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Improving Energy Literacy Using the Problem Based Learning (PBL) Model for Elementary School Students in Grade VI

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ABSTRACT

Education has a strategic role in instilling energy saving awareness in students. Therefore, it is necessary to foster energy-saving awareness for students as early as possible. This study aims to improve the learning outcomes of students in class VI.A SDN 4 Palembang on Energy Literacy material through the application of the Problem Based Learning (PBL) learning model. This research used the Classroom Action Research method carried out in two cycles, involving 23 elementary school students. Data were collected through observation, tests, and documentation to evaluate the effectiveness of the application of the learning model. Each cycle includes planning, action implementation, observation and reflection to ensure continuous improvement. The data obtained were analyzed descriptively quantitatively. The results showed significant improvements in the understanding of energy literacy concepts, learning outcomes, and critical thinking skills of learners. They became more active, enthusiastic and showed deeper engagement in the learning process. In addition, learners also showed an increased ability to connect energy literacy concepts with everyday phenomena, making learning more relevant. This study concludes that the implementation of the PBL model can improve students'

energy literacy. The researcher recommends the use of PBL model as an alternative strategy to be applied in other classes, because it is proven to be able to encourage active, creative, and relevant learning. This strategy is expected to have a positive impact in improving the quality of education, especially at the elementary school level.

Keywords: *Energy Literacy; Problem-Based Learning; Elementary School*

ABSTRAK

Pendidikan memiliki peran strategis dalam menanamkan kesadaran hemat energi kepada peserta didik. Oleh karena itu perlu menumbuhkan kesadaran hemat energi bagi peserta didik sedini mungkin.. Penelitian ini bertujuan untuk meningkatkan hasil belajar peserta didik kelas VI.A SD Negeri 4 Palembang pada materi Literasi Energi melalui penerapan model pembelajaran Problem Based Learning (PBL). Penelitian 24 menggunakan metode Penelitian Tindakan Kelas (PTK) yang dilaksanakan dalam dua siklus, melibatkan 23 peserta didik sekolah dasar. Data dikumpulkan melalui observasi, tes, 24an dokumentasi untuk mengevaluasi efektivitas penera24an model pembelajaran tersebut. Data yang diperoleh dianalisis secara deskriptif kuantitatif. Setiap siklus mencakup perencanaan, pelaksanaan tindakan, observasi, dan refleksi guna memastikan perbaikan berkelanjutan. 24sil penelitian menunjukkan peningkatan signifikan dalam pemahaman konsep literasi energi, hasil belajar, serta kemampuan berpikir kritis peserta didik. Peserta didik menjadi lebih aktif, antusias, dan menunjukkan keterlibatan yang lebih mendalam dalam proses pembelajaran. Selain itu, peserta didik juga menunjukkan peningkatan kemampuan dalam menghubungkan konsep literasi energi dengan fenomena sehari-hari, sehingga pembelajaran terasa lebih relevan. Penelitian ini menyimpulkan bahwa penerapan model PBL dapat meningkatkan literasi energi peserta didik. Peneliti merekomendasikan penggunaan model PBL sebagai strategi alternatif untuk diterapkan di kelas lain, karena terbukti mampu mendorong pembelajaran aktif, kreatif, dan relevan. Strategi ini diharapkan memberikan dampak positif dalam meningkatkan kualitas pendidikan, khususnya di tingkat sekolah dasar.

Kata Kunci: Literasi energi; Problem-Based LearningL; Sekolah Dasar

INTRODUCTION

Education is an effort to optimize the development of learners' potential, skills, and individual characteristics. The educational process is focused on achieving goals that cover the cognitive, affective and psychomotor aspects of learners (Hattie., 2021). Through the learning context, education is expected to provide a positive influence as well as a fun learning experience. This is in line with science learning which aims to help students acquire attitudes, processes, and knowledge about natural and scientific phenomena (Nugraha, 2022; Nurfadilah & Cahyaningsih, 2024).

One of the important issues of concern in science learning is energy literacy, which is defined as the ability to understand the concept of energy, the impact of its use on the environment, and energy-saving actions in everyday life (Sopha & Kurniawan, 2023). Education has a strategic role in instilling energy-saving awareness to the younger generation. These energy-saving values can be instilled through energy literacy, which includes an understanding of energy, its impact on the environment, and skills to manage energy consumption efficiently (Dewi et al., 2021).

Based on initial observations in class VI.A SDN 4 Palembang, students' energy literacy is still relatively low. Previous studies have shown that energy literacy at the elementary school level is also still concerning. For example, research by (Prihanta et al., 2021) revealed that the level of understanding of elementary school students regarding the concept of energy, its impact on the environment, and energy-saving actions is still very limited. Similar research conducted by Trimariana and Santosa (2022) also noted low energy literacy among students

in various elementary schools, both in urban and rural areas, indicating their lack of understanding of efficient energy management. In addition, Chan and Lee (2023) found that many students still have difficulty understanding the relationship between energy and the environment, as well as a lack of awareness to implement energy-saving habits in everyday life. These findings reinforce the need for a more effective learning approach to improve energy literacy among elementary school students. This emphasizes the importance of a more effective learning approach to improve students' understanding and awareness of the importance of energy saving. Students actively engage in contextual learning that is relevant to everyday life. It is hoped that students can better understand the concept of energy and apply it in their daily habits (Ilham et al., 2024).

One of the learning models that can be applied to improve students' energy literacy is Problem-Based Learning (PBL). The Problem-Based Learning model is a learning model that exposes students to real-world problems to start learning and is one of the innovative learning models that can provide active learning conditions for students (Kurniawan et al., 2023). Through PBL, students are trained to analyze problems, think critically, and find creative solutions collaboratively. This model is expected to encourage learners to understand and apply the concept of energy saving in everyday life (Miterianifa & Mawarni., 2024)

PBL is a learning model that emphasizes learning through problem solving and critical thinking in a real context (Kusumawati et al., 2022; Saputri, 2020; Suswati, 2021). PBL is very effective in motivating learners to understand the concept of energy deeply while implementing energy-saving actions in the context of energy literacy. Through this approach, students are invited to learn directly from real problems, such as electricity waste at home or school. This makes learning more applicable and relevant to their daily lives.

The application of PBL in class VI.A SDN 4 Palembang aims to improve students' energy literacy. By presenting real-world problems as a learning stimulus, students are invited to think critically, creatively, and work together in solving problems (Ardianti et al., 2021). Through this learning process, it is hoped that students will not only understand the importance of energy saving but also practice it in everyday life as an effort to preserve the environment. Thus, this study aims to implement the Problem-Based Learning (PBL) model in science learning on electricity saving material to improve the energy literacy of students in class VI.A SDN 4 Palembang.

METHODS

Type and Design

This study used the Classroom Action Research (CAR) method to improve the energy literacy of students of class VI.A SDN 4 Palembang through the application of Problem-Based Learning (PBL). PTK was chosen because it involves teachers and students in a learning improvement cycle consisting of planning, implementation, observation, and reflection. Hopkins (2014) states that PTK is a reflective and systematic research that aims to help teachers improve students' energy literacy. PBL was used as an intervention strategy to strengthen learners' understanding of energy, especially electrical energy saving.

This study used a Classroom Action Research design with the Kurt Lewin model consisting of four stages in each cycle (Santosa & Hidayati, 2023). : (1) Planning: Teachers and

researchers developed a PBL-based learning plan related to electricity saving materials. This included the preparation of learning media, contextual problems, and evaluation instruments. (2) Action: Teachers implement the PBL learning process according to the plan that has been prepared.(3) Observation: Researchers and teachers observe during the learning process to see the extent of learner involvement, understanding, and attitude change related to energy literacy. (4) Reflection: Teachers and researchers reflect on the results of observations and learner tests, which are used as a basis for improvement in the next cycle.

Kurt Lewin model of classroom action research cycle

Figure 1. Cycle of classroom action research Kurt Lewin model

Based on Figure 1, there are four stages of classroom action research which include planning, implementation, observation, and reflection. Each cycle consists of similar activities, but is improved based on the results of reflection from the previous cycle.

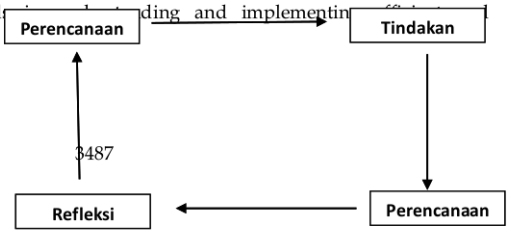
Data and Data Sources

The research was conducted at SDN 4 Palembang for one semester involving 23 students of class VI.A aged 11-12 years and the class teacher as a collaborator. Determination of research subjects was carried out using purposive sampling. The subjects were chosen because the learners had learned the basic concepts of energy in science lessons, so they were considered ready to develop energy literacy further. This study applied a collaborative approach between the researcher and the teacher to ensure the implementation of learning went according to the objectives.

Data collection technique

Research data were collected through several techniques, namely written tests, observation, questionnaires, and documentation. Written tests were used to measure learners' understanding before and after learning (pre-test and post-test). Observations were made to assess learners' involvement as well as the teacher's ability to implement learning. Questionnaires were used to identify changes in learners' attitudes towards energy literacy, while documentation in the form of field notes and learner worksheets (LKPD) were used to complement the data. The energy literacy instrument is designed to measure the energy-saving literacy skills of elementary school students. Energy-saving literacy refers to students' knowledge, awareness, and skills in understanding and implementing efficient and responsible actions in energy use.

Data analysis



Data analysis was carried out using quantitative and qualitative approaches. Quantitative analysis aims to measure the improvement of students' learning outcomes, with a success target of at least 75% of students achieving a complete score. Meanwhile, qualitative analysis was carried out to describe changes in students' attitudes, involvement, and behavior based on observation data and field notes. Reflection on the results of the analysis is used to develop an improvement plan for the next cycle so that the learning objectives are achieved optimally. The results of changes in students' attitudes and behavior in saving energy can be calculated using the appropriate formula as follows.

$$x = \frac{\sum X}{\sum N}$$

Description:

x = Average value
$\sum X$ = Sum of all learners' scores
$\sum N$ = Number of learners

RESULTS AND DISCUSSION

This research was conducted in class IV.A of SD Negeri 04 Palembang in the odd semester of the 2024/2025 school year with 23 students consisting of 8 male students and 15 female students who have heterogeneous abilities. This research was conducted in two cycles.

Learning process using Problem PBL to improve energy literacy

The learning process applied in this study uses the Problem-Based Learning (PBL) model which aims to improve the energy literacy of students in class VI.A SDN 4 Palembang. This PBL model emphasizes real-world problem solving that is relevant to the daily lives of learners (Aprilita & Handican, 2023; Lasminawati et al., 2023). In the context of energy literacy, learners are faced with various problems related to the efficient use of energy and its impact on the environment, such as energy waste at home or school. During the learning process, the teacher's ability to implement various aspects of learning was observed and evaluated in two different cycles. The documentation of cycle 1 and cycle 2 activities can be seen in the following figure.

Figure 2. Cycle 1 Activities

Figure 3. Cycle 2 Activities

The teacher's ability to carry out various aspects of learning in Cycle 1 and Cycle 2 includes the teacher's skills in conditioning the class, making apperceptions, conveying learning objectives, and closing learning. The data obtained showed an increase in most aspects observed from Cycle 1 to Cycle 2. The abilities are shown in table 1 below.

Table 1. Teacher Observation Table

Number	Statement	Cycle 1	Cycle 2
1	The teacher's ability to greet and condition the class	3	4
2	Apperception ability: Relate the material to the learners' initial experience	2,5	4
3	Conveying learning objectives and steps	3,5	4
4	Teacher's ability to raise problems	2	3
5	The teacher's ability to conduct questions and answers with students	3	3,5
6	Teacher's ability to explain terms contained in the material for students' understanding	3	4
7	Teacher's ability to distribute groups of learners	3,5	4
8	The teacher distributes the LKPD	4	4
9	Teacher's ability to guide students in solving problems on LKPD	3	3,5
10	The teacher's ability to encourage learners to present the results of problem solving and present them in front of the class.	2,5	4
11	The teacher's ability to greet and condition the class	3	4
12	Provide evaluation sheet	3,5	3,5
13	Reflect and deliver moral messages	3	4
14	Ability to close the lesson	4	4
	Total	**43,5**	**53,5**
	Average	**78,6**	**95,5**

From the table above, the results are then presented in the form of a bar graph showing changes in teacher observation results in cycle 1 and cycle 2 which are shown in Figure 2 below.

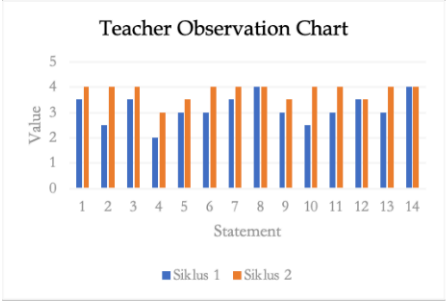


Figure 4. Teacher Observation Chart

The observation results showed an increase in the teacher's ability in learning cycle 1 with an average of 78.6 increased to 95.5 in Cycle 2. Significant increases were seen in the teacher's ability to apperceive, raise learner-centered problems, encourage students to present work in front of the class. Not only that, teachers also utilize educational game technology that can improve learning in cycle 2. This increase in teacher ability shows that the strategies applied are increasingly effective in managing the classroom and facilitating the learning process. This improvement also shows that teachers are increasingly able to create a dynamic, interactive, and learner-centered learning environment, which in turn improves learning outcomes. As explained by Nurillahwaty (2021), learner-centered learning with the appropriate use of technology can increase learner engagement and understanding. This is also in line with the opinion Maulana et al. (2023) which states that the use of technological media in the PBL learning model can make learning more interesting and enjoyable, so that it can increase students' motivation and learning outcomes. Not only that, the results of research conducted by Sumarsih et al. (2024) stated that the use of PBL models in the classroom can not only improve academic results but also increase the activeness of students in the classroom.

Furthermore, learner activities during the learning process in Cycle 1 and Cycle 2 were also carried out. These observations include various aspects of learner involvement, such as giving greetings, participating in apperception, working in groups, and concluding learning. According to Made Ika Priyanti and Nurhayati (2023), students' involvement in learning is strongly influenced by the approach used by the teacher. Learning that is active and fun will increase learner motivation and participation. Data showing a significant increase in learner engagement in almost all aspects measured from Cycle 1 to Cycle 2 can be seen in table 2 below.

Table 2. Learner Observation Results

Number	Statement	Cycle 1	Cycle 2
1	Learners greet and condition the class	4	4
2	Learners answer the teacher's questions when the teacher explores the learners' initial knowledge/perception.	2,5	3,5
3	Students pay attention to the media and ask questions about the media posted by the	2,5	3,5

	teacher in front of the class.		
4	Learners listen to the teacher's explanation of the terms for learners' understanding.	3	4
5	Learners form groups	3,5	4
6	Learners read the text that has been distributed by the teacher	2,5	4
7	Learners solve the problems contained in the LKPD.	2	3,5
8	Learners present the results of group work.	3	4
9	Learners listen to other groups' LKPD presentations in front of the class.	2,5	4
10	Learners summarize the learning that has been learned	2	3
11	Learners listen to reinforcement from the teacher	3	3,5
12	Learners work on the evaluation sheet	3	4
13	Learners listen to moral messages conveyed by the teacher	3,5	4
14	Learners answer the closing greeting	4	4
	Total	**41**	**53**
	Average	**73,2**	**94,6**

Based on table 2. above, then the results are presented in the form of a bar graph showing changes in student observation results in cycle 1 and cycle 2 which are shown in figure 3 below.

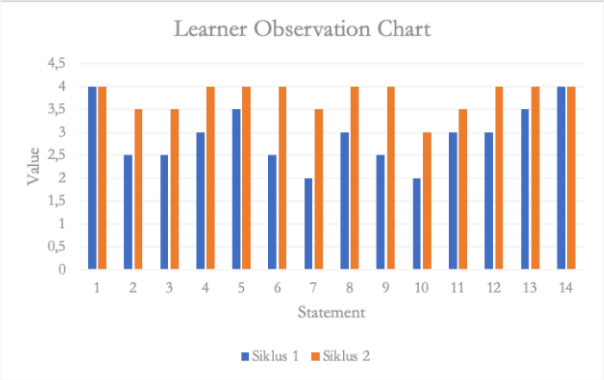


Figure 5. Learner Observation Chart

The table above illustrates the evaluation of learner performance during the two learning cycles conducted by the teacher. Each statement or activity carried out by learners is assessed with a certain number for each cycle. In Cycle 1, the total score obtained by learners was 41 with an average of 73.2, while in Cycle 2, the total score increased to 53 with an average of 94.6. This increase in score indicates a significant improvement in learners' engagement, understanding of the material, and their ability to follow the learning process. This change

could be due to various factors, such as more effective teaching methods in Cycle 2, increased learner motivation, or the application of learning techniques that are more suited to their needs. In line with the opinion of Andeka et al. (2021) and Pubian & Herpratiwi (2022), increased learner engagement is strongly influenced by the learning methods used by teachers. Learning that is more varied and activates learners can increase their motivation to be more involved in the learning process. The application of more dynamic learning strategies, such as group discussions, question and answer, and presentations, can also improve learners' interaction and understanding of the material being taught. For example, in Cycle 2, learners showed improvement in various activities, such as answering questions, paying attention to learning media, working in groups, and presenting group work results. This reflects that learners are more actively participating in learning after the first cycle.

Overall, the table shows that the learning made significant progress. Learners were not only more engaged in every learning activity, but also able to complete tasks better in Cycle 2. This improvement illustrates the teacher's success in improving teaching effectiveness from one cycle to the next. This shows that the implementation of learning that focuses on learners' needs can have a positive impact on the overall quality of learning.

Energy Literacy of Primary School Learners

Energy literacy in primary schools plays an important role in shaping learners' awareness of the importance of efficient and environmentally friendly energy management. Energy literacy can be effectively integrated through hands-on projects, such as learning that engages learners in discussions about energy sources (Schleser et al., 2023). Aspects of energy literacy assessment include knowledge, action and attitude. The following are the results of the learning implementation before cycle 1 and after cycle 2:

Table 3. Aspects of Energy Literacy

Number	Aspects of Energy Literacy	Pre Test	Post test
1	Knowledge	63,5	82,6
2	Action	78,7	94,8
3	Attitude	75,2	90,9

From table 3 above, the results are then presented in the form of a bar graph showing the change in results from the implementation before cycle 1 and after cycle 2 which is shown in figure 4 below.

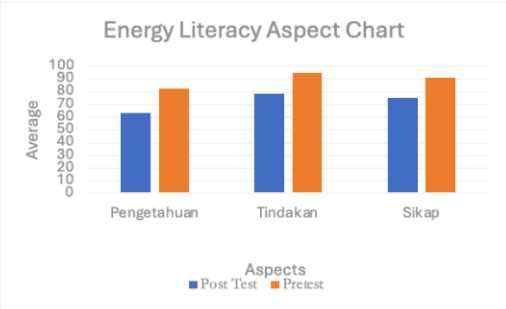


Figure 6. Energy Literacy Aspect Graph

Based on Figure 6 above, it shows an increase in students' energy literacy results based on 3 aspects including knowledge, actions, and attitudes before (pre-test) and after (post-test) learning. In the knowledge aspect, there was an increase from 63.5 in the pre-test to 82.6 in the post-test. This shows that learning has succeeded in improving students' understanding of concepts and information about energy. Knowledge about energy saving can have an impact on energy-saving behavior among young people (Corbos et al., 2023). In the action aspect, there was a significant increase, from 78.7 to 94.8. This increase shows a positive change in the behavior of students in applying energy knowledge in everyday life. Meanwhile, the attitude aspect also showed progress, from 75.2 in the pre-test to 90.9 in the post-test. This reflects positive changes in learners' views and awareness of the importance of energy and its wise use.

Overall, the increase in scores on all three aspects shows the success of learning in improving learners' energy literacy in terms of understanding, behavior, and attitude. The increase reflects that the Probleem Based Learning (PBL) learning model applied is able to have a positive impact on students' understanding of energy, including its concepts, benefits and management. According to Widayati and Khofifah (2022), PBL has been shown to improve various dimensions of critical thinking, including analytical, evaluative, interpretative, and reflective skills, with an average increase of 25% to 32% in these areas. This suggests that the designed learning not only captures learners' attention but is also effective in instilling a strong foundational knowledge of energy literacy. The description of each aspect is explained as follows.

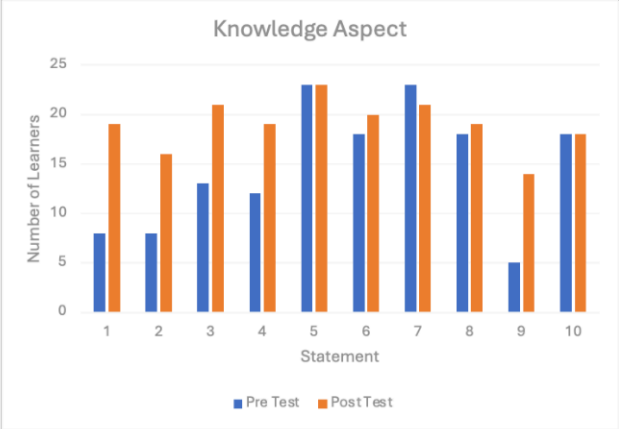


Figure 7. Knowledge Aspect Chart

Based on the graph above, it can be illustrated that the results of students' knowledge in the pretest 63% of students were declared complete. This is reflected in the results of students on the questions that are done still many are wrong. As in question No. 2 only 8 students answered correctly out of 23 students. Likewise, in question No. 3 only 8 students also answered correctly and question No. 9 also only 5 students answered correctly. This indicates that in pretest activities there are still many students who do not understand knowledge

about energy literacy. So that learning activities in cycles one and two teachers are more intense in providing learning about energy literacy itself. By using the PBL model in cycle 1 and adding educational media games in cycle 2, the post test results after cycle 2 were obtained: 83% of students who were declared complete.

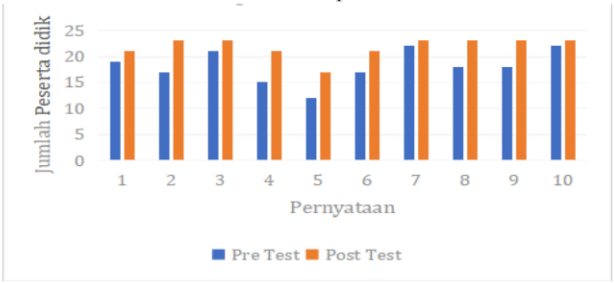


Figure 8. Action Aspect Chart

Based on the table above, the pre-test and post-test results in the table show an increase in scores for all students after the learning process. Learners' pre-test scores varied from 12 to 22, with the lowest score obtained by learner number 5 and the highest scores by learners number 7 and 10. After the learning, the post-test scores increased significantly, with most learners achieving the highest score of 23. The biggest increase was experienced by learners in question number 5 which increased from 12 to 17. Overall, these results show that the learning successfully improved learners' understanding significantly.

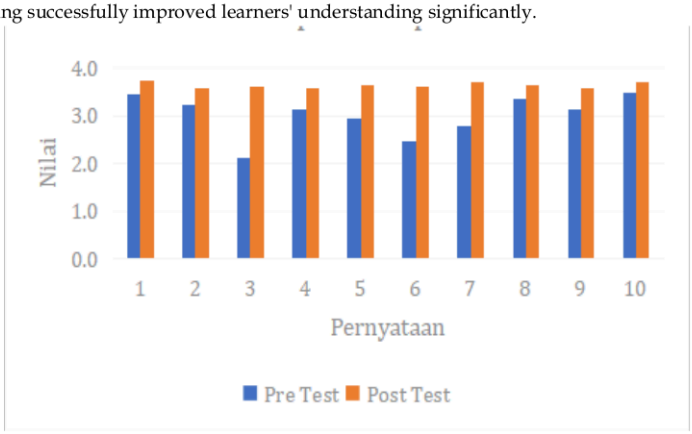


Figure 9. Attitude Chart

Table 3 shows the improvement of pre-test and post-test results on the 10 questions measured. The pre-test scores ranged from 2.1 to 3.5, with the lowest score on question number 3 and the highest score on question number 10. After the learning, the post-test scores improved, with scores ranging from 3.6 to 3.7. Most questions, including numbers 1, 5, 7, 8, and 10, achieved the highest score of 3.7. Question 3 showed the greatest improvement,

from 2.1 to 3.6. Overall, these results reflect a significant improvement in learners' understanding after the learning process.

Overall, the results of the analysis showed that the application of the PBL model successfully improved learners' energy literacy in terms of knowledge, attitudes and actions. The increase in scores in the pre-test and post-test shows that learners become more active, understand the concept of energy literacy better, and can apply the knowledge in daily life. This underlines the effectiveness of the PBL learning model in achieving the desired learning objectives. While in the second table which shows the results of the pre-test and post-test for the knowledge aspect, students reached an average pre-test score of 79 which increased to 95 in the post-test with the total score increasing from 181 to 218. It is proven that implementing problem-based learning (PBL) improves learner learning outcomes (Khotimah et al., 2019; Lumintang et al., 2023; Pristy & Sukartono, 2023), enhances critical thinking skills and problem-solving abilities (Suminar et al., 2024), empowers students to engage deeply with complex topics, including energy and environmental issues, through self-directed learning (Novita & Fitria, 2023) and collaborative environments (Alifatun Ni'mah et al., 2024).

Overall, the results of the analysis showed that the application of the PBL model successfully improved learners' energy literacy in terms of knowledge, attitudes and actions. The increase in scores in the pre-test and post-test shows that learners become more active, understand the concept of energy literacy better, and can apply this knowledge in everyday life. This underlines the effectiveness of the PBL learning model in achieving the desired learning objectives.

CONCLUSION

The classroom action research conducted aims to improve energy literacy through the Problem Based Learning (PBL) learning model. This research was carried out in several cycles with structured steps, starting from planning, implementation, observation, to reflection. The results showed a significant increase in students' understanding and learning outcomes after the application of the method. In addition, students were more active and involved in the learning process. Based on these findings, the researcher recommends using the method as an alternative learning strategy in other classes to improve the quality of learning and learners' learning outcomes. Future studies could explore the application of PBL in diverse educational contexts, such as different grade levels, schools with varying socio-economic backgrounds, or in subjects other than science, to further validate its effectiveness in promoting critical thinking and practical knowledge.

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