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Students' Science Literacy Skills through the Application of *Problem-Based Learning* (PBL) Learning Model Based on *Culturally Responsive Teaching* (CRT)

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Abstract

Background: This research is motivated by the low level of science literacy in Indonesia. Science literacy is essential for students as it can foster critical thinking and problem-solving skills. This study aimed to determine the application of *Problem-based Learning based on culturally responsive teaching (CRT) to students with science literacy skills*. **Method:** This type of research is pre-experimental, using a science literacy test design. The sample of this study was class VII A, totaling 32 students. The sampling technique used was a simple random sampling technique. The analysis technique used in this research is descriptive statistical analysis. **Results:** The results of this study indicate that the application of Problem-Based Learning based on *Culturally Responsive Teaching* (CRT) to science literacy skills is included in the high category seen from the average score of the science literacy test obtained, which is a score of 71,71. **Conclusion:** The problem-based learning model based on culturally responsive teaching (CRT) involves students, allowing them to quickly identify problems independently or in groups and providing meaningful learning experiences by understanding culture.

Keywords: Fermented coconut dregs; Carbohydrates; Maggots; Fish feed; Protein

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Introduction

Given the importance of scientific literacy skills for science learning, the quality of student learning must be improved to achieve the typical abilities of the 21st century. This improvement in the quality of learning is not affected by the learning model chosen (Hafizah & Nurhaliza, 2021). The learning model affects how learning is applied and students' ability to educate themselves. Therefore, using the right learning model can increase students' love of the lesson, increase their motivation, and help them understand the material to achieve extraordinary learning outcomes. Studies increase science knowledge through the use of various learning models and methods. Salma et al. (2020) stated that the problem-based learning model is appropriate.

The problem-based learning (PBL) model can help students improve their skills in the current era of globalization. Irons & Thomas (2016) stated that students will be more motivated to participate in broader PBL activities to improve their knowledge and understanding. At the beginning of learning, this learning model presents real problems to students. This problem is then solved through inquiry and applied through problem-solving. Septiani et al. (2022) research results show that applying PBL can improve systematic problem-solving skills. Therefore, teachers must understand the stages of the problem-based learning model before starting learning.

Problem-based learning (PBL) has had a positive effect on many disciplines (Boud &

Feletti, 1997) proposed that PBL is "the most significant innovation in professional education in years." For several years, PBL has been used in many disciplines to train students' skills in solving realistic and honest problems.

An approach can be taken to support the implementation of the problem-based learning model, including the Culturally Responsive Teaching (CRT) approach. CRT is a responsive-extensional learning approach to the cultural diversity experienced by students. CRT is also a learning approach where teachers position themselves as facilitators tasked with eliminating inequalities that arise in the classroom due to the diversity of backgrounds, customs, ethnicities, and other differences of each student (Abadi & Muthohirin, 2020). According to Taher (2023), CRT learning builds introverted students' enthusiasm, courage, and self-confidence to talk to teachers and friends and work with other students in groups. Teachers have an essential role in helping students learn. They must help their learning personality to learn well and adapt to a fun learning environment.

The learning approach, CRT, is responsive to students' backgrounds and cultural diversity. This method can connect learning materials with real-world experiences and situations, thereby increasing students' understanding and desire to learn (Siswaningsih et al., 2023). Culturally Responsive Teaching (CRT) learning can potentially improve student learning outcomes. This is in accordance with research conducted by Siskawati (2023), that a culturally responsive learning approach can improve student learning outcomes because this approach provides learning that is more relevant to students' lives and culture and makes students more motivated to learn. Likewise, research Ndandara & Hambandima (2021) concluded that this approach helps students become freer to represent their ethnic groups by writing and performing their drama scripts.

Based on the results of interviews with science teachers at one of the State Junior High Schools in Surakarta City regarding the learning models used, teachers use lecture methods more often than other methods. So, they have not implemented an effective learning model because teachers have never measured students' scientific literacy skills. This study aimed to determine students' scientific literacy skills by applying the Problem-Based Learning (PBL) learning model based on Culturally Responsive Teaching (CRT).

Method

This research is a descriptive study with a descriptive statistical analysis method to determine students' scientific literacy skills by applying the Problem-Based Learning (PBL) learning model based on Culturally Responsive Teaching (CRT). This research was conducted in January 2024. The population in this study were all students in grade VII. The sample used in this study was 32 students in grade VII-A. The sampling technique was random sampling (simple random sampling). Supporting data was obtained by interviewing science teachers regarding implementing the Problem-Based Learning (PBL) learning model based on Culturally Responsive Training (CRT).

Several steps were taken while conducting this research. First, the author selects a research sample. Then, the Problem-based Learning (PBL) learning model based on culturally responsive training (CRT) will be applied in teaching and learning activities. The author then presents the data analysis to answer the research problem. The research data were obtained through a written test for grade VII students. The science literacy test questions were compiled using the PISA 2015 indicators in the form of descriptive questions. The data analysis technique used is descriptive statistical analysis to obtain the lowest, highest, average, standard deviation, distribution of science literacy scores, and the percentage of students who achieve science literacy competency.

Result

The data obtained in this study were written test results, namely the science literacy test in science subjects. The science literacy test is given to students at the end of the meeting to determine students' science literacy abilities by applying the Problem-Based Learning (PBL)

learning model based on Culturally Responsive Teaching (CRT). The results of the descriptive analysis to obtain the lowest score, the highest score, the average score, and the standard deviation can be seen in Table 1. as follows:

Table 1. Results of the Science Literacy Ability Test of Students in Science Subjects

Science Literacy Score				
N	Min	Max	ȳ± s	Kategori Skor
32	55	97	71,71 ± 50,10	Tinggi

Description:
80 – 100 = Very High
66 – 79 = High
56 – 55 = Medium
40 – 55 = Low
30 – 39 = Very Low
Source: (Arikunto, 2010)

Based on Table 1., it can be seen that the results of the science literacy test of class VII students of MTs Negeri 1 Surakarta in the science subject showed the lowest score of 55, the highest score of 97, the average score of 71.71 and the standard deviation of 50.10. Thus, from the results of this study, it can be concluded that the average score on the science literacy test is included in the high category. The distribution of science literacy scores of students at MTs Negeri 1 Surakarta is shown in Figure 1 below.

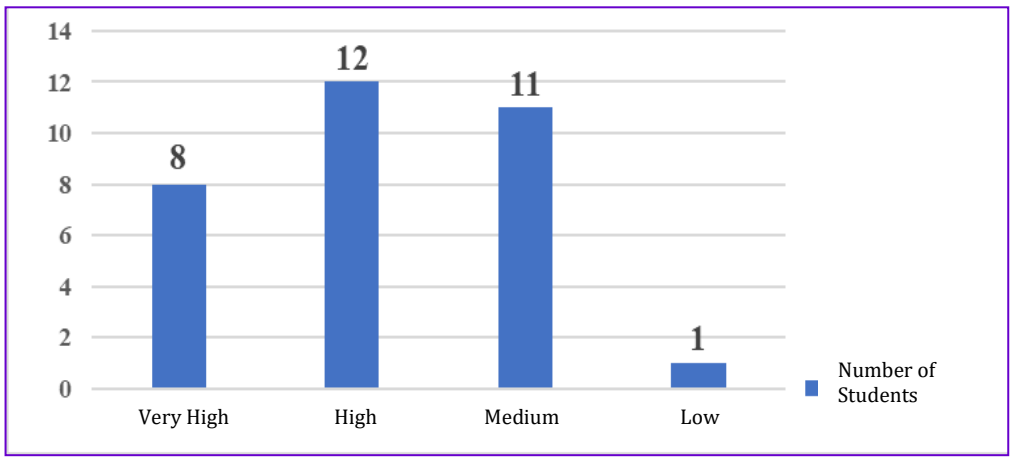

Figure 1. Distribution of scientific literacy score categories of students in science subjects.

Based on Figure 1, it can be seen that the distribution of scientific literacy score categories of class VII students of MTs Negeri 1 Surakarta in science subjects received scores in the very high category, namely eight students, the high category, namely 12 students, the medium category, namely 11 students, and for the low category, as many as one students. Thus, from the results of this study, it can be concluded that the distribution of scientific literacy scores is included in the high category, namely 12 students. The percentage of students who achieved scientific literacy competency can be seen in Table 2 as follows.

Table 2. Percentage of Students Who Achieved Scientific Literacy Competency Based on PISA 2015 Indicators.

Competence	Percentage of Students	Category
Explain phenomena scientifically	62,5%	Medium
Evaluate and design investigations scientifically	59,37%	Medium
Interpret data and evidence scientifically	43%	Low

Description:
86% < p < 100% = Very High
72% < p < 85% = High
58% < p < 71% = Moderate
43% < p < 57% = Low
< p 43% = Very Low
Source: Djaali, & Muljono (2008)

Based on Table 2, the % of students who achieved scientific literacy competency in science subjects at MTs Negeri 1 Surakarta based on the PISA 2015 indicator was that 62.5% of students mastered the competency of explaining phenomena scientifically with a moderate category. 59.37% of students mastered the competency of evaluating and designing scientific investigations with a moderate category and only 43% mastered the competency of interpreting data and evidence scientifically with a low achievement category. Thus, from the research results, it can be concluded that the highest is the competence in explaining phenomena scientifically (62.5%). In comparison, the lowest percentage is shown in the competence in interpreting data and evidence scientifically (43%).

Discussion

This study aims to determine students' scientific literacy skills by applying the Problem-Based Learning (PBL) learning model based on Culturally Responsive Teaching (CRT). To find out the learning model used by teachers, researchers conducted observations by searching for information about the learning model implemented in the classroom. Teachers more often use the lecture method. As a result, students are not yet fully interested in science. In addition to not implementing an effective learning model, teachers have never previously measured students' scientific literacy skills, and researchers gave tests in the form of scientific literacy questions.

A learning model is a plan or pattern used to organize lesson materials and provide instructions to teachers. An effective learning model can make students active in learning. The problem-based learning model involves students seeking information to solve the problem themselves or in groups. According to Septica, E & S. Djaga (2022), guiding students to understand issues, seek information, plan problem-solving, and have the ability to solve problems in the right way. An approach can be taken to support the implementation of the problem-based learning model, namely the Culturally Responsive Teaching (CRT) approach to environmental pollution material.

Based on the results of descriptive statistical analysis of the science literacy ability test (Table 1), the average science literacy score was 71.71, with the highest score of 97 and the lowest score of 55; therefore, it can be concluded that the test score of science literacy ability is included in the high category. Meanwhile, for the results of the distribution of the science literacy category using descriptive statistical analysis, Table 2. shows that the values obtained in the very high category are eight students, the high category is 12 students, the medium category is 11 students, and the low category is one student. The data shows that science literacy skills are considered to be in the high category because Problem-Based Learning based on Culturally Responsive Teaching (CRT) can provide student-centered learning so that students have a basic understanding of science concepts, as well as provide meaningful learning experiences for students by recognizing and understanding their cultural background, language, and experiences. Thus, it can increase student motivation and learning outcomes, affecting students' science literacy skills. Statistical analysis of the percentage of students who achieved scientific literacy competency can be seen in Table 2, where the highest percentage value is the competency of explaining phenomena scientifically, while the lowest percentage is shown in the competency of interpreting data and evidence scientifically. As many as 62.5% of students mastered the competency of explaining phenomena scientifically with a moderate category, 59.37% of students mastered

the competency of evaluating and designing scientific investigations with a moderate category and only 43% of students mastered the competency of interpreting data and evidence scientifically with a low achievement category.

The highest percentage of competency is explaining phenomena scientifically because, according to OECD (2016), students must recall the appropriate knowledge content in the given conditions to interpret and explain interesting phenomena. The ability to evaluate and design scientific investigations is also needed to assess critically reports of findings and research. In addition, the ability to interpret data and evidence scientifically is also required to analyze and make basic meanings of the data and scientific evidence used to conclude. This shows that the problem-based learning model is effective in science learning. In addition, the Problem-based Learning model based on culturally responsive teaching (CRT) has become an alternative option for overcoming the limitations of students' scientific literacy.

So, it can be concluded that students' scientific literacy skills through applying the Problem-Based Learning (PBL) learning model based on Culturally Responsive Teaching (CRT) where the general scientific literacy score averages 71.71 with a high category. This is by research Salma et al. (2020), that learning using the Problem-Based Learning model based on Culturally Responsive Teaching (CRT) can improve the scientific literacy skills of class XI MIPA 6 students. With this learning model, learning in the classroom becomes more effective and can increase motivation and curiosity in solving problems. As stated Nurwahid & Shodikin (2021), curiosity and motivation increase due to the problem-based learning model. Students face issues and then solve them themselves during the learning process. Therefore, students can think, search, process data, and communicate during learning. Problem-based learning can help students. Because problem-based learning focuses on one topic, students do not need to study topics that do not involve problems. Students also learn to use the internet, libraries, observations, and interviews as sources of knowledge.

With a problem-based learning model, teachers are not the only people who can help students learn. The teacher's job is to help and direct students (Nihwan & Widodo, 2020). The Problem-Based Learning learning model is assisted by an approach, namely the Culturally Responsive Teaching (CRT) approach, which is suitable for supporting the implementation of the problem-based learning model, as stated by Abadi & Muthohirin (2020) that Problem-Based Learning is integrated with the Culturally Responsive Teaching (CRT) approach. The Culturally Responsive Teaching (CRT) approach is a learning method in which the teacher acts as a facilitator and is responsible for eliminating inequalities caused by education, ethnicity, background, and other differences that each student has. According to Hardiana (2023), teachers can create relevant, inclusive, and meaningful learning experiences for their students using the Culturally Responsive Teaching (CRT) approach. The CRT approach increases student learning motivation and achievement. Learning based on student culture can make students more interested in the learning process.

The shortcomings in implementing Culturally Responsive Teaching (CRT) according to Dewi et al. (2023) this method requires special knowledge and skills, making it challenging to implement. In addition, this method will not be successful without strong support from the school administration, curriculum, and the school itself. However, these obstacles can be overcome with ongoing commitment to teacher professional development and strong support from the school and district levels. Despite some shortcomings, the Culturally Responsive Teaching (CRT) approach remains a suggestion for creating an effective learning environment for students.

Based on the results of interviews with teachers at one of the State Junior High Schools in Surakarta City, teachers have never used the problem-based learning model based on culturally responsive teaching (CRT), and teachers more often use the lecture method. Teachers provide information without much interaction or discussion, so students struggle to understand. This culturally responsive teaching (CRT) learning model involves students, allows them to quickly identify problems independently or in groups, and provides

meaningful learning experiences by understanding culture. CRT learning model can improve students' motivation, learning outcomes, and science literacy skills. The results are from research conducted by Djahidin et al. (2023), which concluded that applying Problem-Based Learning in learning the scientific literacy skills of grade V students at SDN 37 Kendari can be improved, likewise with research by Maulana & Mediatati (2024), which concluded that the learning process based on Culturally Responsive Teaching (CRT) is considered to improve students' scientific literacy skills because it builds students' knowledge through direct experience.

Conclusion

Based on data analysis and discussion on students' scientific literacy skills through the application of the Problem-Based Learning (PBL) learning model based on Culturally Responsive Teaching (CRT), it can be concluded that students' scientific literacy skills through the application of the Problem-Based Learning (PBL) learning model based on Culturally Responsive Teaching (CRT) are included in the high category. This can be seen from the average value of the scientific literacy test obtained, namely a score of 71.71 with a high category.

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Declaration statement

The authors report no potential conflict of interest.

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