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Problem-Based Learning to Enhance Environmental Awareness and Collaboration Among Elementary School Students

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ABSTRACT

Environmental issues have become a growing global concern, making it essential to instill environmental awareness and collaboration skills in students from an early age. However, preliminary observations in several elementary schools in Kalimanah District, Purbalingga, revealed that science and social studies learning (IPAS) is still dominated by lecture-based methods, resulting in low student engagement, limited environmental awareness, and underdeveloped collaboration skills. This study aimed to investigate the effect of the Problem-Based Learning (PBL) model on environmental awareness and collaboration skills among fourth-grade elementary school students. The research employed a quantitative approach involving 60 fourth-grade students in Kalimanah District, Purbalingga, divided into an experimental group (PBL) and a control group (expository learning). Data were collected through environmental awareness questionnaires and collaboration skills observation sheets and analyzed using inferential statistics, including independent-sample t-tests and correlation analysis. The findings showed that the experimental group demonstrated significantly higher environmental awareness and improved collaboration skills compared to the control group. All indicators of environmental awareness—such as maintaining classroom and school cleanliness, caring for plants, supporting green programs, managing organic and non-organic waste, and maintaining sanitation facilities—improved substantially under the PBL model. Furthermore, active group interaction during PBL activities facilitated the development of collaboration skills, including shared responsibility, communication, and joint problem-solving. These results indicate that PBL effectively enhances students' environmental attitudes and collaborative competencies through hands-on, contextualized, and meaningful learning experiences, offering both theoretical and practical implications for elementary science and social studies education.

INTRODUCTION

Education refers to the process of acquiring knowledge and learning that occurs throughout life in various places and situations, which positively influences individual development. A quality education not only prepares students to understand science but also shapes character and fosters awareness of global issues relevant to their lives. One increasingly urgent issue is environmental awareness. The younger generation, as the nation's successors, needs to be equipped with a deep understanding of the importance of environmental preservation to ensure sustainable living (Pristiwanti et al., 2022).

Nowadays, environmental issues are increasingly becoming a public concern. Problems such as air, soil, and water pollution, as well as extreme climate change, pose serious threats to human survival and other living organisms. Many of these issues stem from human activities that neglect ecosystem sustainability, such as illegal logging, the use of harmful chemicals, and improper waste disposal. If concrete action is not taken immediately, the Earth's condition, which is already approaching a critical point, will worsen. Therefore, it is essential to educate the younger generation about the negative impacts of environmentally harmful behavior (Ajaps & McLellan, 2015; Gupta et al., 2024). This can begin with providing a deep understanding of waste management and proper disposal habits. Such awareness can be instilled early through IPAS learning in schools, where students are taught not only about environmental damage but also about simple actions they can take to maintain ecological balance (Novianti, 2021).

This requires optimizing the role of education that emphasizes environmental conditions, while also developing students' knowledge, skills, and values to shape environmental care attitudes in both their present and future lives (Khoerunisa, 2024).

In elementary schools, students study several subjects, one of which is science. The implementation of the Independent Curriculum has merged science and social studies into Natural and Social Sciences (IPAS). IPAS integrates scientific and social concepts and is closely related to the surrounding environment (Alwi et al., 2024). IPAS learning at the elementary school level plays an important role in developing students' logical thinking and understanding of natural phenomena. Through formal education, environmental awareness can be instilled in children from an early age. Environmental concern is essential for school-age children so that it becomes part of their character development and daily behavior (Santika et al., 2022).

Initial interviews conducted in several elementary schools in Purbalingga, particularly in Kalimanah District, indicated that IPAS learning is still dominated by lecture-based instruction and assignments. This approach tends to make students passive and less motivated, thereby limiting the development of collaboration skills and environmental awareness. As a result, students' environmental understanding and collaborative abilities remain superficial, uncontextualized, and difficult to apply in daily life. In addition, learning strategies significantly influence the success of environmental education in IPAS. Project-Based Learning, for example, can engage students in real-life activities such as waste management, greening, and water conservation (Utami, 2025). Problem-Based Learning (PBL) in IPAS can also develop collaboration skills, problem-solving abilities, and ecological awareness. Through practice-oriented activities, students not only understand environmental concepts but also contribute directly to environmental preservation (Lestari, 2024).

To address this issue, a learning model that encourages active student participation and supports the development of these competencies is needed. One appropriate model is Problem-Based Learning (PBL). In the PBL process, students are presented with problems, identify what is known and what needs to be learned, formulate hypotheses, conduct individual and group investigations (including data collection, analysis, and synthesis), and finally present solutions and evaluate the problem-solving process (Aisyah & Gumala, 2025). Through these stages, students analyze information, evaluate solution alternatives, and make data-based

decisions. Both individual and group processes encourage critical thinking, data processing, and collaborative learning.

Although previous studies have examined Problem-Based Learning in various educational contexts, research focusing specifically on the simultaneous development of environmental awareness and collaboration skills in elementary school students remains limited. Moreover, most studies have been conducted in different regions and do not reflect the specific characteristics of schools in Kalimanah District, Purbalingga. The novelty of this study lies in its integrated analysis of environmental awareness and collaboration skills as interconnected competencies rather than separate variables. In addition, this research addresses a contextual gap in the implementation of PBL within IPAS learning at the elementary level in Purbalingga, which has distinct geographical and socio-cultural characteristics.

This study aims to investigate the effect of the Problem-Based Learning model on environmental awareness and collaboration skills among fourth-grade elementary school students, including analyzing its influence compared to expository learning, examining its effect on collaboration skills, and determining the relationship between environmental awareness and collaboration skills in PBL learning. The study offers both theoretical and practical benefits. Theoretically, it contributes to the field of elementary education by providing empirical evidence on the effectiveness of PBL in developing environmental awareness and collaboration skills simultaneously. Practically, it provides insights for teachers, school administrators, and curriculum developers in designing more effective and engaging learning strategies. For teachers, it offers an alternative instructional approach to address low environmental awareness and collaboration in IPAS learning. For schools, it serves as a reference for policy development aligned with the Pancasila Student Profile. Overall, the findings are expected to improve the quality of elementary education in developing students' character and preparing them for future environmental challenges.

Based on this description, the study entitled "Problem-Based Learning to Enhance Environmental Awareness and Collaboration Among Elementary School Students" is proposed. Accordingly, the Problem-Based Learning (PBL) model is expected to serve as an effective solution for improving environmental awareness and collaboration among elementary school students.

METHOD

Research Design

This research employed a quantitative approach to examine the effect of the Problem-Based Learning model on elementary school students' environmental awareness and collaboration skills in environmental learning materials. The quantitative approach was used because it enabled the collection of numerical data and their analysis using statistical methods.

Population and Research Subjects

1. Populasi

   The population in this study is all fourth grade students of Kalimanah District School, Purbalingga Regency in the 2025/2026 school year. The selection of this population is based on the consideration that students at the grade level are in a phase of cognitive

development that allows them to engage in Problem Based Learning (PBL) activities and have materials appropriate for environmental concern and collaboration.

2. Sample
   Given the limited scope of the research, not all members of the population will be involved. Therefore, the researcher used the sample as a representative of the population. The sampling technique that will be used is Cluster Random Sampling.

Research Location and Time

1. Research Location
   The research was carried out at the Kalimanah District State Elementary School, Purbalingga Regency.
2. Research Time
   The research was carried out in the odd semester of the 2025/2026 school year, which is from September to December 2025, including the preparation stage, product development, trials, and data analysis.

Research Variables and Operational Definitions

1. Independent Variables
   The Independent Variable (Independent Variable) in this study is the Application of the Problem Based Learning (PBL) Model. This variable is a treatment or intervention that will be given to the experimental group. PBL will be manipulated by researchers through the application of syntax or planned and systematic learning steps, ranging from problem orientation to evaluation of the problem-solving process, as an effort to see its influence on student learning outcomes.
2. Dependent Variable
   Meanwhile, Dependent Variables (Bound Variables) are aspects that are expected to undergo changes or increases as a result of the treatment of independent variables. In this study, there are two dependent variables, namely:
   a. Environmental Concern: This variable refers to a student's awareness and attitude towards the surrounding environment, including the ability to identify environmental problems and seek solutions.
   b. Collaboration: This variable refers to the student's ability to work together with others to achieve Common goals, including the ability to communicate and make decisions.

   To ensure that the changes that occur in dependent variables are really caused by the application of the Problem Based Learning (PBL) model, not by other factors outside the treatment, several variables will be tried to be controlled. For example, the students' initial ability (measured through the pre-test), the same science learning material for both groups.

RESULTS AND DISCUSSION

This research was carried out at SD Negeri Kalimanah District, Purbalingga Regency by involving 60 grade IV students who were divided into two groups, namely the experimental class and the control class of 30 students each. The experimental class used the Problem Based Learning (PBL) model while the control class used the expository learning model. Measurements were taken at the second meeting posttest and the third meeting posttest to see the learning progress of both groups. Data was collected through environmental awareness

questionnaires and collaboration observation sheets that have been validated by experts. Data analysis was carried out using parametric statistical tests preceded by analysis prerequisite tests including normality tests and homogeneity tests.

First Hypothesis: The Influence of the Problem Based Learning Model on Students' Environmental Concern

The first hypothesis in this study states that there is a positive influence of the application of the Problem Based Learning model on the environmental concern of elementary school students. Environmental concern is the attitude and behavior of students that show attention, concern, and responsibility for environmental sustainability. This variable was measured using a questionnaire consisting of 20 statement items that measured five main indicators, namely knowledge about the environment, environmental awareness, attitude towards the environment, participation skills, and environmentally friendly behavior. To test this hypothesis, a series of statistical tests were carried out which included analysis prerequisites and hypothesis tests.

Analysis Per Environmental Concern Indicator

To provide a deeper and more comprehensive understanding of the influence of the Problem Based Learning model on students' environmental concerns, the researcher analyzed each environmental concern indicator separately. The variables of environmental concern in this study consisted of five main indicators, namely: (1) maintaining the school and classroom environment, (2) maintaining plants well, (3) supporting the go green program, (4) managing organic and non-organic waste, and (5) maintaining the cleanliness of sanitation facilities. Each indicator was analyzed in detail to see the extent to which the Problem Based Learning model affected specific aspects of environmental concerns. This analysis per indicator is important because it allows researchers to identify the strengths and weaknesses of the PBL model in developing various dimensions of environmental concern, as well as provide more specific recommendations for further learning development.

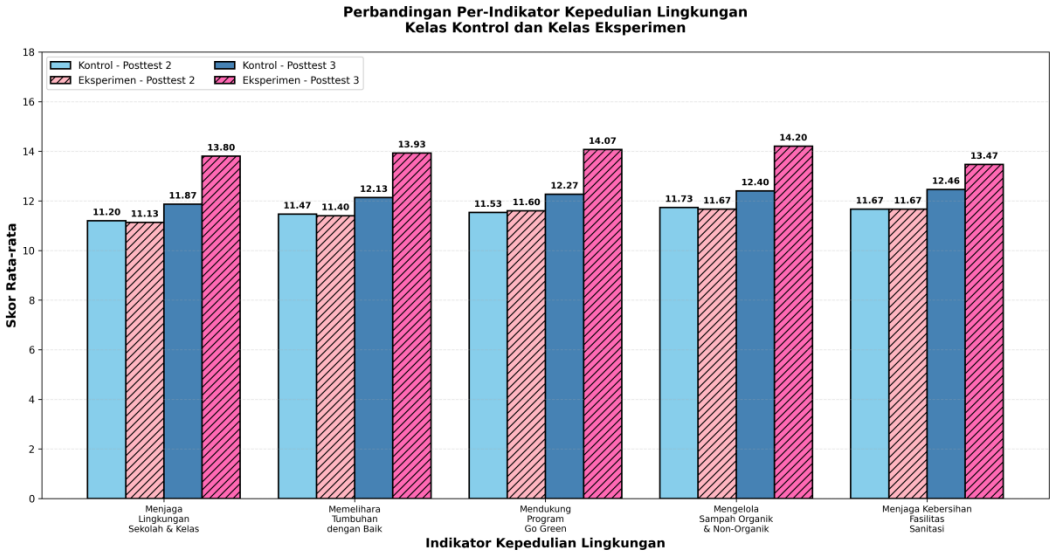

Figure 1. Comparison Per Indicator of Environmental Concern Control Class and Experimental Class

Source: Research data processed by researchers, 2025

Based on Figure 1, a comprehensive comparison of the five environmental concern indicators between the control class and the experimental class can be seen at two measurement times (the second meeting posttest and the third meeting posttest). The bar graph shows that in the initial condition (posttest of the second meeting), all five indicators had relatively equal scores between the control class and the experimental class, indicating that both groups departed from the same condition before receiving different treatments. However, in the final measurement (posttest of the third meeting), a consistent pattern was seen where the experimental class using the PBL model showed a much more substantial improvement than the control class on all indicators. This improvement includes aspects of maintaining the school and classroom environment, maintaining plants, supporting the go green program, managing waste, and maintaining the cleanliness of sanitation facilities.

Indicator 1: Maintaining the School and Class Environment

The indicator of maintaining the school and classroom environment measures students' behavior and habits in maintaining the cleanliness, neatness, and comfort of their learning environment. This indicator covers various aspects such as not littering in classrooms and school yards, maintaining the cleanliness of desks and chairs, maintaining classroom facilities such as whiteboards and cabinets, participating in class pickets regularly and responsibly, and actively participating in community service activities to clean the school environment. Protecting the school and classroom environment is an early manifestation of environmental concern because it starts from the student's immediate environment, and becomes the foundation for broader environmental concern.

Based on the diagram, in the second meeting posttest, the average score of maintaining the school and classroom environment in the control class was 11.20 and the experimental class was 11.13, showing an equal initial condition and not significantly different. In the third meeting posttest, the control class increased to 11.87 with an increase of 0.67 points (5.98%), while the experimental class experienced a much more significant increase to 13.80 with an increase of 2.67 points (23.99%). The difference in improvement between the two groups reached 2.00 points, which shows that the Problem Based Learning model is very effective in improving student behavior in maintaining the school and classroom environment. PBL's success in improving these indicators can be explained through learning experiences that encourage students to identify hygiene and neatness issues in their own classroom and school environments. In PBL learning, students are not only told about the importance of maintaining cleanliness, but they experience firsthand the impact of a poorly maintained environment and then devise solutions to overcome it. For example, when students observe dirty and messy classroom conditions, they discuss their impact on learning comfort, health, and school image, then design a more effective picket system, create reminder posters to maintain cleanliness, or even create classroom rules that govern the responsibility of maintaining cleanliness. This experience makes students feel a sense of ownership of their classroom and school environment, so they are motivated to take better care of it.

Indicator 2: Taking Good Care of Plants

The indicator of maintaining plants well measures students' concern and responsibility for plants and plants in the school environment. These indicators include activities such as regularly watering plants, cleaning pots and the area around plants from garbage and weeds, not damaging or picking plants carelessly, participating in tree or ornamental plant planting

activities, and caring for classroom gardens or school gardens with great attention. Taking good care of plants is an important aspect of caring for the environment because it teaches students about the responsibility of caring for other living things, understanding the life cycle, and appreciating the role of plants in maintaining ecosystem balance.

Based on the diagram, in the posttest of the second meeting, the average value of maintaining plants well in the control class was 11.47 and the experimental class was 11.40, indicating relatively equivalent initial conditions. In the third meeting posttest, the control class increased to 12.13 with an increase of 0.66 points (5.75%), while the experimental class experienced a significant increase to 13.93 with an increase of 2.53 points (22.19%). The difference in improvement between the two groups reached 1.87 points, which shows the superiority of the Problem Based Learning model in building students' concern for plants. The PBL model effectively improves this indicator because it provides students with hands-on experience to plan and execute plant maintenance projects. In learning, students might identify problems such as the number of dead or unmaintained plants at school, then they investigate the causes (lack of water, lack of light, pest infestation, etc.), design a systematic maintenance schedule, divide tasks in groups to water and clean plants, and maybe even make compost from school organic waste. This process not only teaches practical skills of caring for plants, but also builds an emotional bond between students and the plants they care for. When students see the plants they care for grow well, they feel satisfaction and pride in their efforts, which strengthens the motivation to continue nurturing the plants. Unlike expository learning that only explains how to take care of plants verbally, PBL provides a hands-on experience that makes learning more meaningful and has a long-term impact.

Indicator 3: Supporting the Go Green Program

The indicators supporting the go green program measure students' active participation and support for various green environmental programs and activities organized by schools or communities. These indicators include positive attitudes and student involvement in programs such as energy-saving movements (turning off lights and air conditioners when not in use), reducing the use of single-use plastics by bringing their own drinking bottles and eating places, participation in environmental campaigns, supporting the wise use of paper with the reduce-reuse-recycle principle, and becoming agents of change who invite friends and family to behave in an environmentally friendly manner. Supporting the go green program shows that students not only care about the environment individually, but also collectively and organized.

Based on the diagram, in the posttest of the second meeting, the average score in favor of the go green program of the control class was 11.53 and the experimental class of 11.60, indicating that the initial conditions were not significantly different. In the third posttest meeting, the control class increased to 12.27 with an increase of 0.74 points (6.42%), while the experimental class experienced a drastic increase to 14.07 with an increase of 2.47 points (21.29%). The difference in increase of 1.73 points confirms the effectiveness of the Problem Based Learning model in increasing student support for the go green program. The success of PBL in this indicator occurs because students are not only required to participate in the existing go green program, but they are also involved in designing and implementing the program. For example, students identify energy waste problems in schools through direct observation (lights that are often left on in empty classrooms, air conditioners that keep on throughout the day), then they calculate the estimated electricity waste and costs incurred, design an energy-saving

campaign by creating posters, reminder stickers on light switches, or electricity usage monitoring systems in each classroom. When students see the concrete results of the program they designed (e.g. a reduction in school electricity bills), they feel the positive impact of their actions and are even more motivated to support other go green programs. PBL learning also develops advocacy skills where students learn how to communicate the importance of the go green program to others, create persuasive campaigns, and mobilize the participation of the school community more broadly. This experience builds leadership skills and social skills that are important to become an agent of environmental change.

Indicator 4: Managing Organic and Non-Organic Waste

The indicators of managing organic and non-organic waste measure students' knowledge and skills in sorting, managing, and recycling waste correctly. These indicators include students' ability to distinguish between types of waste (organic, inorganic, and B3), dispose of waste in bins that are appropriate to their type, understand the process of composting organic waste, know how to recycle inorganic waste such as paper, plastic, and cans, and actively participate in waste bank activities or recycling programs at school. Good waste management is one of the crucial aspects of environmental concern considering that the waste problem is a very urgent environmental issue in Indonesia, especially plastic waste that pollutes the land and sea.

Based on the diagram, in the posttest meeting of the two control classes had an average of 11.73 and the experimental class 11.67, indicating no significant difference in the initial condition. In the third posttest meeting, the control class increased to 12.40 with an increase of 0.67 points (5.71%), while the experimental class experienced a significant increase to 14.20 with an increase of 2.53 points (21.67%). The difference in improvement between the two groups reached 1.86 points, showing that the Problem Based Learning model was very effective in developing students' skills in managing organic and non-organic waste. The success of PBL in this indicator is particularly noteworthy because waste management is a well-suited topic for problem-based learning. Students can easily identify waste problems in their school environment – accumulated garbage, unsorted bins, scattered garbage, etc. Through investigation, students learn the impact of poor waste management on health, environmental aesthetics, and ecosystems. Then students design comprehensive solutions such as providing sorted bins in each classroom with clear labels, making compost from school canteen organic waste, organizing waste banks where inorganic waste of economic value is collected and sold, or even making crafts from used goods. This practical experience provides a deep understanding of the importance of sorting waste from the source, and building a habit of sorting waste that will be carried home. Many students then began to implement waste sorting in their homes and even invited their families to participate. PBL learning also allows students to understand that waste is not just waste that must be disposed of, but also a resource that can be reused if managed properly, thus changing students' paradigm about waste.

Indicator 5: Maintaining the Cleanliness of Sanitation Facilities

The indicator of maintaining the cleanliness of sanitation facilities measures student behavior in maintaining and using school sanitation facilities such as toilets, sinks, and bathrooms correctly and responsibly. This indicator includes habits such as cleaning the toilet after use by flushing it clean, not doodling or damaging toilet facilities, throwing garbage in the place provided in the toilet (not throwing garbage in the toilet), using enough water and not

wasting, washing hands with soap after using the toilet, and participating in maintaining the cleanliness of the sink area by not throwing food scraps or garbage in the sink. Maintaining the cleanliness of sanitation facilities is an important indicator because it is closely related to health and hygiene, as well as reflecting a sense of responsibility and concern for common comfort.

Based on the diagram, in the posttest of the second meeting the two groups had an identical average of 11.67, indicating a completely equivalent initial condition. In the third meeting posttest, the control class increased to 12.46 with an increase of 0.79 points (6.77%), while the experimental class experienced a more substantial increase to 13.47 with an increase of 1.80 points (15.43%). Although the difference in improvement (1.01 points) is relatively small compared to other indicators, these results still show that the Problem Based Learning model is effective in improving student behavior in maintaining the cleanliness of sanitation facilities. The more moderate increase in this indicator is understandable because toilet cleanliness behavior is often considered a sensitive or uncomfortable issue to discuss openly, and is also highly dependent on personal habits that have been formed since childhood so that it is more difficult to change in a short period of time. However, PBL learning still has a positive impact through a sensitive but effective approach. Students identify toilet hygiene problems in schools (dirty, smelly, or damaged toilets), discuss their impact on health (disease spread) and psychological (discomfort, reluctance to use the toilet), then design solutions that are not only technical but also educational and persuasive. Student-designed solutions can be toilet cleanliness campaigns with creative posters reminding of the importance of maintaining cleanliness, a more organized toilet cleaning picket system, adequate provision of soap and tissues, or even a class competition with the cleanest toilet. Most importantly, in the learning process, students learn to empathize that the toilet they use will also be used by others after them, so they need to take care of it so that others are comfortable using it too. This experience builds civic consciousness and social responsibility which are important values in character education. Although behavioral changes in these indicators require longer time and consistency, the fact that there is a significant increase suggests that PBL is able to instill the values and awareness that are the foundation for long-term behavioral change.

Second Hypothesis: The Influence of the Problem Based Learning Model on Student Collaboration

The second hypothesis in this study states that there is a positive influence of the application of the Problem Based Learning model on the collaboration of elementary school students. Collaboration is the ability of students to cooperate effectively with others in completing tasks or achieving common goals. Collaboration variables were measured using an observation sheet consisting of 12 observation items that measured five main indicators, namely positive interdependence, interaction in learning, individual responsibility, collaboration skills, and ability to work in groups. Just like the environmental concern variable, to test this second hypothesis, a series of statistical tests were carried out which included analysis prerequisite tests and hypothesis tests.

Analysis Per Collaboration Indicator

To provide a more comprehensive understanding of the influence of the Problem Based Learning model on student collaboration, an analysis of each collaboration indicator was conducted. This analysis reveals how PBL affects various specific aspects of students' collaboration skills.

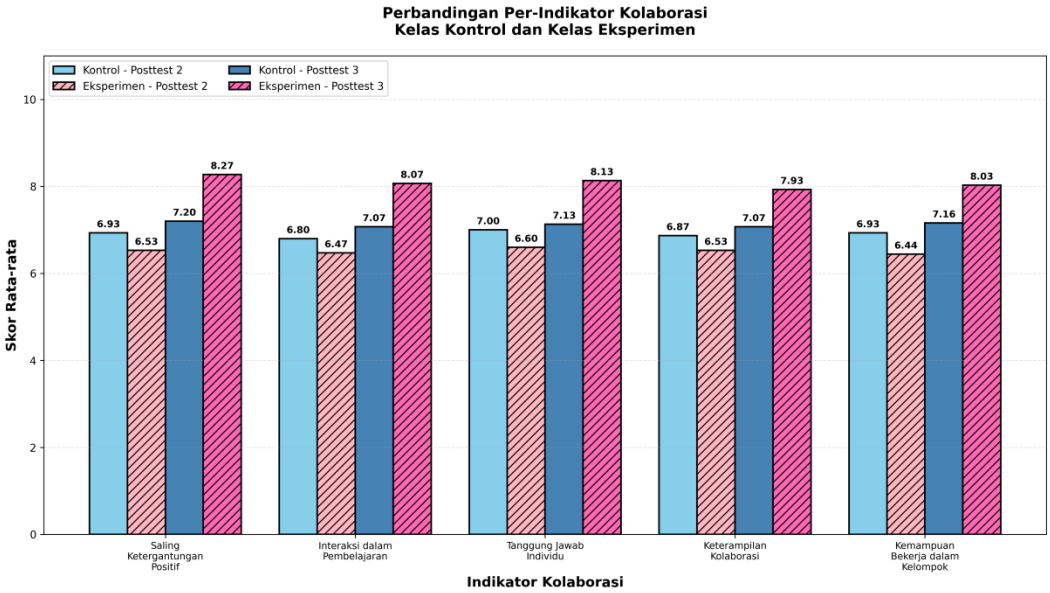

Figure 2. Comparison Per-Indicator of Collaboration of Control Class and Experimental Class

Source: Research data processed by researchers, 2025

Based on Figure 2, a comprehensive comparison of the five indicators of collaboration between the control class and the experimental class at the two measurement times can be seen. The bar chart shows an interesting pattern where in the posttest of the second meeting, the experimental class actually had a slightly lower score than the control class on almost all indicators. However, there was a remarkable transformation in the posttest of the third meeting where the experimental class experienced a very significant improvement in all indicators, surpassing the control class by a considerable margin. This pattern suggests that collaboration skills take time to develop through PBL learning, but when students have become accustomed to collaborative learning methods and structures, their development becomes very rapid.

Third Hypothesis: The Relationship between Environmental Concern and Collaboration

The third hypothesis in this study states that there is a significant positive relationship between environmental concern and collaboration of elementary school students who participate in Problem Based Learning. To test this hypothesis, a Pearson correlation test was performed.

Table 1. Pearson Correlation Test Results

Variabel	N	Correlation Coefficient (r)	Sig. (2-tailed)
Environmental Concern	30	0,466**	0,000
Collaboration	30		

Source: SPSS version 25 output, 2025

Based on the table above, the value of the Pearson correlation coefficient (r) was 0.466 with a significance of 0.000 < 0.05. A positive r value indicates a positive relationship direction, meaning that the higher the students' environmental awareness, the higher their collaboration ability. Based on the interpretation of the correlation strength, the value r = 0.466 is included in the category of moderate correlation. Significance values of 0.000 < 0.05 indicate that the relationship is statistically significant. Thus, the third hypothesis (H_1) is

accepted, which means that there is a significant positive relationship between environmental concern and student collaboration.

The discussion in this section describes in depth the results of the research that have been presented previously by relating them to relevant theories and the results of previous research. The discussion was divided into three main aspects, namely: (1) the success of the implementation of the Problem Based Learning model, (2) the factors that affect the success, and (3) recommendations for the implementation of the PBL model in elementary schools.

1. Successful Implementation of the Problem Based Learning Model

The results of the study showed that the application of the Problem Based Learning model had a significant positive influence on environmental awareness and collaboration of elementary school students. This success can be explained through the characteristics and principles inherent in the PBL model.

a. **Success for Environmental Care**

A significant increase in environmental awareness in the experimental class (from 57.47 to 69.47 with an increase of 12.00 points) compared to the control class (from 57.60 to 61.13 with an increase of 3.53 points) demonstrated the effectiveness of the PBL model in building students' environmental awareness. These findings are in line with the research of Nurwidodo et al. (2024) who found that PBL significantly improves students' environmental literacy because it engages them in the investigation of authentic environmental issues. Humairoh et al. (2024) also stated that PBL is effective in increasing environmental awareness because it exposes students to real problems they experience in their daily lives.

The success of PBL in increasing environmental awareness can be explained through several psychological and pedagogical mechanisms. First, PBL uses authentic environmental issues as a starting point for learning, which makes students realize that environmental issues are not something abstract or far from their lives. Newman (2005) emphasizes that the authenticity of the problem is the key to the success of PBL, because problems relevant to students' lives will increase their motivation and engagement in learning. When students observe piles of plastic waste in their schools, see river pollution in their neighborhood, or measure electricity and water waste, they experience an emotional connection to the problem.

Second, PBL encourages active and constructive learning where students not only passively receive information but actively seek, process, and construct their own knowledge. Hoan & Khue (2024) found that PBL improves students' critical thinking skills as they must analyze problems, evaluate various sources of information, and synthesize solutions. In the context of environmental education, this in-depth investigative process builds a more comprehensive understanding of the complexity of environmental problems and the interdependence between natural and social systems.

Third, PBL provides students with the opportunity to experience success in solving environmental problems, which builds their self-efficacy. Alwi et al. (2024) explained that successful experience in solving problems increases students' confidence that they are able to make a difference in environmental conservation. This high self-efficacy in turn strengthens students' motivation to continue engaging in eco-friendly behaviors.

b. **Success to Collaboration**

A significant increase in collaboration in the experimental class (from 32.57 to 40.43 with an increase of 7.86 points) compared to the control class (from 34.53 to 35.63 with an increase

of 1.10 points) showed that PBL was highly effective in developing students' collaboration skills. These findings are consistent with research by Alfaeni et al. (2022) who found that PBL significantly improves students' collaboration skills due to a learning structure that requires students to work in groups to solve complex problems. Castañer & Oliveira (2020) also suggest that collaborative project-based learning improves various aspects of collaboration including communication, coordination, and conflict resolution.

The success of PBL in developing collaboration can be explained through several mechanisms. First, PBL creates positive interdependence where individual success depends on the success of the group. Nurwidodo et al. (2024) explained that the task structure in PBL is designed in such a way that each member has a role that complements each other and contributes to a common goal. This interdependence encourages students to communicate, share resources, and support each other.

Second, the complexity of the problems in PBL requires students to collaborate because the problems cannot be solved individually. Students must integrate different perspectives, knowledge, and skills to find comprehensive solutions. This collaborative process trains students in a variety of social skills such as active listening, giving and receiving feedback, managing disagreements, and making decisions together.

Third, PBL provides scaffolding that allows students to develop collaboration skills gradually. Teachers act as facilitators who provide support when students face difficulties in working together, teach communication strategies and conflict resolution, and provide reflection on the collaboration process that has taken place. This gradual support allows students to gradually develop their collaboration competencies.

c. The Relationship Between Environmental Concern and Collaboration

The results showed a significant positive correlation between environmental concern and collaboration ($r = 0.466$, $p < 0.05$). These findings suggest that students who have a high level of environmental concern tend to have good collaboration skills, and vice versa. This relationship can be explained through several perspectives.

First, both environmental concern and collaboration develop through student-centered and experiential learning. SALSABILA & MUQOWIM (2024) argue that PBL creates a learning environment that supports the simultaneous development of these two competencies because students must work together in groups to solve complex environmental problems. In this process, students not only learn about the environment but also learn how to work effectively with others.

Second, the environmental problems used in PBL are inherently collective and require collaborative solutions. Hairida et al. (2024) explain that environmental problems such as pollution, deforestation, or climate change cannot be solved by individuals alone, but require collective action from various stakeholders. When students realize that they must work together to address environmental issues, they develop an appreciation for the importance of collaboration.

Third, collaboration skills facilitate more effective environmental action. Students who have good collaboration skills will be better able to organize environmental activities, mobilize others to participate, and create greater impact. Conversely, high environmental awareness can be a motivator for developing collaboration skills, as students realize that they need to work together with others to achieve their environmental goals.

2. Factors Influencing the Success of the Problem Based Learning Model

The success of the application of the Problem Based Learning model in this study is influenced by various factors that interact with each other. An understanding of these factors is important to ensure effective PBL implementation in other contexts.

a. Issue Authenticity

The first factor that is very decisive is the authenticity of the problem used in learning. Newman (2005) emphasizes that problems should be relevant to students' lives, meaningful, and challenging. In this study, the environmental issues raised such as plastic waste in schools, waste of water and electricity, or pollution of rivers around schools, are problems that students actually experience in their daily lives. This authenticity increases students' intrinsic motivation because they feel that they are solving real problems, rather than simply working on artificially generated academic tasks. Latukau (2023) found that PBL with authentic problems significantly increased student engagement compared to problems that were only hypothetical or textbook-based.

b. Systematic Learning Structure

The implementation of PBL requires a systematic and well-organized structure. Maryati (2018) explained that PBL is not just about giving problems to students and letting them work without guidance, but requires clear stages ranging from problem orientation, learning organization, investigation, development and presentation of results, to analysis and evaluation. In this study, teachers use a clearly structured Learning Implementation Plan (RPP), provide scaffolding that suits the needs of students, and monitor the learning process. Limbong (2024) found that a systematic learning structure increases the effectiveness of PBL in developing students' higher-order thinking skills.

c. Availability of Adequate Learning Resources

The success of PBL also depends on the availability of adequate learning resources to support student investigations. Nurmasari et al. (2023) stated that students need access to various sources of information to be able to explore problems in depth. In this study, students have access to books, the internet, resource persons (such as school cleaners or community leaders who care about the environment), and the physical environment as a natural laboratory. Mayudin & Rahmi (2024) found that the variety of learning resources increases the quality of solutions produced by students in PBL learning.

d. The Role of Teachers as Effective Facilitators

The role of teachers is crucial in the success of PBL. In contrast to traditional learning where teachers play the role of knowledge transmitters, in PBL teachers play the role of facilitators who guide the student investigation process without providing direct answers. Fitria et al. (2024) explained that effective teachers in PBL are teachers who are able to ask questions that encourage students to think more deeply (probing questions), provide the right scaffold when students experience difficulties, and create a supportive learning environment where students feel safe to ask questions and express ideas. Aisyah & Gumala (2025) found that the quality of teacher facilitation is an important predictor of the success of PBL implementation.

e. Adequate Learning Time

PBL takes longer than conventional learning because students need to conduct in-depth investigations, discuss with groups, develop solutions, and present results. Nurwidodo et al. (2024) suggest that adequate time allocation allows students to truly explore problems and not

rush in coming up with superficial solutions. In this study, PBL learning was carried out in 6 meetings with sufficient duration for each stage of learning. If time is too limited, PBL can be counter-productive because students will feel depressed and unable to explore problems optimally.

f. Supportive Class Culture

PBL implementation requires a classroom culture that supports collaboration, inquiry, and risk-taking. Khoerunisa (2024) explains that students need to feel safe to ask questions, express ignorance, try new ideas, and even make mistakes as part of the learning process. In this study, teachers consistently created classroom norms that valued effort rather than outcomes, encouraged students to help each other, and viewed mistakes as learning opportunities rather than failures. This positive classroom culture facilitates more in-depth and meaningful learning.

g. Parent and Community Involvement

Although not the main focus of this study, parental and community involvement also contributed to the success of PBL learning. Saputri (2024) found that when parents and the community are involved in learning, for example as resource persons or supporting the implementation of solutions developed by students, learning becomes more meaningful and impactful. In this study, several parents were asked to support waste sorting activities at home, and the school community (teachers, cleaners, canteens) was involved in the implementation of plastic waste reduction programs developed by students. This engagement reinforces the relevance of learning and helps students see the real impact of their efforts.

CONCLUSION

Based on the results of the research and discussion, it was concluded that the Problem-Based Learning (PBL) model had a significant positive effect on both environmental awareness and collaboration skills among elementary school students. Students who participated in PBL learning demonstrated significantly higher levels of environmental awareness—including environmental knowledge, environmental attitudes, participation skills, and eco-friendly behaviors—as well as stronger collaboration skills, including positive interdependence, quality interaction, individual responsibility, communication, conflict resolution, and group work ability, compared to students who participated in expository learning. This success was attributed to PBL's use of authentic environmental issues as learning contexts, its encouragement of active investigation, and its provision of opportunities for students to develop and implement real solutions. In addition, the structured group-based learning process fostered positive interdependence and collaborative problem-solving.

Furthermore, a significant positive relationship was found between environmental awareness and collaboration skills ($r = 0.466$, $p < 0.05$), indicating that both competencies reinforce and develop each other simultaneously within PBL learning.

Based on these findings, several recommendations are proposed. For teachers, it is recommended to implement the Problem-Based Learning to Enhance Environmental Awareness and Collaboration Among Elementary School Students model as an alternative instructional strategy to improve students' environmental awareness and collaboration skills, as well as to continuously develop authentic environmental issues relevant to students' daily lives as learning contexts. For schools, it is suggested to provide training and adequate

facilities to support the implementation of PBL and other innovative learning models, as well as to develop environmental programs integrated into the curriculum to strengthen students' environmental literacy. For future researchers, it is recommended to conduct studies with a broader scope, different grade levels, or longer experimental durations to examine the long-term effects of PBL on students' environmental awareness and collaboration skills, as well as to explore the integration of PBL with other approaches such as Project-Based Learning or outdoor learning for more comprehensive outcomes.

REFERENCES

Aisyah, F. N., & Gumala, Y. (2025). Implementation of the problem-based learning (PBL) model as an effort to improve the critical thinking skills of elementary school students: Literature review. *Papanda Journal of Mathematics and Sciences Research (PJMSR), 4*(1), 1–14.

Ajaps, S., & McLellan, R. (2015). "We don't know enough": Environmental education and pro-environmental behaviour perceptions. *Cogent Education, 2*(1), Article 1124490. https://doi.org/10.1080/2331186X.2015.1124490

Alfaeni, D., Nurkanti, M., & Halimah, M. (2022). Students' collaboration skills through a project-based learning model using Zoom on ecosystem materials. *Bioedukasi (Journal of Biology Education), 13*(2), 143–151. https://doi.org/10.24127/bioedukasi.v13i2.6330

Alwi, M., Sutajaya, M., & Suja, I. W. (2024). The development of tri-oriented IPAS learning modules to improve the environmental care character of elementary school students. *JPGI (Indonesian Teacher Research Journal), 9*(1), 1–9.

Castañer, X., & Oliveira, N. (2020). Collaboration, coordination, and cooperation among organizations: Establishing the distinctive meanings of these terms through a systematic literature review. *Journal of Management, 46*(6), 965–1001. https://doi.org/10.1177/0149206320901565

Fitria, Z., Arianto, F., & Sumarno, A. (2024). The effect of the problem-based learning model on students' critical thinking skills. *Journal of Teacher Studies and Learning, 7*(2), 693–703. https://doi.org/10.30743/best.v3i1.2435

Gupta, M. S., Samrutwar, A. M., Rahandale, A. M., & Edlabadkar, A. A. (2024). The influence of environmental education on college students' behavioural attitudes towards sustainability. *Journal of Learning and Educational Policy, 4*(6), 48–58.

Hairida, H., Hadi, L., & Kurniasih, D. (2024). Validity of Project Based Integrated Environmental Science Problem Learning (PBIESPL) model with authentic assessment. *Educational Journal, 8*(2).

Hoan, N. D. N., & N. T. K. (2024). Applying project-based learning to educate primary school students on environmental protection. *Journal of Science, 69*(4), 97–108. https://doi.org/10.18173/2354-1075.2024-0067

Humairoh, U., Retnowati, R., & Istiadi, Y. (2024). Design and development of a PBL e-module in environmental education for enhancing pro-environmental behaviour. *Indonesian Journal of Applied Environmental Studies, 6*(1).

Khoerunisa, S. (2024). The character of caring for the environment of students in the application of eco literacy to support ESD in elementary schools. *Journal of Educational Research, 24*(1), 110–118. https://doi.org/10.17509/jpp.v24i1.6928

Latukau, M. (2023). Application of problem-based learning to improve mastery of science concepts and scientific attitudes of elementary school students. *Scientific Journal of Education, 9*(11), 31–39.

Lestari, D. (2024). Integration of the independent curriculum with environmental issues in

elementary schools. *Journal of Indonesian Basic Education, 9*(1), 33–45.
Limbong, I. N. (2024). Exploration of the role of students in the problem-based learning (PBL) learning process in elementary schools. *Sci.*, 24167–24174.
Maryati, I. (2018). Application of problem-based learning model to number pattern material in Grade VII junior high school. *Mosharafa: Jurnal Pendidikan Matematika, 7*(1), 63–74. https://doi.org/10.31980/mosharafa.v7i1.475
Mayudin, I., & Rahmi, L. (2024). The effect of the problem-based learning (PBL) learning model on student learning outcomes in the science subject of energy change material Class IV SD Negeri 76 Pekanbaru. *Didaktik: Jurnal Ilmiah PGSD FKIP Universitas Mandiri, 10*(3), 222–234.
Newman, M. J. (2005). Problem-based learning: An introduction and overview of the key features of the approach. *Journal of Veterinary Medical Education, 32*(1), 12–20. https://doi.org/10.3138/jvme.32.1.12
Novianti, R. (2021). Learning model to foster the character of caring for the environment in science subjects. *JPB: Jurnal Pendidikan Biologi, 2*(2), 16–23.
Nurmasari, I., Faradita, M. N., & Setiawan, F. (2023). Application of problem-based learning model assisted by learning video media to improve science learning outcomes of Grade IV elementary school students. *Satya Widya, 39*(1), 21–30. https://doi.org/10.24246/j.sw.2023.v39.i1.p21-30
Nurwidodo, N., Wahyuni, S., Hindun, I., & Fauziah, N. (2024). The effectiveness of problem-based learning in improving creative thinking skills, collaborative skills and environmental literacy of Muhammadiyah secondary school students. *Research and Development in Education (RaDEn), 4*(1). https://doi.org/10.22219/raden.v4i1.32123
Pristiwanti, D., Badariah, B., Hidayat, S., & Dewi, R. S. (2022). Definition of education. *Jurnal Pendidikan dan Konseling, 4*(6), 7911–7915.
Salsabila, Y. R., & Muqowim, M. (2024). Correlation between Lev Vygotsky's constructivist learning theory and the problem-based learning (PBL) learning model. *Learning: Jurnal Inovasi Penelitian Pendidikan dan Pembelajaran, 4*(3), 813–827. https://doi.org/10.51878/learning.v4i3.3185
Santika, I. N. G., Suastra, I. W., & Arnyaman, I. B. P. (2022). Forming environmental care character in elementary school students through science learning. *Journal of Learning and Mathematics Sigma (JPMS), 10*(1), 207–212.
Saputri, Y. E. (2024). The character of environmental care in elementary school students: A case study on Grade 1 students of Menadi State Elementary School, 12–47.
Utami, U. (2025). Creates an environmental care generation through impactful social science learning in elementary schools. *Journal of Integrative Elementary Education, 1*(1), 16–23.