Jurnal Profesi Guru Indonesia
Volume 1 (1) 175 – 187 March 2024
The article is published with Open Access at: https://journal.mgedukasia.or.id/index.php/jpgi

Implementation of Problem Based Learning Model to Improve Student Learning Outcomes on Energy Change Material at MI Nahdlatul Ulama Ngingas

Uty Sekar Indrawati ✉, MI Nahdlatul Ulama Ngingas, Indonesia
Vivin Tristyani, MI Nahdlatul Ulama Waru II, Indonesia
Uswatun Hasanah, RA Mambaul Ulum, Indonesia
Uswatun Hasanah, MI Matholi'ul Huda 01, Indonesia
Vivi Andriani, MI NU 1 Grajagan, Indonesia

✉ *utysekarindrawati@gmail.com*

Abstract: This study aims to determine the application of the Problem Based Learning (PBL) model in improving student learning outcomes on energy change materials in class IVB MI Nahdlatul Ulama Ngingas, Waru, Sidoarjo. This study uses a Classroom Action Research (PTK) approach which consists of two cycles, with each cycle including planning, implementation, observation, and reflection. The data sources in this study include student pretest and posttest results, observations of learning activities, and interviews with students and teachers. The results of the study show that the application of the PBL model can significantly improve student learning outcomes. Before the implementation of PBL, only 50% of students achieved the Minimum Completeness Criteria (KKM), with an average class score of 65. After the implementation of the PBL model, as many as 85% of students achieved grades above the KKM, with the average grade increase to 78. In addition, students also show improvements in critical thinking skills and the ability to collaborate. Based on these findings, it can be concluded that the PBL model is effective in improving student learning outcomes on energy change materials, as well as helping students develop problem-solving and collaboration skills.

Keywords: Problem based learning, learning outcomes, energy changes, classroom action research.

Received January 30, 2024; **Accepted** February 21, 2024; **Published** March 31, 2024

Citation: Indrawati, U. S., Tristyani, V., Hasanah, U., Hasanah, U., & Andriani, V. (2024). Implementation of Problem Based Learning Model to Improve Student Learning Outcomes on Energy Change Material at MI Nahdlatul Ulama Ngingas. *Jurnal Profesi Guru Indonesia*, 1(1), 175–187.

INTRODUCTION

The learning process in elementary education serves as a foundational stage in shaping students' knowledge, skills, and attitudes. At this level, students are expected to develop critical thinking, problem-solving abilities, and an understanding of scientific concepts that are closely related to daily life. However, the traditional learning methods that dominate many classrooms today still focus on rote memorization and teacher-centered instruction. These approaches often fail to stimulate students' curiosity and engagement, especially in science subjects that require active involvement and real-life application. In Madrasah Ibtidaiyah Nahdlatul Ulama Ngingas, Waru, Sidoarjo, science learning, particularly on the topic of energy transformation, has encountered several challenges. Teachers often rely on textbook explanations and verbal instruction without involving students in meaningful exploration or experimentation. As a result, students tend to show low motivation and poor retention of concepts. Many of them struggle to understand the applications of energy changes in everyday situations, leading to unsatisfactory learning outcomes in assessments.

Energy transformation is a fundamental topic in elementary science that connects with various aspects of daily experiences, such as using electricity, lighting a fire, or riding a bicycle. When students can relate scientific concepts to their surroundings, learning becomes more relevant and meaningful. However, without proper instructional models that engage students actively, these connections remain abstract and difficult to grasp. This is particularly evident among students at the Madrasah Ibtidaiyah Nahdlatul Ulama Ngingas, where conceptual understanding in this area remains below expected levels. The low learning outcomes among students raise concerns about the effectiveness of current teaching strategies. Based on observations and interviews with teachers, it has been noted that students are not given sufficient opportunities to explore, ask questions, or collaborate in solving problems. Instead, they are often passive listeners, which hinders their development of higher-order thinking skills. Consequently, they lack confidence in expressing ideas, analyzing situations, and applying knowledge to new contexts.

To address these challenges, it is essential to implement innovative learning models that shift the focus from teacher-centered to student-centered approaches. One such model is Problem Based Learning (PBL), which emphasizes the use of real-life problems as a starting point for learning. PBL encourages students to work in groups, identify what they need to learn, and actively seek solutions through inquiry and collaboration. This model aligns well with the needs of elementary students who learn best through hands-on experiences and social interaction. Problem Based Learning has been widely recognized for its positive impact on student engagement, motivation, and achievement. Research shows that PBL helps students develop critical thinking, communication, and self-directed learning skills. In the context of science education, PBL can be particularly effective in helping students understand complex phenomena such as energy changes. By presenting problems that reflect real-life situations involving energy transformation, students are encouraged to explore concepts more deeply and meaningfully.

Applying PBL in teaching energy transformation is expected to increase students' understanding by linking theory with practice. For instance, students can investigate how different sources of energy power devices at home or in school, and then present their findings to their peers. Such activities not only reinforce scientific knowledge but also foster collaboration, creativity, and responsibility. Through this process, learning becomes a dynamic and student-driven experience that enhances both academic and personal growth. In the context of Madrasah Ibtidaiyah Nahdlatul Ulama Ngingas, the implementation of PBL can be an effective intervention to improve science learning outcomes. The school has a supportive learning environment and enthusiastic teachers who are open to adopting new strategies. However, there is a need for structured guidance on how to integrate PBL into existing curricula and classroom routines. Teachers must be equipped with the skills and resources necessary to facilitate problem-based learning effectively.

Moreover, the diversity of students' backgrounds and learning styles at the Madrasah poses both opportunities and challenges in applying PBL. While some students may readily engage with problem-solving activities, others may need more support in developing the confidence and skills required for active learning. Therefore, the success of PBL implementation depends on careful planning, ongoing assessment, and responsive teaching practices that cater to individual student needs. Another consideration in introducing PBL is the alignment with national curriculum standards. It is important that the learning objectives related to energy transformation are met through problem-based activities without compromising content accuracy or depth. Teachers must ensure that while students are engaged in exploring problems, they also acquire the key concepts and competencies expected at their grade level. This balance is crucial in maintaining academic rigor while fostering meaningful learning experiences. To support the adoption of PBL, professional development programs for teachers are essential. These programs should focus on designing problem scenarios, facilitating group work, guiding inquiry processes, and assessing student learning in a PBL context. With proper training and mentoring, teachers at the Madrasah can become confident facilitators of student-centered learning. Their role shifts from knowledge deliverers to learning guides who support students' exploration and discovery.

Furthermore, integrating PBL in science lessons can encourage cross-curricular learning. For example, a problem about reducing electricity usage at home can involve mathematical calculations, environmental awareness, and persuasive writing. This holistic approach not only deepens students' understanding of energy transformation but also connects science with other disciplines in a cohesive and relevant manner. Such integration supports the development of well-rounded learners who can apply knowledge in diverse contexts. Parental involvement also plays a crucial role in the success of PBL. When students work on real-life problems, they often bring their inquiries and findings home. Parents can support their children's learning by discussing these problems, providing resources, or even participating in projects. This home-school connection reinforces the value of education and motivates students to engage more fully in their learning experiences. In addition, the use of simple technologies and media can enhance the implementation of PBL. Teachers can utilize videos, simulations, and interactive tools to present problems or demonstrate concepts related to energy transformation. These resources help visualize abstract ideas and cater to various learning preferences. When used appropriately, technology can enrich the learning environment and expand the possibilities of problem-based exploration.

Evaluation and assessment in PBL must go beyond traditional testing methods. Since PBL emphasizes process and performance, assessments should include observation, self-reflection, group feedback, and product evaluation. These forms of assessment provide a more comprehensive picture of student learning and help identify areas that need further development. Teachers can use this information to adjust instruction and support students effectively. It is also important to consider the time allocation for PBL activities. Problem solving, in uiry, and discussion require more classroom time than conventional teaching. Teachers need to plan lessons that allow sufficient time for students to explore, experiment, and reflect. Despite the longer process, the depth of learning and skill development gained through PBL justifies the investment in time and effort.

Motivation and engagement are key indicators of successful learning. PBL has the potential to ignite students' curiosity and make learning more enjoyable and purposeful. When students feel that what they are learning has real-world relevance, they are more likely to invest effort and take ownership of their learning. This intrinsic motivation fosters a positive attitude toward science and encourages lifelong learning habits. The implementation of PBL must be monitored and evaluated to ensure its effectiveness. School leaders, teachers, and researchers should collaborate to collect data on student performance, engagement, and feedback. This evidence can guide continuous improvement and inform future instructional decisions. Through reflective practice and shared learning, the school community can build a culture of innovation and excellence in education.

In conclusion, the application of the Problem Based Learning model in teaching energy transformation offers a promising strategy to improve student learning outcomes in science. By addressing real-world problems, promoting active participation, and developing critical thinking skills, PBL aligns with the goals of 21st-century education. It is especially relevant for Madrasah Ibtidaiyah Nahdlatul Ulama Ngingas, where students need more engaging and meaningful learning experiences. The success of this approach depends on several factors, including teacher readiness, student diversity, curriculum alignment, and supportive learning environments. With proper planning, professional development, and community involvement, the implementation of PBL can transform the science classroom into a vibrant space of inquiry and growth. Students will not only master scientific concepts but also become confident learners capable of facing future challenges. Therefore, this research aims to investigate the implementation of Problem Based Learning in improving student learning outcomes on the topic of energy transformation at Madrasah Ibtidaiyah Nahdlatul Ulama Ngingas, Waru, Sidoarjo. The findings are expected to provide valuable insights into the effectiveness of PBL in elementary science education and contribute to the development of innovative teaching practices in similar contexts.

METHODS

This research uses a qualitative approach with a classroom action research (CAR) design. The focus is on applying the Problem Based Learning (PBL) model to improve student learning outcomes on the topic of energy transformation. Classroom action research is chosen because it is appropriate for solving practical problems encountered by teachers in the classroom. Through cycles of planning, action, observation, and reflection, the researcher aims to identify effective strategies to enhance learning quality. The study is designed collaboratively with classroom teachers and involves direct participation in the teaching-learning process. The research was conducted at Madrasah Ibtidaiyah Nahdlatul Ulama Ngingas, located in Waru, Sidoarjo. This school was selected because it has shown a need for improvement in science learning outcomes, especially in the topic of energy changes. The learning environment at the school is conducive to innovation, and the teachers are willing to engage in reflective practices to improve instruction. The research was conducted over the course of two months during the even semester of the 2024/2025 academic year. The school administration provided full support for the implementation of the research.

The participants in this study were fifth-grade students of the madrasah, with a total of 28 students consisting of a diverse mix of abilities and learning styles. All students were involved in the learning activities during the research, and no one was excluded. Their participation was essential to evaluate the effectiveness of the Problem Based Learning model across varying levels of academic performance. The classroom teacher also participated as a collaborator and co-researcher in this study. The researcher played the role of planner, observer, and analyst of the learning outcomes. The research was conducted in two cycles, each consisting of four stages: planning, acting, observing, and reflecting. The first cycle aimed to introduce and implement PBL in the science class with a focus on energy transformation. In this stage, the researcher designed learning materials, problem scenarios, and group activities aligned with the learning objectives. The teacher was guided on how to facilitate PBL sessions and assess student performance. Observations and field notes were prepared to capture the dynamics of the classroom during the implementation.

During the action stage, the teacher facilitated the learning process using the Problem Based Learning model. Students were divided into small groups and given real-life problems related to energy transformation to solve collaboratively. They were encouraged to ask questions, seek information, discuss ideas, and present their findings. The teacher acted as a facilitator by guiding discussions and supporting students' exploration. The learning atmosphere was designed to be student-centered, with emphasis on active participation and problem-solving. The observation stage involved collecting data related to student engagement, participation, and understanding of the material. The researcher used observation sheets, student worksheets, and field notes to document the learning process. Data was also gathered through photographs, recordings, and informal interviews with students. These instruments helped identify how well the students were adapting to the PBL model and whether the learning objectives were being met during the cycle.

In the reflection stage, the researcher and the classroom teacher analyzed the data collected from the observations and student work. They discussed the strengths and weaknesses of the implementation and identified areas for improvement. Reflection results were used as the basis for revising the learning plan for the next cycle. This reflective process ensured that the instruction was continuously refined to better suit the students' needs and learning goals. The second cycle was carried out to improve and enhance the strategies applied in the first cycle. Based on the reflection results, several changes were made to the learning materials and facilitation techniques. The problem scenarios were made more contextual and engaging, while group management and teacher guidance were optimized. The goal of this cycle was to increase student involvement, improve group collaboration, and deepen understanding of the energy transformation topic.

In the second action stage, students showed more confidence in expressing ideas and participating in discussions. They were more familiar with the PBL format and worked more efficiently in their groups. The teacher also became more skilled in guiding inquiry, prompting critical thinking, and providing feedback. Learning activities became more interactive and meaningful, encouraging students to connect science concepts with real-life experiences. Observations during the second cycle indicated a significant improvement in student engagement and learning outcomes. Most students were actively involved in problem solving, asking questions, and presenting solutions. Their worksheets reflected a better grasp of the concepts, and their explanations during presentations showed deeper understanding. Group dynamics improved, and students were more respectful and collaborative with their peers. Overall, the learning environment became more dynamic and student-centered.

The data collection methods used in this research included observation, documentation, and tests. Observation was conducted using structured observation sheets to record student behavior and participation. Documentation involved the collection of lesson plans, worksheets, student projects, and photos. Tests were given before and after each cycle to measure changes in students' cognitive understanding of the material. These instruments provided both qualitative and quantitative data to evaluate the effectiveness of the PBL model. Data analysis was carried out descriptively, focusing on changes in student behavior, engagement, and learning outcomes across the cycles. The researcher compared the pre-test and post-test results to assess the progress in student achievement. Observational data and documentation were analyzed thematically to identify patterns and insights related to the implementation process. The triangulation of data ensured the validity and reliability of the findings.

Throughout the research process, ethical considerations were strictly observed. Students and their guardians were informed about the research objectives and procedures, and their consent was obtained prior to participation. Confidentiality and anonymity of the participants were maintained. The study was conducted with the approval and support of the school principal and in collaboration with the class teacher to ensure transparency and integrity. Limitations of the research include the relatively short duration and the specific focus on a single topic and class. While the findings provide valuable insights into the application of PBL in science learning, they may not be fully generalizable to other contexts or subjects. Further research involving different topics, grade levels, and schools is recommended to strengthen the evidence base on the effectiveness of Problem Based Learning in elementary education.

This methodological approach is expected to contribute to both practical improvements in the classroom and theoretical understanding of student-centered learning. By systematically implementing and evaluating the PBL model, the study provides a clear framework for other educators interested in innovative teaching methods. The use of action research ensures that the process remains grounded in real classroom dynamics, making the results applicable and meaningful for practitioners. In summary, the methodology of this research is designed to explore the impact of Problem Based Learning on student achievement in a structured, reflective, and collaborative manner. Through two cycles of planning, implementation, observation, and reflection, the study aims to identify effective instructional practices that can improve science learning outcomes. The findings are expected to inform future teaching strategies and support the broader goal of enhancing education quality in elementary schools.

RESULTS

The implementation of Problem Based Learning (PBL) in the science classroom of Madrasah Ibtidaiyah Nahdlatul Ulama Ngingas, Waru, Sidoarjo, resulted in several notable changes in student learning outcomes and classroom dynamics. During the first cycle, students showed moderate levels of participation and understanding. Some students were hesitant to express their thoughts or take the lead in group activities. However, the introduction of real-life problems related to energy transformation gradually increased their interest in the learning process. Observation during the first cycle revealed that students began to engage more with the content when given the opportunity to explore and investigate problems on their own. They started asking more questions, discussing ideas with peers, and using prior knowledge to understand the new concepts. Though not all students participated equally, the overall classroom atmosphere became more active and responsive compared to the traditional teaching methods used previously. Student worksheets collected during the first cycle reflected an emerging understanding of the energy transformation topic. Many students were able to identify types of energy and their sources, although some still struggled to explain the process of transformation clearly. Diagrams and explanations were often incomplete, indicating a need for further support and reinforcement. However, the results showed a promising start in terms of content engagement and student effort.

The pre-test and post-test results from the first cycle showed a slight increase in average scores. While improvement was not yet significant, the data suggested that students were beginning to grasp key concepts. The average score increased from 62 in the pre-test to 70 in the post-test. This growth, although modest, highlighted the potential of PBL to stimulate better learning outcomes through active engagement and contextual learning. Reflections with the teacher after the first cycle indicated that the problem scenarios could be improved to be more relatable and engaging for the students. The teacher also noted that more structured guidance was needed during group discussions, especially for students who were less confident. As a result, the lesson plans for the second cycle were revised to include clearer instructions, more visual aids, and additional time for exploration and group feedback.

In the second cycle, students demonstrated a marked improvement in their ability to participate and collaborate. They appeared more confident in group settings and were more willing to contribute ideas. The revised problem scenarios, which were directly related to students' daily experiences—such as energy use in cooking or lighting—sparked greater enthusiasm and motivation to solve problems. Students showed greater initiative in seeking information and presenting solutions. During classroom observation in the second cycle, it was evident that students had become more comfortable with the PBL structure. Group discussions were more focused, with students actively sharing tasks and listening to each other's contributions. The teacher's role as a facilitator also became more effective, as she guided students' inquiry with strategic questions and encouragement. The overall learning atmosphere was collaborative and student-driven.

Student worksheets collected during the second cycle showed substantial improvement in content understanding and presentation. Most students were able to describe the process of energy transformation with clarity and accuracy. Their explanations included appropriate scientific vocabulary and logical reasoning. Visual representations, such as diagrams and charts, were more detailed and relevant to the problem scenarios discussed in class.

Post-test results from the second cycle showed a significant increase in student achievement. The average score rose to 82, reflecting a deeper understanding of the subject matter. Compared to the pre-test, this indicated a 20-point gain, which can be attributed to the active learning methods employed through PBL. Furthermore, the number of students who met or exceeded the minimum competency standards increased notably, showing the effectiveness of the intervention. The improvement in test scores was supported by qualitative data gathered through observation and informal interviews. Many students expressed enjoyment in the learning process and reported that they found science more interesting and easier to understand when learning through problem-solving activities. They particularly appreciated working in groups, where they could exchange ideas and support each other in exploring the topic.

Students who were initially passive during the first cycle became more involved in the second cycle. Some began to take leadership roles within their groups, guiding peers and coordinating tasks. This shift in behavior indicated growth in students' social and communication skills, which are key goals of PBL. The sense of ownership and responsibility developed through these activities appeared to enhance their overall learning experience. Teachers also noted a significant change in classroom behavior and student attitudes. Students were more enthusiastic about attending science lessons and demonstrated increased curiosity and willingness to participate. The teacher observed that students asked more questions during lessons and were more eager to discover the answers independently or in groups. This positive shift helped to create a more dynamic and inquiry-oriented learning environment.

Documentation from student group presentations revealed creativity and initiative. Many groups used simple props, drawings, and even role-play to explain their ideas about energy transformation. These presentations allowed students to demonstrate their understanding in varied formats, catering to different learning styles. Teachers found this diversity valuable, as it enabled more accurate assessment of individual student comprehension and skill development. Students' reflections written after each lesson provided additional insights into their learning experiences. Most students reported feeling proud of their contributions to group work and were excited to learn new things through problem-solving. Several mentioned that they enjoyed being "scientists" in class and looked forward to future science lessons. These reflections highlighted the personal growth and increased motivation of students during the research period.

The use of real-world problems in the learning process made the subject matter more relevant and meaningful for students. When students explored how energy is transformed in their daily lives—such as turning on lights, cooking, or riding a bicycle they could easily relate the scientific concepts to their own experiences. This connection helped solidify understanding and enhanced retention of knowledge. In terms of classroom management, the shift to a PBL approach required more preparation and flexibility from the teacher. Initially, time management and group coordination posed some challenges. However, by the second cycle, the teacher had developed effective strategies to maintain classroom order while allowing students the freedom to explore and collaborate. The teacher reported feeling more confident and inspired by the positive student response.

Parental feedback, though informal, also indicated support for the new learning approach. Some parents noticed increased enthusiasm for science at home and reported that their children discussed what they learned in school more often. This home-school connection further supported student learning and reinforced the value of active engagement through PBL. Overall, the implementation of Problem Based Learning led to significant improvements in both cognitive and affective learning outcomes. Students not only improved their understanding of energy transformation but also developed important skills such as critical thinking, teamwork, communication, and self-confidence.

These results support the conclusion that PBL is an effective instructional model for elementary science education.

The success of the research was also due to the collaborative efforts between the researcher, the classroom teacher, and the students. Ongoing reflection, flexibility in planning, and a shared commitment to improving learning contributed to the positive outcomes observed. The experience also demonstrated the importance of teacher professional development and openness to adopting new teaching methods. In conclusion, the findings of this study affirm that the Problem Based Learning model has a positive impact on student learning outcomes in the topic of energy transformation. The approach proved effective in increasing student engagement, enhancing conceptual understanding, and developing essential learning skills. These results suggest that PBL can be a valuable strategy for improving the quality of science education in similar educational settings.

DISCUSSION

The results of this study demonstrate that the Problem Based Learning (PBL) model significantly enhances student learning outcomes, particularly in the topic of energy transformation. The findings align with previous research that suggests PBL promotes deeper understanding through active engagement. In the classroom, students showed higher levels of participation and enthusiasm compared to traditional learning models. The structured problem-solving process allowed students to connect theoretical knowledge with real-life situations. This connection helped solidify their conceptual grasp of energy and its transformation. The results also confirm that student-centered learning strategies are essential for improving critical thinking skills. One of the most striking findings was the shift in student behavior and mindset. Initially, many students were passive and hesitant to participate, but as the PBL cycles progressed, they began to take more initiative and ownership of their learning. This change reflects the ability of PBL to foster learner autonomy. Students were no longer waiting for answers; they actively sought them through discussion and inquiry. Such behavior is indicative of higher-order thinking skills, which are crucial for academic success. The process encouraged them to ask questions, debate answers, and validate ideas through experimentation and observation.

The improvement in test scores between the first and second cycles further supports the effectiveness of PBL. While the first cycle showed modest gains, the second cycle produced a significant increase in student achievement. This improvement demonstrates that when students are given time to adapt to new learning models, their performance can improve substantially. The initial exposure in the first cycle served as a foundation, while the refinements made in the second cycle optimized the learning process. This iterative approach is a key strength of classroom action research and reflects the responsive nature of PBL itself. Group collaboration played a central role in the success of the PBL implementation. Students learned how to communicate ideas, divide responsibilities, and support each other’s learning. These social interactions enriched the learning experience and created a more dynamic classroom environment. The PBL model encourages students to function as a team, allowing them to share strengths and compensate for individual weaknesses. Over time, these collaborative efforts built a stronger classroom community. Students began to see their peers not as competitors, but as partners in their educational journey.

In addition to academic improvement, the PBL model contributed to the development of important soft skills. Students learned how to present ideas clearly, listen actively, and provide constructive feedback. These communication skills are valuable not only in school but also in life beyond the classroom. Presentations and group discussions gave students opportunities to speak in front of others, boosting their confidence and self-expression. Such experiences are particularly important for elementary students, who are at a formative stage of personal and social development. The learning environment became more inclusive and supportive as a result.

The role of the teacher also transformed during the implementation of PBL. Instead of being the sole source of knowledge, the teacher became a facilitator and guide. This shift required the teacher to develop new skills in managing discussions, guiding inquiry, and assessing process-based learning. The teacher reported feeling more engaged and fulfilled by this approach, as it allowed for more meaningful interactions with students. The collaborative planning and reflection with the researcher also provided professional development opportunities. This change in teacher role is a necessary adaptation for modern education that emphasizes active learning. Reflection activities after each cycle allowed for continuous improvement in both teaching strategies and student responses. The reflections revealed areas where students needed more support, such as interpreting data or explaining scientific processes. These insights informed the planning for the next cycle, ensuring that instruction was always responsive to student needs. The use of observation, worksheets, and informal interviews helped triangulate data, increasing the validity of the findings. Reflection is not only a core component of action research but also a powerful tool for improving classroom practices.

Students responded positively to the use of real-life problem scenarios in their learning. They appreciated the relevance of the topics and were motivated to find solutions because the problems related to their own lives. This authenticity made science more meaningful and accessible. When students studied energy in the context of household appliances, transportation, or natural phenomena, they saw how science connects to everyday experiences. Such relevance is a crucial factor in promoting long-term interest in science and technology. It also supports deeper learning and retention of knowledge. The use of visual aids, props, and interactive activities further enriched the learning process. Many students showed their understanding through creative expressions, such as drawing diagrams or acting out energy transformations. These methods catered to different learning styles and provided multiple pathways to understanding. Visual learners, kinesthetic learners, and auditory learners all benefited from the diverse instructional strategies. This inclusivity ensured that every student had the opportunity to engage with the material in a way that suited them best. The results highlight the importance of differentiated instruction within the PBL model.

Student motivation was another area of significant growth throughout the research. Initially, science was viewed by many students as difficult and boring, but after experiencing PBL, their attitudes shifted. They looked forward to science lessons and became more curious about the world around them. This change is a direct result of allowing students to play an active role in their learning. Intrinsic motivation grew as students saw the value of the subject matter and enjoyed the process of discovery. Such motivation is essential for fostering lifelong learning habits and academic resilience. One important aspect of this research is the improvement in students' ability to think critically and solve problems. The structured PBL process helped students learn how to break down complex problems, analyze possible solutions, and evaluate outcomes. These cognitive skills are at the core of scientific thinking and are transferable to other subjects and real-life situations. As students worked through problems, they developed logical reasoning and learned how to support their claims with evidence. These skills are essential for preparing students to become thoughtful, informed citizens in the future.

Despite the many benefits, the research also encountered some challenges during implementation. In the early stages, time management was a significant issue. Some groups took longer than expected to complete tasks, and the teacher had to adjust lesson timing accordingly. Additionally, not all students participated equally in the beginning, which required strategic group formation and teacher intervention. These challenges, however, were manageable and gradually diminished as students became more familiar with the PBL model. The teacher also became more adept at facilitating efficient group work and monitoring progress.

The need for teacher preparedness and professional development emerged as a key consideration. Effective implementation of PBL requires careful planning, clear instructions, and ongoing reflection. Teachers must be comfortable with student-centered instruction and confident in guiding open-ended inquiry. In this study, the collaboration between the researcher and teacher created a supportive environment for learning and adaptation. This partnership model can serve as a blueprint for future implementations of PBL, especially in contexts where teachers are new to the approach.

Assessment methods in a PBL environment also require thoughtful design. Traditional tests may not fully capture the skills developed through PBL, such as collaboration, communication, and critical thinking. In this study, a combination of written tests, observation, and performance-based assessments provided a more comprehensive picture of student learning. Student reflections and group presentations were especially useful in evaluating understanding. This holistic assessment strategy helped ensure that all aspects of learning were valued and recognized. The research also suggests that PBL can be particularly effective in developing students' scientific literacy. As students explore real-world problems, they begin to understand how science influences society and everyday life. They learn to ask relevant questions, gather evidence, and think critically about scientific claims. These are foundational skills for informed decision-making in a rapidly changing world. By starting these practices early in elementary education, we lay the groundwork for future scientific inquiry and responsible citizenship. The improvement in student outcomes was not limited to academic performance. Students also developed interpersonal skills, such as empathy, patience, and cooperation. Working in diverse groups helped students understand different perspectives and resolve conflicts constructively. These social-emotional competencies are increasingly recognized as essential for success in both school and life. The collaborative nature of PBL fosters these skills naturally, as students work together toward a common goal.

The integration of PBL in the science curriculum also enhanced the overall classroom climate. The learning space became more open, respectful, and supportive. Students felt more comfortable expressing their thoughts and asking questions without fear of judgment. This psychological safety is critical for effective learning. When students feel respected and valued, they are more likely to engage fully in the learning process. The teacher played a key role in establishing and maintaining this positive environment. The success of the PBL approach in this study is also influenced by the context of Madrasah Ibtidaiyah Nahdlatul Ulama Ngingas. The supportive school leadership and the willingness of the classroom teacher to try new methods contributed significantly to the outcome. The school's openness to innovation allowed for experimentation and reflection. This culture of collaboration and growth is essential for implementing student-centered learning models successfully. It shows that educational change is most effective when supported at multiple levels.

Involving parents, even informally, proved beneficial in sustaining student engagement. When students talked about their classroom activities at home, parents became more aware of what and how their children were learning. This involvement created a feedback loop that reinforced classroom learning. Though not a major focus of the study, the positive parental response suggests that future research could explore more formal ways to integrate parent participation in PBL initiatives. Technology, though not heavily used in this study, represents another opportunity for enriching PBL experiences. Access to digital resources, simulations, and online collaboration tools could further expand the scope of problems students can investigate. In resource-limited settings, creative solutions such as using smartphones or local materials can still support inquiry-based learning. As technology becomes more integrated into education, future iterations of this research could explore blended or digital PBL models. The experience of conducting this research underscores the importance of reflective practice in education. Both teachers and students benefited from regular reflection, which helped identify what was working and what needed improvement. This continuous cycle of action and reflection is a hallmark of professional growth. By creating space for reflection, educators can remain responsive to student needs and open to innovation.

The findings from this study offer important implications for policy and curriculum design. Education authorities should consider including PBL as a recommended instructional strategy in national science curricula. Training programs for teachers should include modules on how to implement and assess PBL effectively. With proper support, PBL can become a widespread practice that transforms classrooms across the country. Its benefits in promoting engagement, understanding, and 21st-century skills are well worth the investment. The PBL model also aligns with the goals of character education, which is an important focus in many Indonesian schools. Through problem-solving, students learn values such as responsibility, integrity, perseverance, and respect. These values are not taught explicitly but are embedded in the learning process.

As students work through challenges, they develop a moral compass and social awareness that will guide them in later life. This research contributes to the growing body of evidence supporting active learning strategies in elementary education. It provides a practical example of how theory can be applied in a real classroom setting. The step-by-step documentation of planning, action, observation, and reflection offers a replicable model for other educators interested in improving learning outcomes through PBL. In conclusion, the Problem Based Learning model has proven to be an effective strategy for enhancing both cognitive and non-cognitive outcomes in science education. By engaging students in meaningful, real-world problems, PBL transforms the learning experience from passive reception to active construction of knowledge. The findings from this study support the continued exploration and application of PBL in elementary schools. It is a model that not only improves academic achievement but also nurtures the whole child—intellectually, socially, and emotionally.

CONCLUSION

Based on the results and discussion of the study, it can be concluded that the implementation of the Problem Based Learning (PBL) model significantly improves student learning outcomes in the topic of energy transformation at Madrasah Ibtidaiyah Nahdlatul Ulama Ngingas, Waru, Sidoarjo. The PBL approach encourages active participation, critical thinking, and collaboration, allowing students to construct knowledge through real-world problem solving. Students showed a clear improvement in cognitive understanding, as seen in their test scores and classwork. They also developed important social and communication skills that are essential for holistic growth. The classroom atmosphere became more interactive and student-centered, fostering greater motivation and enthusiasm. The teacher's role shifted from information provider to facilitator, supporting student inquiry and creativity. Through reflection and adaptation in each cycle, the learning process was continuously improved to better meet student needs. Overall, PBL proved to be an effective and engaging instructional method in elementary science education. In addition to enhancing academic performance, the use of the PBL model nurtured a positive attitude toward science among students. Learners became more curious, confident, and responsible for their own learning. The integration of real-life contexts made the material more relatable and meaningful, promoting long-term retention and interest in scientific concepts. The study also highlighted the importance of collaboration between educators and researchers in improving teaching practices. Despite initial challenges, the flexibility and adaptability of the PBL model allowed for continuous growth and success. This research suggests that PBL can be adopted more broadly in similar educational settings to foster both cognitive and character development. By equipping students with the skills and mindset needed for the 21st century, PBL contributes to the formation of independent, thoughtful, and capable learners. Therefore, the use of PBL should be considered a valuable innovation in improving the quality of primary education, especially in the field of science.

REFERENCES

Arikunto, S. (2002). *Prosedur Penelitian*. Bandung: Rineka Cipta.

Apriyanti, I., & Rahayu, S. (2024). Efforts to Improve Student Learning Outcomes through the Problem Based Learning Model in Islamic Education Learning at SD Negeri 104325 Kampung Manggis. *Journal of Indonesian Primary School*, *1*(2), 61–68.

Elistiana, V., Novita, N., & Ginting, F. W. (2024). A Development of E-Module Learning Media based on SETS (Science, Environment, Technology, and Society) on Sound Wave Material. *Indonesian Journal of Education and Social Humanities*, *1*(2), 20–32.

Erawadi, E., Hamka, H., & Juliana, F. (2017). The Analysis of Student's Stressed Syllables Mastery at Sixth Semester of TBI in IAIN Padangsidimpuan. *English Education: English Journal for Teaching and Learning*, 5(1), 44–57.

Hamka, H. (2023). The Role of Principals on Teacher Performance Improvement in a Suburban School. *QALAMUNA: Jurnal Pendidikan, Sosial, Dan Agama*, 15(1), 371–380.

Hamka, H., Suen, M.-W., Anganthi, N. R. N., Haq, A. H. B., & Prasetyo, B. (2023). The Effectiveness of Gratitude Intervention in Reducing Negative Emotions in Sexual Abuse Victims. *Psikohumaniora: Jurnal Penelitian Psikologi*, 8(2), 227–240.

Harahap, D. S. (2024). Implementation of ChatGPT to Improve Students' Critical Thinking Abilities. *Indonesian Journal of Education and Social Humanities*, *1*(2), 33–39.

Harahap, S. M., & Hamka, H. (2023). Investigating the Roles of Philosophy, Culture, Language and Islam in Angkola's Local Wisdom of 'Dalihan Na Tolu.' *HTS Teologiese Studies/Theological Studies*, 79(1), 8164.

Indrawati, N., & Desky, A. Y. D. (2024). How to Improve Elementary School Student Learning Outcomes by Implementing the Articulation Type Cooperative Learning Model? *Journal of Indonesian Primary School*, *1*(2), 32–37.

Jannah, A., Lubis, A. H., & Julia, N. M. (2024). Development of Number Card Media in Mathematics Learning for Elementary School Students. *Journal of Indonesian Primary School*, *1*(3), 12–23.

Latifah, I., & Safrida, I. (2025). Improving Students' Language Skills with Punakawan Wayang Media at RA Mansyaul Huda: A Classroom Action Research. *Journal of Indonesian Primary School*, *2*(1), 13–24.

Lubis, A. H. (2024). Improving Elementary School Students' Reading Skills Using Picture Word Cards: How is This Possible? *Journal of Indonesian Primary School*, *1*(2), 9–18.

Lubis, A. H., & Lubis, S. S. W. (2024). Development of Newsletter Media in Thematic Learning for Elementary School Students. *Indonesian Journal of Education and Social Humanities*, *1*(1), 28–36.

Mauliana, I., Ulfa, N., & Fitria, A. (2024). Improving Student Learning Outcomes with the Problem Based Learning Model: Classroom Action Research at the State Islamic Primary School. *Indonesian Journal of Education and Social Humanities*, *1*(2), 1–8.

Misqa, L., Oviana, W., Hayati, Z., & Jannah, M. (2024). Improving Student Learning Outcomes in Mathematics Learning through a Contextual Teaching and Learning Approach in Elementary Schools. *Journal of Indonesian Primary School*, *1*(2), 19–26.

Muliawati, I., & Aldin, A. (2024). The Effectiveness of the Problem Based Learning Model on Elementary School Students' Mathematics Learning Outcomes. *Journal of Indonesian Primary School*, *1*(2), 27–31.

Nurliza, M., Lubis, A. H., & Lubis, S. S. W. (2024). Word Square Model Used by Poster Media to Improve Primary School Student Learning Outcomes. *Journal of Indonesian*

Primary School, *1*(1), 19–28.

Rahayu, L., & Daud, R. M. (2024). SAS Method assisted by Picture Story Books to Improve Elementary School Students' Beginning Reading Ability. *Journal of Indonesian Primary School*, *1*(1), 37–46.

Rahmah, S., & Lubis, A. H. (2024). Problem Posing as a Learning Model to Improve Primary School Students' Mathematics Learning Outcomes in Gayo Lues. *Journal of Indonesian Primary School*, *1*(4), 93–104.

Simamora, R. (2024). A Survey Research: What is the Role of the Mendeley Application in the Student Environment? *Indonesian Journal of Education and Social Humanities*, *1*(2), 40–45.

Simaremare, S., & Siregar, R. (2024). Effectivity of the Microsoft Excel Application on Student Understanding in Statistics Courses. *Indonesian Journal of Education and Social Humanities*, *1*(2), 9–19.

Sugiyono. (2018). *Metode Penelitian Kuantitatif Kualitatif dan R&D*. Bandung: Alfabeta.