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Improving Students' Science Literacy Skills through Treasure Hunting Games with Problem Based Learning Model

Farah Albi Febianti[1*], Wati Sukmawati[1]

[1] Program Studi Pendidikan Guru Sekolah Dasar, Universitas Muhammadiyah Prof. DR. Hamka, Jakarta, Indonesia.

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Corresponding Author:
Farah Albi Febianti
2001025101@uhamka.ac.id

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Abstract: This study aims to evaluate the impact of the Problem Based Learning (PBL) model with a treasure hunt game strategy on improving students' scientific literacy skills. The research method employed a quasi-experimental approach with a pretest-posttest control group design. The subjects consisted of two classes: an experimental class implementing the PBL model with the treasure hunt game strategy and a control class using conventional teaching methods. Data were collected through scientific literacy tests administered before and after the intervention and analyzed using stacking and racking analysis based on the Rasch Model. The results indicated that both classes experienced an increase in scientific literacy skills, with the experimental class showing a higher average increase of 1.99 compared to the control class's 1.80. Although the percentage difference in improvement was only about 11.24%, this suggests that the PBL method with the game strategy can provide additional positive contributions to science learning. The discussion highlights the importance of proper method implementation, teacher-student interaction, and learning environment conditions in influencing learning outcomes. In conclusion, while the PBL method with the game strategy is effective in enhancing scientific literacy, a holistic approach is still needed for optimal development of students' abilities.

Keywords: Problem based learning; Quasi-experimental; Rasch model; Scientific literacy; Treasure hunt game

Introduction

Science education has a very important role in shaping the young generation who are able to think critically, creatively, and innovatively. Science literacy is one of the competencies that must be possessed by students in order to be able to understand natural phenomena, technology, and scientific issues that develop in society (Kinslow et al., 2019). Science literacy is not just an understanding of basic scientific concepts, but also includes the ability to apply that knowledge in everyday life, as well as the ability to think analytically and solve problems effectively. However, the reality on the ground shows that the science literacy ability of students in Indonesia is still relatively low. This can be seen from the results of various international surveys and tests, such as the Programme for International Student Assessment (PISA), which shows that the science literacy of Indonesian students is below the average of other countries (Pisa, 2023). The problem of low science literacy can be caused by various factors, one of which is less effective learning methods. Learning that is still teacher-centered and less involved in the learning process can make students less motivated and not interested in learning science. In addition, learning that is less contextual and does not relate science material to daily life is also an obstacle in improving students' science literacy (Glew et al., 2019; Mehrvarz et al., 2021; Nadrah et al., 2017). Therefore, innovations are needed in learning methods that can increase students' interest and motivation, as well as be able to develop their science literacy skills. One of the learning approaches

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that is considered effective to improve science literacy is the Problem Based Learning (PBL) model.

The PBL model is a student-centered learning approach, where students are faced with a real problem that they must solve through a process of investigation, collaboration, and reflection (Aranzabal et al., 2022; Churiyah et al., 2020; Lee et al., 2015). Through the PBL model, students are expected to develop critical, creative, and analytical thinking skills, as well as be able to relate science concepts to the real situations they face. In addition, the PBL model can also increase students' involvement and motivation in the learning process, because they feel they have a responsibility and an active role in solving the given problems. To further integrate the PBL model with an engaging and fun learning context, treasure hunt games can be one of the innovative strategies (Sukmawati et al., 2023; Sukmawati et al., 2021). Treasure hunt games are activities that involve searching for and solving clues to find hidden treasures. In the context of science learning, the game can be designed in such a way that students must use their knowledge and science skills to solve the clues. Thus, treasure hunt games can be an effective medium to improve students' science literacy through the PBL model.

This study aims to examine changes in students' science literacy abilities through the application of treasure hunting games with the Problem Based Learning model. This research is expected to contribute to overcoming the problem of low student science literacy, as well as providing innovative and fun alternative learning methods. Several previous studies have shown that the PBL model can improve students' science literacy skills. However, research combining the PBL model with the treasure hunt game is still very limited (Claesgens et al., 2013; Sukmawati, 2023). This study attempts to fill this gap by exploring how treasure hunt games designed based on the PBL model can affect students' science literacy skills. Thus, this research not only contributes to the development of science learning theory and practice, but also offers novelty in learning strategies that combine elements of play and problem-based learning. In this study, students' science literacy skills will be measured through several indicators, such as understanding science concepts, the ability to apply these concepts in real situations, critical and analytical thinking skills, and the ability to communicate and collaborate in solving problems. The treasure hunt game will be designed with the principles of the PBL model in mind, where students will be given problems that they must solve using their knowledge and science skills. Each clue in the game will be designed in such a way that it challenges students to think critically, conduct investigations, and collaborate with their peers.

This study will also analyze how the application of treasure hunting games with the PBL model can affect student motivation and engagement in the learning process. It is hoped that this approach can make science learning more interesting and enjoyable, so that students are more motivated to learn and develop their science literacy skills. In order to achieve this goal, this research will use mixed methods, which involve the collection of quantitative and qualitative data (Fauziah & Sukmawati, 2023; Fitria & Sukmawati, 2022). Quantitative data will be obtained through science literacy tests before and after the application of the treasure hunt game with the PBL model, while qualitative data will be obtained through observations, interviews, and questionnaires to measure student motivation and engagement. This research is expected to make a significant contribution to improving students' science literacy through the application of innovative and effective learning methods (Novianti et al., 2023; Sukmawati et al., 2021; Wanningrum & Sukmawati, 2023). The results of this research are expected to be the basis for the development of better science learning strategies in the future, as well as provide inspiration for educators to continue to innovate in developing interesting and relevant learning methods for students. Thus, students' science literacy can be improved, and they can become a generation better prepared to face global challenges in the future.

This research holds significant importance in enhancing students' science literacy. By integrating the Problem Based Learning (PBL) model with treasure hunt adventure games, the study aims not only to address the low science literacy skills among students but also to provide an innovative and enjoyable alternative learning method. It is anticipated that this approach will not only improve students' understanding of scientific concepts but also foster their critical and analytical thinking skills, as well as their ability to collaborate and communicate effectively in problem-solving (Boulton, 2017; Longhurst et al., 2020; Salam et al., 2015). Thus, the research contributes not only to the theory and practice of science education but also introduces a learning strategy that combines playfulness with problem-based learning, making science learning more engaging and effective for students.

Method

This study uses an experimental design with two groups, namely the experimental class and the control class. The experimental class will receive learning using a treasure hunt game with the Problem Based Learning (PBL) model, while the control class will receive conventional learning without games and the PBL

model. This research was conducted in one of the elementary schools in the city of Jakarta with a research sample consisting of two randomly selected classes. The instruments used in this study include science literacy tests and learning motivation questionnaires (Laliyo et al., 2022; Sumintono, 2018). The science literacy test consists of questions that measure the understanding of science concepts, critical thinking skills, and the ability to apply science concepts in real situations. This test was given to both groups before and after treatment to measure changes in science literacy skills. The learning motivation questionnaire is used to measure the level of motivation and involvement of students in the learning process. Data analysis was carried out using the Rasch model with a stacking and racking approach to evaluate changes in students' science literacy skills (Ramadhani & Sukmawati, 2022; Sukmawati, 2022).

The Rasch model allows for a more in-depth analysis of the test data by taking into account the difficulty level of the question items and the individual abilities of the students. The stacking approach is used to combine pretest and posttest data from both groups, so that they can be compared directly (Ifdaniyah & Sukmawati, 2024; Istiqomah & Sukmawati, 2023; Kusnadi & Sukmawati, 2023; Nurliana & Sukmawati, 2023). Meanwhile, the racking approach is used to analyze the difficulty of the questions. The research procedure began with the implementation of a science literacy pretest and filling out a learning motivation questionnaire by both groups. Furthermore, the experimental class carried out learning with a PBL-based treasure hunt game for six weeks, while the control class carried out conventional learning of the same duration. After the learning period, the two groups conducted a science literacy posttest and filled out a motivation questionnaire to learn again. The collected data was then analyzed using the Rasch model to identify the influence of treatment on students' science literacy ability and learning motivation. See Figure 1.

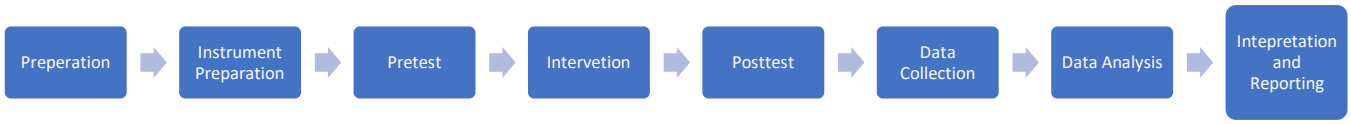

Figure 1. Research Procedure

Result and Discussion

Data analysis using the Rasch model in the experimental and control classes provides an overview of the changes in the difficulty level of the questions in the experimental and control classes that will affect students' science literacy skills. In the experimental class. which used a treasure hunt game with the Problem Based Learning (PBL) model. there was a significant change in students' science literacy skills. The average pretest score in the experimental class was 0.944 with a standard deviation of 0.9506755. while the average posttest score decreased to -1.2468 with a standard deviation of 1.0987619. This decrease indicates greater variability after the treatment. reflecting that some students may experience an increase in understanding of the material so that students can easily answer questions (Apriliana & Sukmawati, 2021). On the other hand. in the control class that used conventional learning methods. the average pretest score was 0.9412 with a standard deviation of 0.7219824. and the average posttest score was -0.9628 with a standard deviation of 0.9281057. Although there was a decrease in the average posttest score in the control class. this decrease was not as large as that in the experimental class. suggesting that conventional learning may have a more stable but less effective impact on improving overall science literacy.

In general, the decrease in posttest scores in both groups showed a decrease in the level of difficulty of the questions. The difference in standard deviation between pretest and posttest in the two groups is also interesting to observe. In the experimental class. the standard deviation increased from 0.9506755 to 1.0987619. indicating an increase in variation in student performance. This may reflect that the PBL model with treasure hunt games provides different challenges for each student. resulting in a wider range of scores (Nurliana & Sukmawati, 2023; Sukmawati, 2022; Sukmawati et al., 2022). Conversely. in the control class. the standard deviation also increased but not as much as the experimental class. from 0.7219824 to 0.9281057. showing a smaller variation. From these results. it can be concluded that although the PBL model with treasure hunt games offers a more interactive and engaging learning method. its effectiveness may not be evenly distributed across students. Some students may benefit greatly and show significant improvements in science literacy. while others may be less able to adapt to these methods so as not to experience changes and show declines.

In the context of learning. these findings suggest that innovative approaches such as PBL with treasure hunt games require appropriate adjustments and support to ensure all students can follow along well. Teachers need to understand the individual needs of students and may need to provide additional guidance for students who are experiencing difficulties. In addition. it is also necessary to further investigate why some students show a decrease in posttest scores and how learning methods can be adapted to address these challenges. Based on the findings. this study provides important insights into the application of the PBL model with the game of treasure hunting in improving students' science literacy. as well as showing the need for a more holistic and adaptive approach in learning. For more clarity see Figures 2 and 3.

Figures 2 and 3 examine the changes in the difficulty level of the questions in the experimental and control classes to understand the effectiveness of the learning methods applied. The experimental class uses a treasure hunt game based on Problem Based Learning (PBL). While the control class uses conventional learning methods.

Table 1. Racking of experimental classes

Items	Pretest		Posttest	
	Measure	S.E.	Measure	S.E.
1	2.24	0.46	0.01	0.41
2	2.24	0.46	-3.77	1.8
3	-0.55	0.47	-1.84	0.74
4	1.12	0.39	-1.06	0.54
5	0.33	0.39	-2.58	1.02
6	0.48	0.39	0.01	0.41
7	0.77	0.38	-1.39	0.61
8	2.03	0.44	-0.79	0.5
9	0.48	0.39	0.01	0.41
10	0.17	0.4	-0.16	0.42
11	-0.79	0.5	-1.06	0.54
12	1.98	0.44	-0.16	0.42
13	1.51	0.4	-2.58	1.02
14	0.92	0.38	-1.06	0.54
15	0.33	0.39	-1.39	0.61
16	0.01	0.41	-0.79	0.5
17	1.36	0.39	0.33	0.39
18	0.63	0.38	-2.58	1.02
19	-0.55	0.47	-1.39	0.61
20	0.48	0.39	-3.77	1.8
21	1.06	0.38	-0.79	0.5
22	1.51	0.4	-1.84	0.74
23	2.47	0.5	-0.79	0.5
24	0.63	0.38	-1.39	0.61
25	2.74	0.54	-0.35	0.44
Mean	0.944		-1.2468	
S.D.	0.9506755		1.0987619	

Table 2. Control-grade racking

Items	Pretest		Posttest	
	Measure	S.E.	Measure	S.E.
1	1.42	0.42	-0.17	0.38
2	3.07	0.73	-0.32	0.39
3	2.03	0.49	0.12	0.37
4	2.03	0.49	-0.32	0.39
5	0.95	0.38	0.12	0.37
6	0.95	0.38	0.53	0.37
7	0.66	0.37	-1.25	0.49
8	0.12	0.37	-0.64	0.42
9	1.26	0.4	-0.32	0.39
10	-0.17	0.38	-1.25	0.49
11	0.25	0.37	-2.29	0.73
12	0.95	0.38	-0.32	0.39
13	0.39	0.37	-1.25	0.49
14	0.8	0.38	-1.02	0.46
15	-0.02	0.38	-2.29	0.73
16	0.53	0.37	-1.51	0.54
17	0.95	0.38	-0.47	0.4
18	0.25	0.37	-3.02	1.02
18	0.25	0.37	-1.25	0.49
20	0.53	0.37	-3.02	1.02
21	0.95	0.38	-0.17	0.38
22	1.26	0.4	-1.51	0.54
23	1.1	0.39	-0.47	0.4
24	1.42	0.42	-1.51	0.54
25	1.6	0.44	-0.47	0.4
Mean	0.9412		-0.9628	
S.D.	0.7219824		0.9281057	

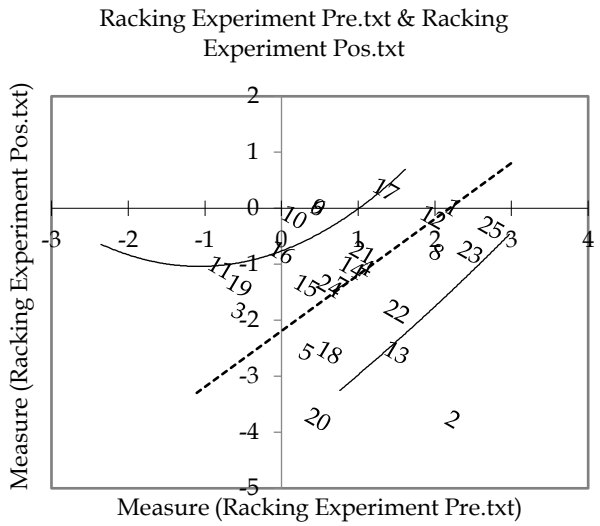

Figure 2. Difficulty level of questions in the experimental classes

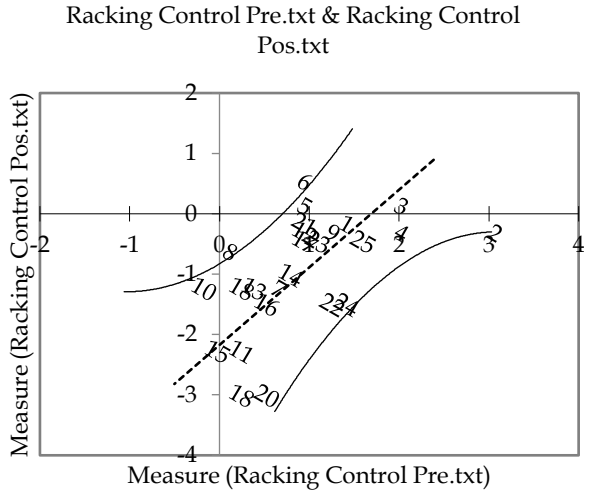

Figure 3. Difficulty level of questions in the control classes

From the data analyzed, it is known that 60% of the items in the experimental class experienced a decrease in difficulty. While in the control class, 84% of the items showed a decrease in difficulty. The decrease in difficulty in the experimental class may be caused by several factors. One of the factors is the variability of the effectiveness of the PBL model. PBL-based treasure hunt games require students' active involvement and critical thinking skills. which may be more challenging for some students. This can lead to differences in learning outcomes. where some students may experience significant improvements. while others have difficulty adapting to these methods and show a decrease in scores. In addition, adapting to new learning methods also takes time. Students may not fully understand or master the material taught through the PBL model at the time of the posttest. So, their scores decrease. On the other hand. in a control class that used conventional learning methods. a significant decrease in scores on 84% of items may be due to the limitations of the method in improving students' understanding and motivation. Conventional learning methods tend to be less interactive and less interesting. which can result in students being less motivated to learn and remember the material. This decrease in learning motivation has an impact on the decrease in posttest scores (Novianti et al., 2023; Sukmawati & Wahjusaputri, 2018; Wanningrum & Sukmawati, 2023). These results suggest that although the PBL model with treasure hunt games offers a more engaging approach and can increase student engagement. its effectiveness may vary among students. To optimize this method. additional adjustments and support are needed for students who are experiencing difficulties. Meanwhile. conventional learning methods. although more stable. may be less effective in encouraging significant improvements in students' science literacy. This research highlights the importance of a holistic and adaptive approach to learning to ensure that all students can get maximum benefits. For more clarity see Figures 4 and 5.

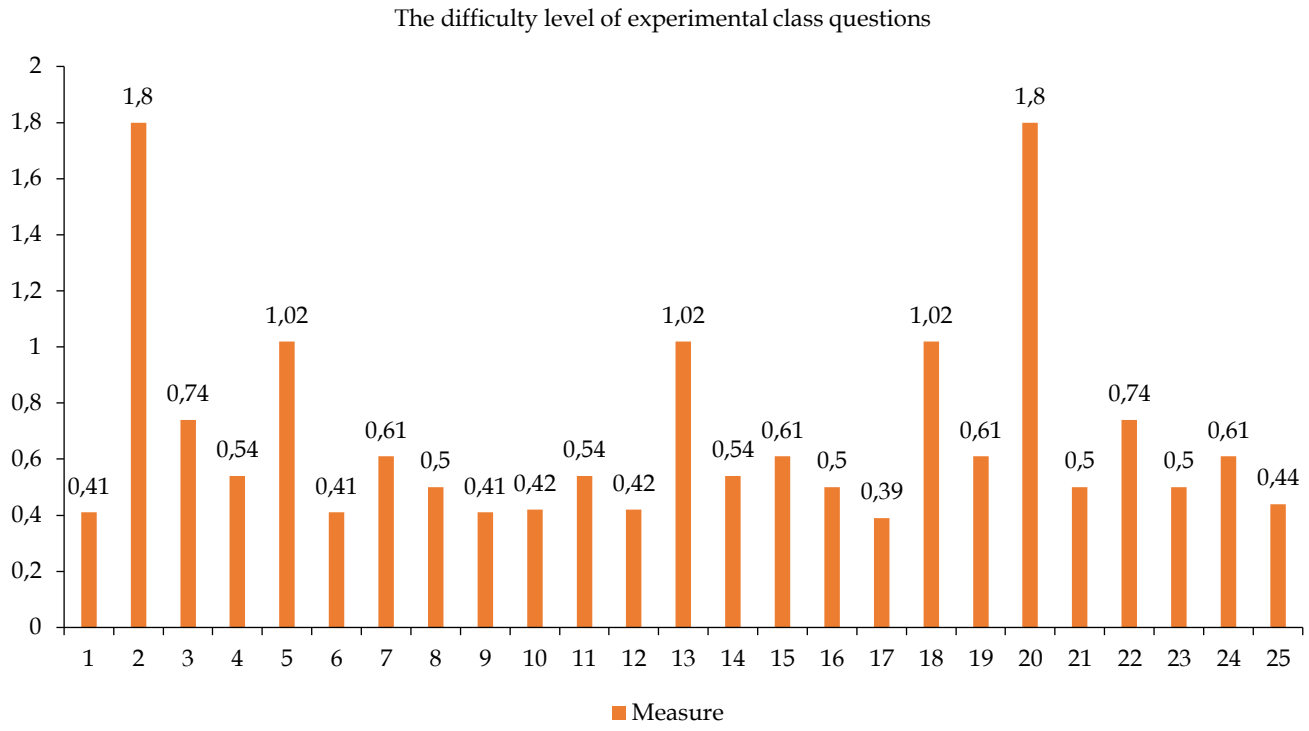

Figure 4. Changes in the difficulty level of questions in the experimental classes

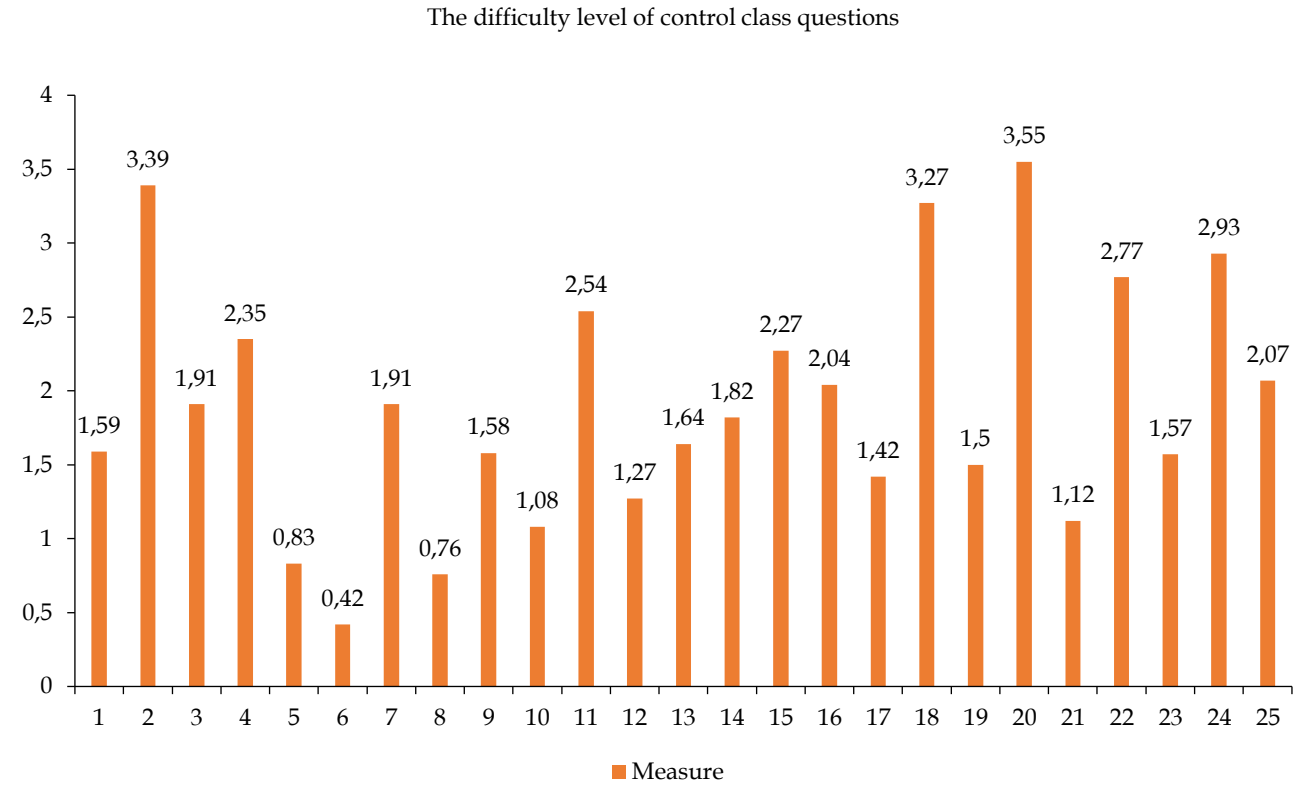

Figure 5. Changes in the difficulty level of questions in the control classes

The data on the difficulty level of the questions in the experimental and control classes showed a significant decrease. but with a different pattern. In the experimental class. 60% of the items experienced a decrease in difficulty. while in the control class. 84% of the items showed a decrease. This difference shows that

although the Treasure Hunt game based on Problem Based Learning (PBL) is challenging. this method has the potential to reduce the difficulty level of the questions for some students. Previous research implementing conventional learning models generally showed greater stability but without significant improvements in student comprehension. Data from this study highlights that PBL models can be more varied in their results. offering advantages for students who can adapt to a more interactive and contextual approach. The main difference from previous research is in the level of student engagement and motivation. This study reveals that treasure hunt games with PBL models can increase student engagement. although not all students are able to adapt quickly. This is in contrast to conventional methods which tend to be more static and less attractive. but provide higher stability in learning outcomes. These data point to the need for a more adaptive approach to the application of the PBL method. such as additional guidance for students with difficulties. to ensure that all students can get the maximum benefit from this method. These findings provide new insights into how more interactive learning methods can be applied effectively to improve students' science literacy.

The stacking data for the experimental and control classes showed a significant change in the students' science literacy ability after their respective treatments. In the experimental class. which uses the Problem Based Learning (PBL) model with a treasure hunt game strategy, there was a significant increase in posttest scores compared to the pretest. The average pretest score in the experimental class was -0.091 with a standard deviation of 0.52, while the average posttest score increased to 1.90 with a standard deviation of 0.33. This shows that the PBL method with treasure hunting game strategy is effective in improving students' science literacy skills. The decreasing standard deviation from pretest to posttest also indicates that the distribution of student scores has become more uniform. signaling an increase in more consistent understanding among students.

On the other hand, in the control class that used conventional learning methods. the average pretest score was -0.555 with a standard deviation of 0.398. while the average posttest score increased to 1.234 with a standard deviation of 0.210. Although there was an increase in posttest scores. this increase was not as large as that seen in the experimental class. The decreasing standard deviation also showed a more even increase in understanding among students. but the overall improvement was less significant compared to the experimental class. These findings indicate that the use of the PBL model with the treasure hunt game strategy has a greater impact on improving students' science literacy compared to conventional learning methods. PBL encourages students to actively engage in the learning process through real-life problem-solving, while treasure hunt games add an element of gamification that increases student motivation and engagement. These interactive activities not only make learning more engaging but also help students develop critical thinking and analytical skills. which are essential in science literacy. In the control class. the increase in posttest scores showed that conventional methods still had a positive effect on learning, but this effect was more limited.

Table 3. Experimental class data stacking

Person	Pretest		Posttest	
	Measure	S.E.	Measure	S.E.
1	-0.64	0.44	1.53	0.52
2	0.09	0.42	2.18	0.63
3	0.27	0.43	1.82	0.56
4	-0.09	0.42	2.18	0.63
5	-0.64	0.44	1.53	0.52
6	0.46	0.43	2.18	0.63
7	0.46	0.43	1.53	0.52
8	0.46	0.43	2.18	0.63
9	0.46	0.43	2.18	0.63
10	0.27	0.43	1.82	0.56
11	-0.64	0.44	1.53	0.52
12	0.64	0.44	2.65	0.75
13	-0.45	0.43	1.82	0.56
14	-0.45	0.43	1.82	0.56
15	-0.27	0.43	1.53	0.52
16	0.37	0.44	2.65	0.75
17	-0.27	0.43	1.82	0.56
18	-0.45	0.43	1.53	0.52
19	0.46	0.43	1.82	0.56
20	0.46	0.43	2.18	0.63
21	0.33	0.44	1.82	0.56
22	-0.09	0.42	1.82	0.56
23	-1.28	0.49	1.53	0.52
24	-1.05	0.47	1.53	0.52
25	0.09	0.42	1.82	0.56
26	0.27	0.43	2.18	0.63
27	-0.45	0.43	2.18	0.63
28	-1.05	0.47	1.53	0.52
29	0.09	0.42	2.18	0.63
Mean	-0.0910345		1.8989655	
S.D.	0.5243015		0.3280175	

Table 4. Control class data stacking

Person	Pretest		Posttest	
	Measure	S.E.	Measure	S.E.
1	-1.49	0.51	0.82	0.45
2	-0.26	0.42	1.25	0.48
3	-1.02	0.46	0.82	0.45
4	-0.26	0.42	1.25	0.48
5	-0.44	0.43	1.49	0.51
6	-0.26	0.42	1.25	0.48
7	-1.02	0.46	1.25	0.48
8	-0.44	0.43	1.49	0.51
9	-1.25	0.48	1.02	0.46
10	-1.25	0.48	0.82	0.45
11	-1.02	0.46	1.02	0.46
12	-1.02	0.46	1.02	0.46
13	-0.26	0.42	1.25	0.48
14	-0.26	0.42	1.25	0.48
15	-0.62	0.43	1.02	0.46
16	-0.09	0.42	1.49	0.51
17	-0.44	0.43	1.49	0.51
18	0.26	0.42	1.78	0.56
19	-0.26	0.42	1.25	0.48
20	-0.26	0.42	1.25	0.48
21	-0.44	0.43	1.25	0.48
22	-0.09	0.42	1.25	0.48
23	-0.44	0.43	1.25	0.48
24	-0.62	0.43	1.25	0.48
25	-0.62	0.43	1.25	0.48
26	-0.26	0.42	1.49	0.51
27	-0.44	0.43	1.25	0.48
28	-0.82	0.45	1.25	0.48
29	-0.44	0.43	1.25	0.48
30	-0.82	0.45	1.25	0.48
Mean	-0.555		1.234	
S.D.	0.3976493		0.2103584	

Conventional methods tend to be more static and less engaging. which can result in students not being fully motivated or engaged in the learning process (Maryana & Sukmawati, 2021; Wahjusaputri et al., 2022). It can also limit students' opportunities to develop critical and analytical thinking skills in depth. From an educational perspective. these findings emphasize the importance of adopting more interactive and problem-based learning methods such as PBL. especially with gamification strategies such as treasure hunt games. to improve students' science literacy. This method not only improves the understanding of science concepts but also motivates students to be more active and enthusiastic in learning.

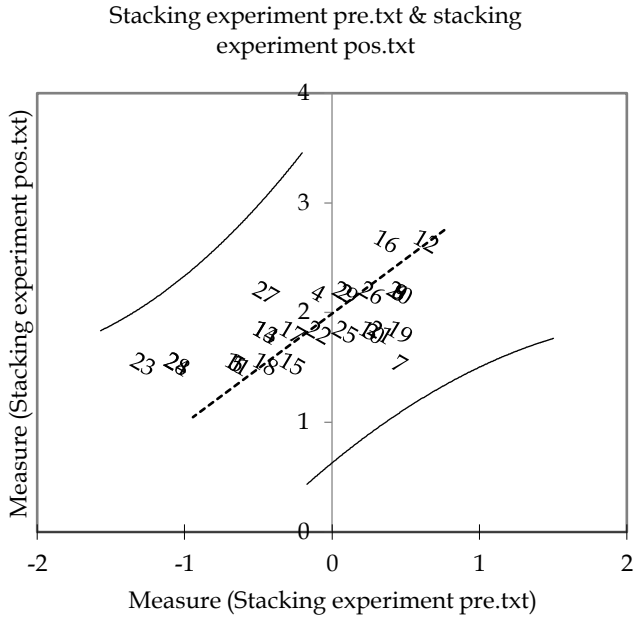

Figure 6. Changes in the literacy ability of students in the experimental classes

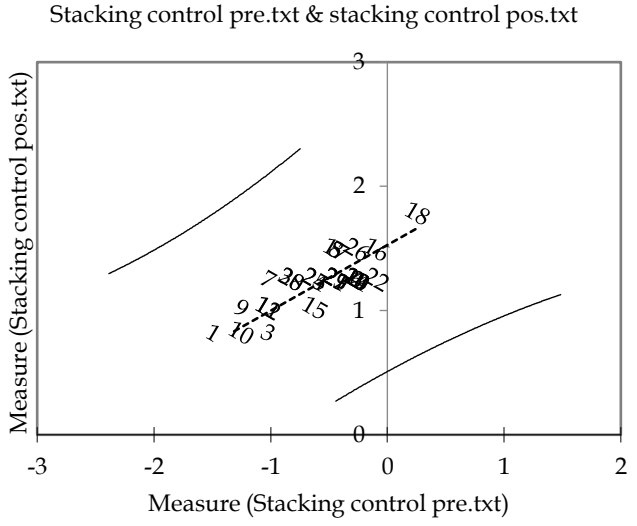

Figure 7. Changes in the literacy ability of students in the control classes

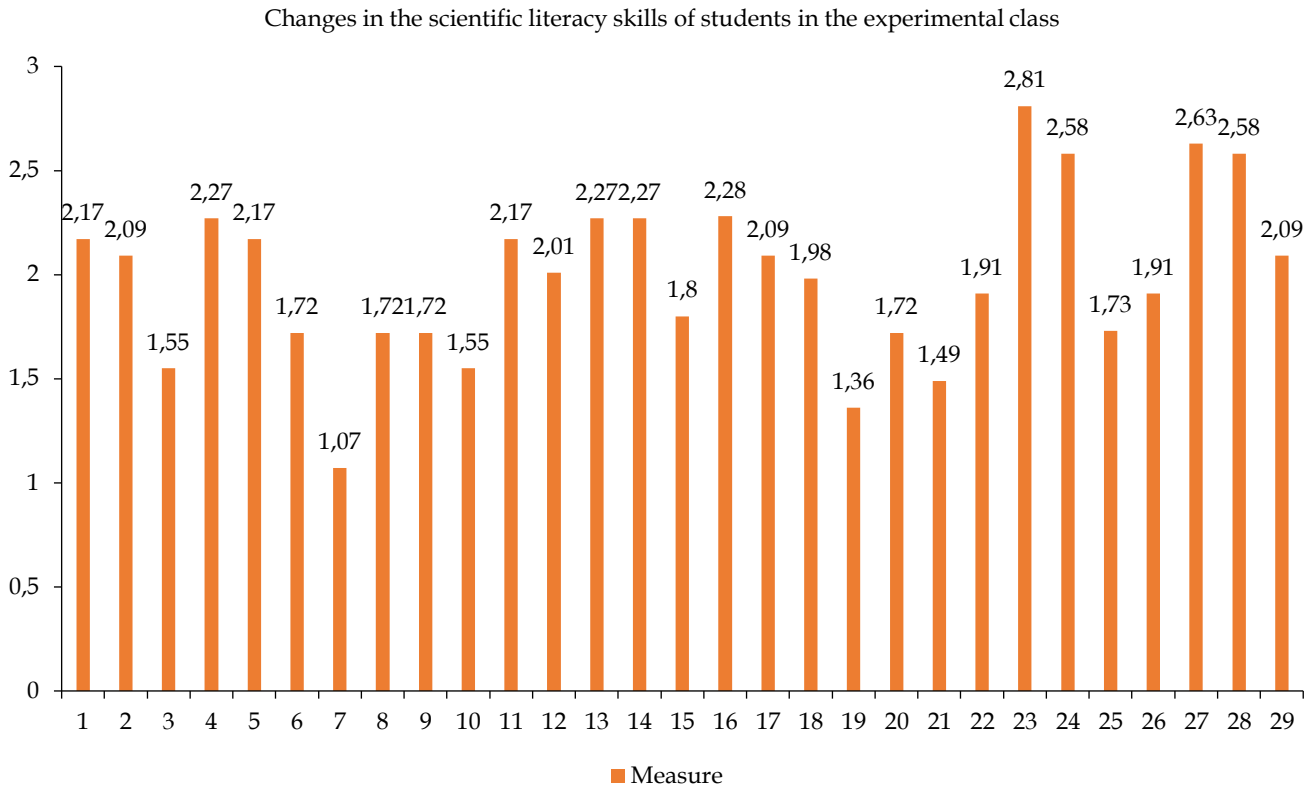

Figure 8. Improvement of science literacy skills in experimental classes

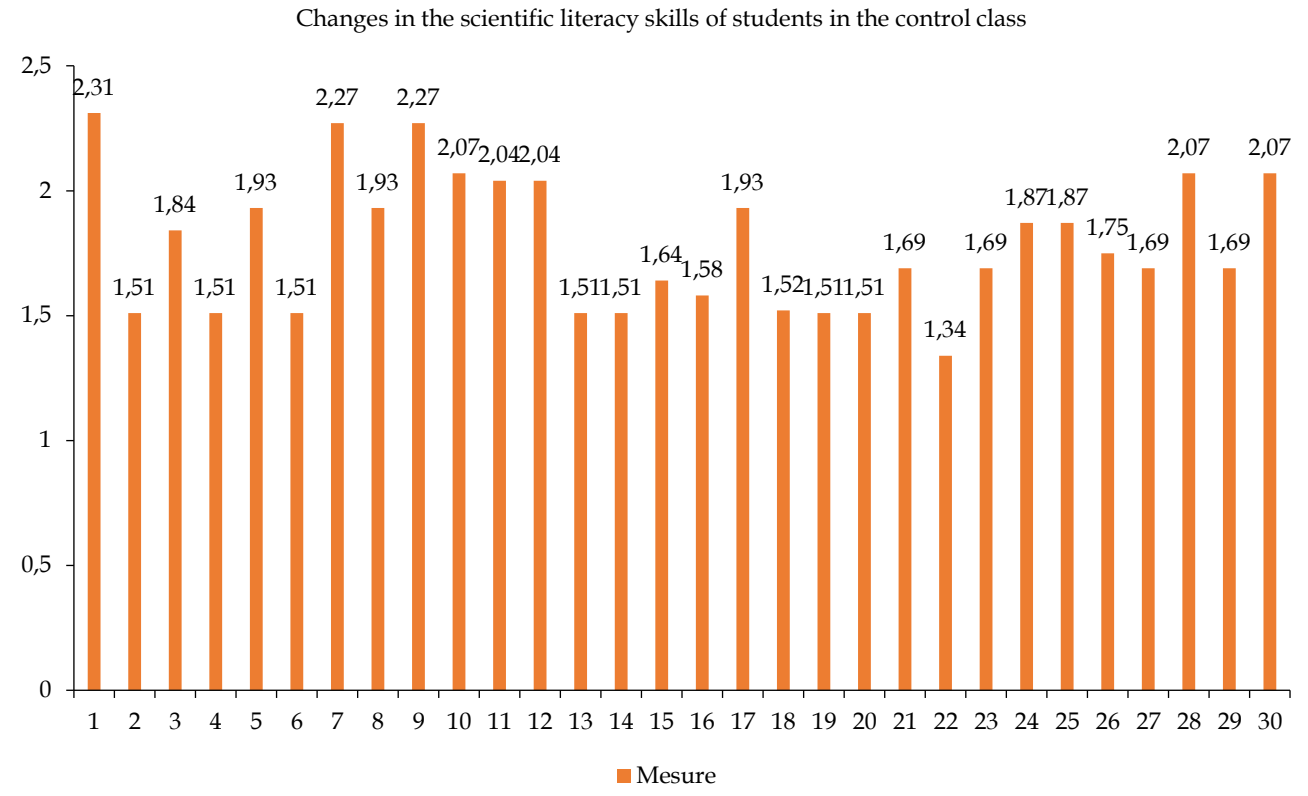

Figure 9. Improvement of science literacy skills in control classes

While conventional learning methods still have a place in education. there is a clear need for innovation and adaptation of methods that can be more effective in facing modern educational challenges and the needs of today's students. Thus, the application of PBL and treasure hunt game strategies has proven to be a more effective approach in improving science literacy skills (Aslan, 2021; Yew & Goh, 2016). It is relevant for educators and education policymakers to consider integrating these methods into the curriculum to maximize students' learning potential and ensure better and more equitable educational outcomes at all levels of education. For more clarity, see Figures 6 and 7.

Based on Figures 6 and 7, the experimental data did not show a significant difference between the experimental class that applied the Problem Based Learning (PBL) model and the treasure hunt game strategy and the control class that used conventional learning methods. several factors may explain this result. First. the limited sample size in this study may not be enough to detect significant differences between the two groups. In addition, the initial variation in students' abilities in each class and the duration and intensity of the intervention can also affect the final outcome. The quality of PBL implementation and treasure hunt game strategies can also be a determining factor, where the success of these methods is highly dependent on the teacher's understanding and skills in implementing them (Ismail et al., 2018). The influence of external factors such as learning environment conditions. parental support and the availability of additional resources also need to be considered. Nonetheless, follow-up research with larger samples and tighter control of external variables may be able to provide a deeper understanding of the difference in effectiveness between conventional and innovative learning methods in improving students' science literacy skills. For more clarity, can be seen in Figures 8 and 9.

Based on Figures 8 and 9, the improvement of science literacy skills in the experimental and control classes showed significant results, although the percentage difference between the two was not too large. The experimental class, which applied the Problem Based Learning (PBL) method with a treasure hunt game strategy, recorded an increase of 1.99 from the pretest score to the posttest score. On the other hand, the control class, which uses conventional learning methods, also recorded a fairly high increase of 1.789. Although the increase in posttest scores in the experimental class was higher than in the control class, the difference in the percentage increase of about 11.24% was not too large.

Figure 10. Experiment Class Activity

This shows that although the PBL method with the treasure hunt game strategy may provide additional advantages in improving science literacy skills. the conventional method is also able to provide quite significant results. Factors such as the quality of the implementation of the learning method, the interaction between teachers and students, and the conditions of the learning environment may affect these outcomes (Boye & Agyei, 2023; Seibert, 2021). In addition, students' initial abilities and the intensity of the intervention also need to be considered in evaluating learning outcomes. Nonetheless, keep in mind that a qualitative and more in-depth evaluation of the effectiveness of both methods is needed to gain a more holistic understanding. Although experimental classes show a relatively higher improvement, the potential and effectiveness of the learning method must be comprehensively assessed through various aspects, including student engagement, application of concepts, and application of knowledge in real-world contexts (Dring, 2019; Hamburg & Vladut, 2016).

Conclusion

This study evaluates the effectiveness of integrating the Problem Based Learning (PBL) model with a treasure hunt game strategy in enhancing students' scientific literacy skills. Using a quasi-experimental approach with a pretest-posttest control group design, the study involved an experimental class implementing the PBL model with the treasure hunt game strategy and a control class using conventional teaching methods. Scientific literacy tests administered before and after the intervention were analyzed using stacking and racking approaches based on the Rasch Model. Results showed that both groups demonstrated improved scientific literacy skills, with the experimental class exhibiting a

slightly higher average improvement of 1.99 compared to 1.80 in the control class. Despite an 11.24% difference in improvement, these findings suggest that the PBL method with the game strategy can offer additional benefits to science education. The discussion underscores the importance of method implementation, teacher-student interaction, and learning environment conditions in influencing educational outcomes. In conclusion, while the PBL method with the game strategy effectively enhances scientific literacy, a comprehensive educational approach remains essential for optimizing students' overall development.

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N.T.P contributed to the data collection process, data processing, and article writing. W.S contributed to the data processing and article writing.

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Conflicts of Interest
The authors declare no conflict of interest.

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