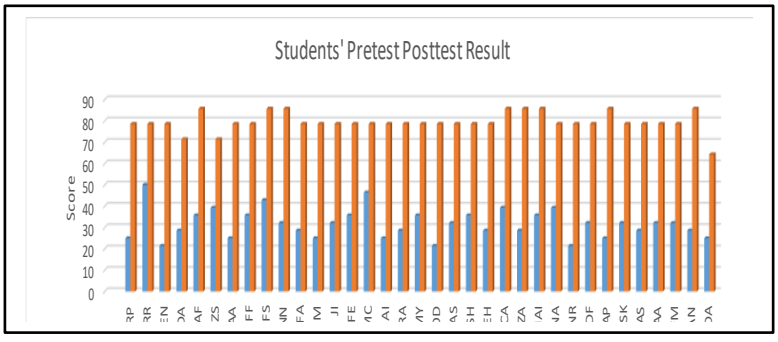

Figure 1. Graph of Students' Pretest and Posttest Results

Figure 1 shows that as many as 35 students before implementing the scientific literacy-oriented PBL model got a pretest score of <75, so it can be said that all students had not achieved individual completeness. However, after implementing the scientific literacy-oriented PBL model, almost all students got a posttest score of >75 and had achieved individual mastery. Student classical completeness graph is show in Figure 2.

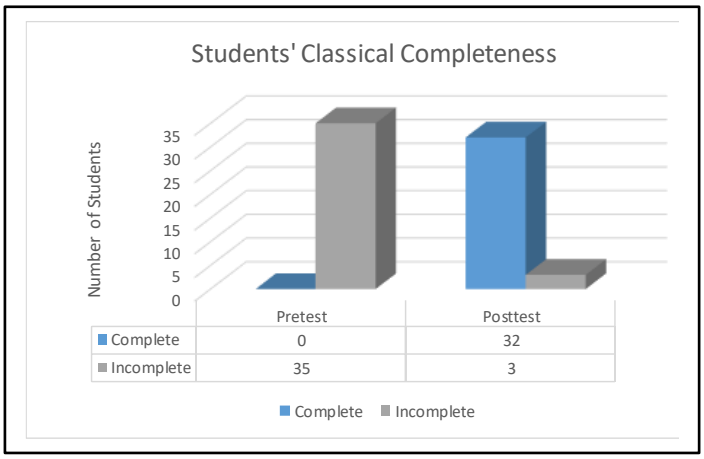

Figure 2. Student Classical Completeness Graph

A class is said to be complete if it is minimal 85% of students have achieved individual completeness, namely getting a score of ≥75 out of a maximum score of 100. Based on Figure 2, it can be seen that in the pretest results, classical completeness in this class was 0% where not a single student achieved individual completeness. However, if you look at the posttest results, classical completion in this class is 91.42%, where there are 3 students who have not yet completed it. This shows that after implementing scientific literacy-oriented PBL learning, students' critical thinking skills have improved. Improving students' critical thinking skills is also seen from the results of hypothesis testing. Hypothesis testing was carried out on the value of each indicator of critical thinking skills in the pretest and posttest sections. Indicators of critical thinking skills include interpretation, analysis and explanation. However, before testing the hypothesis, it is necessary to carry out a normality test as a prerequisite test in order to know which hypothesis test to use, namely the Paired Sample t-test hypothesis test or the Wilcoxon Signed Rank hypothesis test. Data is said to be normally distributed if the significance value is > 0.05. The results of testing each indicator of students' critical thinking skills will be described as in Table 1.

Table 1. Pretest and Posttest Normality Test of Interpretation Indicators

Group	Statistics	Df	Sig
Pretest	0.418	35	0.000
Posttest	0.161	35	0.000

Based on Table 1, in the normality test of the interpretation indicators, the pretest and posttest significance values were obtained at 0.000. Both pretest and posttest significance values are <0.05 and indicate that the data is not normally distributed. Data that is not normally distributed is then subjected to a non-parametric hypothesis test, namely the Wilcoxon Signed Rank test. The results of the Wilcoxon Signed Rank test on interpretation indicators are presented in Table 2.

Table 2. Hypothesis Test Pretest and Posttest Interpretation Indicators

Statistics	Posttest-Pretest
Z	-5.600
Asymp. Sig. (2-tailed)	0.000

Table 2 shows that the significance value obtained in the pretest and posttest hypothesis tests on the interpretation indicators was 0.000. The significance value obtained was <0.05. Based on this, Ha is accepted, namely that there is a significant difference between the pretest and posttest scores of students' critical thinking skills on the interpretation indicator. Thus, it can be said that there is an influence of the

implementation of the scientific literacy-oriented PBL model on improving students' critical thinking skills on interpretation indicators. Pretest and posttest normality test of analysis indicators is show in Table 3.

Table 3. Pretest and Posttest Normality Test of Analysis Indicators

Group	Statistics	Df	Sig
Pretest	0.885	35	0.002
Posttest	0.736	35	0.000

Table 3 is the result of the pretest and posttest normality test of students' critical thinking skills on analysis indicators. The pretest and posttest significance values are 0.002 and 0.000 respectively. The two significance values obtained were <0.005, so it can be said that the data is not normally distributed. The pretest and posttest data on this analysis indicator were then tested for hypotheses using the Wilcoxon Signed Rank test because the data included data that was not normally distributed. The results of the pretest and posttest Wilcoxon Signed Rank test on the analysis indicators are presented in Table 4.

Table 4. Pretest and Posttest Hypothesis Testing Analysis Indicators

Statistics	Posttest-Pretest
Z	-5.189
Asymp. Sig. (2-tailed)	0.000

Based on Table 4, it can be seen that the results of the pretest and posttest hypothesis tests on the analysis indicators are 0.000. The significance value obtained is <0.005, so Ha is accepted and can be interpreted as meaning that there is a difference between the pretest and posttest scores of students' critical thinking skills on the analysis indicators. It can be concluded that there is an influence of the implementation of the scientific literacy-oriented PBL model on improving students' critical thinking skills on analytical indicators. Pretest and posttest normality test of explanation indicators is show in Table 5.

Table 5. Pretest and Posttest Normality Test of Explanation Indicators

Group	Statistics	Df	Sig
Pretest	0.844	35	0.000
Posttest	0.458	35	0.000

Table 5 shows that in the normality test on the explanatory indicators a significance value was obtained pretest and posttest of 0.000. The two significance values obtained were <0.05, indicating that the data was not normally distributed. Based on the results of the normality test, the hypothesis test used was the Wilcoxon Signed Rank test. The results of the pretest and posttest Wilcoxon Signed Rank test for explanation indicators are presented in Table 6.

Table 6. Hypothesis Test Pretest and Posttest Explanatory Indicators

Statistics	Posttest-Pretest
Z	-5.225
Asymp. Sig. (2-tailed)	0.000

Data in Table 6 shows that the pretest and posttest hypothesis tests for the explanation indicators obtained a significance value of 0.000. The significance value obtained is <0.05, so Ha is accepted. Based on this, it can be seen that there is a significant difference between the pretest and posttest scores of students' critical thinking skills on the explanation indicator. Thus, it can be said that there is an influence of the implementation of scientific literacy-oriented PBL on increasing students' critical thinking skills on explanatory indicators. Hypothesis testing is also carried out on students' pretest and posttest scores which cover all indicators. This aims to find out more precisely whether there is a significant difference between the pretest and posttest results of students' critical thinking skills regarding all indicators. The results of the pretest and posttest testing of students' critical thinking skills as a whole are presented in Table 7.

Table 7. Overall Critical Thinking Skills Pretest and Posttest Normality Test

Group	Statistics	Df	Sig
Pretest	0.945	35	0.078
Posttest	0.700	35	0,000

Based on Table 7, it shows that the pretest significance value was > 0.05, namely 0.078, while the posttest significance value was <0.05, namely 0.000. Judging from the results of the normality test, there is one significance value <0.05, so it can be said that the data is not normally distributed. Referring to the results of the normality test, the hypothesis test used is a non-parametric hypothesis test. The non-parametric test is the Wilcoxon Signed Rank test. The results of the Wilcoxon Signed Rank test are presented in Table 8.

Table 8. Pretest and Posttest Hypothesis Test Overall Critical Thinking Skills

Statistics	Posttest-Pretest
Z	-5,171
Asymp. Sig. (2-tailed)	0,000

Table 8 is the result of a hypothesis test used to see whether there is a significant difference between the pretest and posttest scores of students' critical thinking skills which includes all indicators. Based on the results in the table, it shows that a significance value of 0.000 (<0.05) was obtained, so Ha was accepted. It can be seen that there is a significant difference between the pretest and posttest scores of students' critical thinking skills and it can be concluded that there is an influence of the implementation of the scientific literacy-oriented PBL model on students' critical thinking skills in buffer solution material.

Discussion

Based on the data explained in the previous section, critical thinking is one of the most important skills to be trained in students so that they can face difficulties that exist now and in the future. Critical thinking skills in students are very important because they will have an impact on students' daily lives. By utilizing critical thinking skills, students are able to build quality thinking so as to produce good learning. Students with high critical thinking skills tend to be more successful in learning compared to students with low critical thinking skills (Arviani et al., 2023; Syafitri et al., 2021). The level of students' critical thinking skills can be seen by analyzing students' learning outcomes. This is in line with opinion which states that every time there is an increase in students' critical thinking skills, it will be followed by an increase in learning outcomes (Fransiskus et al., 2023). Developing critical thinking skills requires sufficient time of practice. Critical thinking skills will increase according to the form of training and guidance of the mind. Critical thinking is one of the skills involved in science competency (Andres & Hamid, 2023; Nevrita et al., 2019). Practicing scientific literacy questions oriented in PBL learning can improve critical thinking skills. When completing scientific literacy exercises, the ability to interpret and apply various information and make good decisions is required, so this process requires critical thinking skills in students (Azrai et al., 2020; Rochmatin & Muchlis, 2023). According to Students who do literacy before answering questions will be able to develop critical thinking skills that go beyond just recognizing the answer (Hasan et al., 2022). Students will try to find alternative solutions based on analysis and information gathered from a situation. This statement is also supported which states that through scientific literacy, students can provide diverse learning experiences, including learning experiences related to critical thinking, problem solving skills and collaboration in groups (Prahastiwi & Saraswati, 2019).

Critical thinking skills trained to students include interpretation, analysis and explanation. The first indicator of critical thinking skills is interpretation. Interpretation is related to students' ability to interpret and describe the objects observed. Interpretation trains students to explain and understand the meaning of an event, data, procedure or rule (Agnafia, 2019; Harisantoso et al., 2020). According to previous study in the interpretation indicator, the ability that students must have is being able to write down what is asked in the question clearly and precisely (Facione, 2013). In general, the answers written by students on the interpretation indicator are correct and appropriate, that is, they are able to use their thinking skills to identify the component substances that make up the buffer solution. Based on the results of the pretest and posttest on interpretation indicators, it is known that students' critical thinking skills have improved after implementing the scientific literacy-oriented PBL model. There is an increase in critical thinking skills on interpretive indicators because students have gained a deep understanding of concepts from learning experiences gained through problem solving learning, namely scientific literacy-oriented PBL model learning which is assisted by teacher guidance so that students are able to work on questions on interpretive indicators correctly. . This is in line with opinion which states that in the learning process, students are given a problem and students are accustomed to interpreting the problem in order to find solutions to the problems presented (Dharma et al., 2018). Other researchers also explained that in PBL learning, students are trained to identify a problem and describe it (Wati & Yuliani, 2020).

The second indicator of critical thinking skills is analysis. Students are said to be able to solve questions on analytical indicators if they are able to identify intended and actual inferential relationships

between statements, questions, concepts, descriptions, or other representations designed to express beliefs, judgments, experiences, reasons, information, or opinions (Facione, 2013; Lubis et al., 2021). Judging from critical thinking skills on analytical indicators, it is known that there is a significant difference between the pretest and posttest results so it can be concluded that critical thinking skills on analytical indicators have increased after the implementation of the scientific literacy-oriented PBL model. Analysis indicators are indicators with the lowest achievements compared to interpretation and explanation indicators. The low indicator of analysis is because based on the results of the pretest and posttest, students are still unable to relate the mechanism and properties of the buffer solution. In answering questions, students do not answer completely so they do not show the analysis process that occurs. According to other study there are things that influence students' thinking abilities during the analysis process, namely factors where students are lazy about reading and thinking about reasons for answering questions that they have observed and understood as well as interference from friends so that students' concentration is affected and they cannot solve questions well (Hidayati et al., 2021).

The third indicator of critical thinking skills is explanation. Explanation indicators can be seen from the way students solve questions, namely being able to write down the final results and provide reasons for the conclusions drawn based on the knowledge they have (Facione, 2013; Lianqing et al., 2020). In general, students' answers to the explanatory indicators are correct and appropriate, that is, they are able to calculate the pH of the buffer solution and then adjust the calculation results to the type of buffer solution contained in the product as a form of conclusion in expressing their opinion. Based on the results of the analysis, it is known that there has been an increase in students' critical thinking skills on explanatory indicators after implementing the scientific literacy-oriented PBL model. The increase in critical thinking skills in explanatory indicators is due to the fact that in the learning process, students are trained to convey arguments and ideas that can solve problems. This is in line with opinion which states that the freedom of thought in solving authentic problems by students is an opportunity to assimilate previously held knowledge so that it can improve students' critical thinking skills (Simarmata & Mayuni, 2023).

The description above explains that students, in their learning process using the PBL model, are trained to interpret or interpret a problem, then analyze the problem, and also explain the problem to create an appropriate problem solving process so that students will be trained in their critical thinking skills. In the learning process, it is necessary to pay attention to the implementation of the PBL model syntax because students who are not used to dealing with problems will have difficulty understanding the problems assigned to them. In addition, students who tend to have low critical thinking scores will find it difficult in the third and fourth syntax of the PBL model, especially in the investigation and group discussion phases (Halimah et al., 2023; Suradika et al., 2023). During the learning process, the teacher only acts as a facilitator and students are trained to find answers to problems through practicing scientific literacy questions so that the teacher is no longer the center of learning and if the teacher guides students too often in learning, it can result in student learning outcomes as well as improvements. Students' critical thinking skills are less than optimal (Arviani et al., 2023; Jamhari et al., 2020).

Based on the results of data analysis, it shows that students' critical thinking skills are significantly higher after being taught through a scientific literacy-oriented PBL model. This is because the PBL model is a learning model that has the characteristic that a problem is used as a source or topic in learning. When teaching using the PBL model, students are trained to find their own answers to the problems posed by using their thinking skills to form concepts about the material they have studied. So that during learning activities, students can develop their critical thinking skills optimally. Problem-based learning requires students' active role in the learning process because it can enable students to become independent learners (Widayanti & Dwi Nur'aini, 2020; Yulianti, E., & Gunawan, 2019). However, in supporting learning with PBL, to manage interactions between students by placing problems as a source of interaction, it is necessary to form small groups in the learning process. Problem-based learning is in line with constructivist learning theory. Constructivism theory views that students must find and change complex information, match new information with old rules, and correct when the rules are no longer appropriate by involving an active role during the learning process (Hotimah, 2020; Kusumawati et al., 2022). So that this model is in accordance with the characteristics of implementing buffer solution learning material which requires critical thinking skills.

Students' critical thinking skills improved after implementing the scientific literacy-oriented PBL model, supported by the results of previous research conducted state that the results obtained show that PBL learning based on scientific literacy can improve students' critical thinking skills (Widayanti & Dwi Nur'aini, 2020). Other researchers also stated that the integration of scientific literacy in problem-based learning has an effect on students' critical thinking skills, namely it can improve students' critical thinking skills in the high category (Rohmah & Jauhariyah, 2020). The results of data analysis are also relevant to

research conducted by other researchers that by implementing a PBL model based on scientific literacy can improve students' critical thinking skills (Rubiyanti et al., 2020; Wati & Yuliani, 2020).

Based on the description of the discussion and relevant theories presented, this research has the implication that teachers can implement a scientific literacy-oriented PBL model to improve critical thinking skills, the implementation of which needs to be readjusted to the context of the material to be used. Penelitian ini menunjukkan bahwa model pembelajaran berbasis proyek (PBL) yang berorientasi pada literasi sains dapat meningkatkan keterampilan berpikir kritis siswa. Implikasi ini dapat digunakan oleh para pendidik untuk mengimplementasikan PBL sebagai strategi pengajaran yang efektif dalam mengembangkan kemampuan berpikir kritis siswa. Dengan berfokus pada literasi sains, PBL membantu siswa mengaitkan pengetahuan teoretis dengan situasi dunia nyata, menjadikan pembelajaran lebih kontekstual dan relevan. Ini dapat menginspirasi perubahan kurikulum untuk memasukkan lebih banyak pembelajaran kontekstual yang memotivasi siswa melalui masalah-masalah nyata.

This study may have limitations in terms of sample size and variation. If the sample is limited to one school or one particular group, the results may not be generalizable to the wider population. The effectiveness of a scientific literacy-oriented PBL model may depend on the duration of its implementation. Studies of short duration may not be enough to see the full impact on critical thinking skills. Long-term research is needed to confirm these findings.

4. CONCLUSION

Based on the results of the research and discussion, it can be concluded that the implementation of the scientific literacy-oriented PBL model has a significant effect on improving students' critical thinking skills in studying buffer solution material. This increase in critical thinking skills is shown by the increase in scores obtained by students on the pretest and posttest. This research has limitations, namely that it only measures 3 indicators of critical thinking skills which include interpretation, analysis and explanation. Seeing this, the researcher provides suggestions for future researchers to measure other indicators of critical thinking skills as well.

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