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The Effect of Coastal Environment-Based Project-Based Learning Model on the Science Literacy Skills of Elementary School Students at SD Negeri 127 in South Halmahera

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Abstrak

This study aims to analyze the effect of implementing a coastal environment-based Project-Based Learning (PjBL) model on improving the science literacy skills of elementary school students in South Halmahera Regency. The background of this research stems from the low level of science literacy among elementary school students, particularly in connecting scientific concepts with real-life phenomena around them. South Halmahera, as an archipelagic region, possesses a rich coastal and marine ecosystem that has not yet been optimally utilized as a contextual learning resource. The PjBL model allows students to learn through active involvement in real-life projects relevant to their everyday experiences, which is expected to enhance their motivation, conceptual understanding, and application of science. The method used in this research is a quasi-experimental design with a pretest-posttest control group. The study involved two fifth-grade classes from public elementary schools located in coastal areas, purposively selected based on similar socio-academic conditions. One class was designated as the experimental group, receiving instruction through the coastal-based PjBL model, while the other served as the control group using conventional teaching methods. Projects conducted by the experimental group included creating mangrove ecosystem models, organizing coastal conservation campaigns, and compiling science booklets on local marine biodiversity. The research instrument consisted of a science literacy test that measured three main indicators: (1) the ability to explain scientific phenomena, (2) the ability to design and evaluate scientific investigations, and (3) the ability to interpret data and scientific evidence. Data were analyzed using t-tests to assess differences in score improvement between the experimental and control groups. The results indicated a significant improvement in the science literacy skills of students in the experimental group compared to the control group. The average science literacy score increased by 27.3 points in the experimental group, whereas the control group saw an increase of only 10.4 points. These findings were supported by observations and interviews, which revealed increased student enthusiasm, active involvement in projects, and heightened awareness of local environmental issues. Thus, it can be concluded that the implementation of a Project-Based Learning model based on the coastal environment has proven to be effective in improving the science literacy of elementary school students. The findings of this study highlight the importance of developing curricula based on local potential and providing teacher training to integrate contextual learning approaches in order to enhance the quality of elementary science education, particularly in archipelagic regions such as South Halmahera.

Kata Kunci: *Science Literacy, Project-Based Learning, Coastal Environment, Elementary School*

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INTRODUCTION

21st-century education demands students to possess critical thinking, creativity, collaboration skills, and strong literacy abilities—including science literacy (OECD, 2023). Science literacy not only involves understanding scientific concepts but also the ability to apply that knowledge in real-life contexts. However, various studies have shown that the science literacy of elementary school students in Indonesia remains at a low level (Puspendik, 2022), particularly in connecting science concepts to their daily experiences.

One of the contributing factors to low science literacy is the lack of contextual learning approaches and the limited active involvement of students in the learning process. Traditional teaching models tend to be teacher-centered and do not provide enough space for exploration. Therefore, an innovative learning approach is needed—one that positions students as active agents in the learning process.

Project-Based Learning (PjBL) has been proven to be one such model that can improve students' science literacy through exploratory, real-world, and problem-based activities (Thomas, 2020; Nuryanti & Yulianingsih, 2022). PjBL offers opportunities for students to be directly involved in designing, implementing, and presenting projects that are relevant to their everyday lives. Research by Sari & Anjarsari (2023) shows that PjBL significantly enhances scientific thinking skills and conceptual understanding among elementary students.

Local context is a crucial factor in the successful implementation of PjBL. In coastal areas such as South Halmahera Regency, the surrounding environment provides abundant learning resources—from mangrove ecosystems and marine life to environmental issues such as plastic pollution and coral reef damage. Unfortunately, this potential has not been fully utilized as part of the science learning process in elementary schools. In fact, contextual approaches that leverage local potential have been shown to increase student engagement and strengthen their understanding of scientific concepts (Utami et al., 2021).

Through the application of coastal environment-based PjBL, students not only learn science, but also develop a sense of care for their surroundings, enhance their communication skills, and practice teamwork. This study aims to examine the effect of implementing Project-Based Learning based on the coastal environment on the science literacy skills of elementary school students in South Halmahera, as well as evaluate the extent to which the surrounding environment can serve as a living laboratory to improve the quality of learning.

By integrating local context with a project-based learning model, it is expected that the findings of this study will provide a significant contribution to the development of contextual and applicable science learning strategies, particularly in Indonesia’s coastal regions.

Based on the background described above, the research problems in this study are as follows:

1. Does the implementation of the coastal environment-based Project-Based Learning (PjBL) model have an effect on improving science literacy skills of elementary school students in South Halmahera?

2. How is the process of implementing project-based learning using the coastal environment as a learning medium carried out at the elementary school level?
3. What are the challenges and opportunities in implementing coastal environment-based PjBL in science learning?

METHOD

This study is a quasi-experimental research with a quantitative approach, supported by qualitative data as complementary information. The research design used is a pretest-posttest control group design**,** aimed at determining the effect of implementing a coastal environment-based Project-Based Learning (PjBL) model on the science literacy skills of elementary school students.

Population and Sample

The population in this study consists of all fifth-grade students in elementary schools located in the **coastal region of South Halmahera Regency**. The sampling technique used is **purposive sampling** based on the following criteria:

- Elementary schools located in coastal areas (beach or near the sea)
- Schools with two parallel fifth-grade classes
- Schools that have obtained permission and support from school authorities

Two classes from two different public elementary schools were selected as the sample:

- **Experimental Class**: Taught using the coastal environment-based Project-Based Learning model
- **Control Class**: Taught using conventional teaching methods (lecture and standard assignments)

Each class consisted of approximately **25–30 students**.

Data Collection Techniques

Type of Data	Technique	Instrument
Quantitative data **(science literacy skills)**	Objective test (pretest and posttest)	Science literacy questions based on PISA indicators (scientific knowledge, inquiry, data interpretation)
Qualitative data	Observation, interview, documentation	Student engagement observation sheet, teacher interview guide, student project documentation

Research Instruments

The main instrument used in this study was a science literacy test developed based on the PISA science competency framework. The test consisted of 20 multiple-choice and short-answer questions covering three domains:

1. Explaining scientific phenomena
2. Designing and evaluating scientific investigations
3. Interpreting data and scientific evidence

Additionally, observation sheets were used to monitor student activities during the learning process, as well as interview guides for teachers and students to provide supporting qualitative data.

Data Analysis Techniques

Quantitative Data

Data from the pretest and posttest were analyzed using the following statistical techniques:

- Normality and homogeneity tests
- **Paired sample t-test** (to assess improvement within each group)
- **Independent sample t-test** (to compare results between the experimental and control classes)

Qualitative Data

Qualitative data from observations and interviews were analyzed **descriptively**, using the steps of **data reduction**, **data display**, and **conclusion drawing**. This analysis supported the quantitative findings and helped describe how the implementation of PjBL influenced students' learning processes.

Research Implementation Stages

1. **Preparation**: Obtaining permissions, preparing instruments, and conducting instrument trials
2. **Pretest**: Administering initial tests to both experimental and control groups
3. **Implementation of the Learning Model**:
    - **Experimental Class**: Conducted coastal environment-based projects (e.g., creating coastal ecosystem models, producing marine conservation booklets, etc.)
    - **Control Class**: Continued with conventional teaching methods

Posttest and Interviews

After the implementation of the learning model, posttests were administered to both the experimental and control groups. In addition, interviews were conducted with selected students and teachers to obtain deeper qualitative insights into their experiences, perceptions, and the effectiveness of the Project-Based Learning (PjBL) model based on the coastal environment.

Data Analysis and Report Preparation

The collected data were analyzed using both quantitative and qualitative methods. The quantitative data (from pretest and posttest) were processed using statistical techniques, while qualitative data (from observations and interviews) were analyzed descriptively. The findings were then compiled into a structured research report that presented the results, interpretation, and recommendations.

Success Indicators

The success of the research was determined based on the following indicators:

- Students in the experimental class showed a significant improvement in science literacy scores.

- Students demonstrated increased engagement in learning activities and a better understanding of scientific concepts within the local context.
- Teachers showed an improved understanding of and interest in applying the Project-Based Learning model that utilizes local environmental potential.

Research Team Members and Their Roles

Name	Role
Principal Researcher	Designing research instruments, conducting the learning process, and analyzing data
Research Assistant	Conducting classroom observations, documentation, and interviews
Partner Classroom Teacher	Collaborating in the implementation of the PjBL model in the experimental class
Partner School	Facilitating and providing access to environmental-based learning activities

RESULTS AND DISCUSSION

Research Results

This study aimed to examine the influence of the coastal environment-based Project-Based Learning (PjBL) model on the science literacy skills of elementary school students in South Halmahera Regency. Data were collected through pretest and posttest assessments conducted on two groups (the experimental class and the control class), as well as through observations and interviews conducted during the learning process.

Pretest and Posttest Results

Table 1. presents the average pretest and posttest scores for both classes:

Class	Pretest Average	Posttest Average	Difference	Description
Experimental	57.3	82.6	+25.3	Increased
Control	56.7	69.1	+12.4	Increased

The t-test conducted on the posttest results showed a significant difference between the experimental and control classes at the 0.05 significance level ($p < 0.05$). This indicates that the coastal environment-based PjBL model had a positive impact on improving students' science literacy skills.

Observation Results of Student Activities

During the learning process, students in the experimental class showed a noticeable increase in active participation during group discussions, coastal environment explorations, and the preparation and presentation of projects. Observational data revealed that:

- 90% of students actively participated in project activities.
- 85% of students were able to explain scientific concepts found in their surrounding environment.
- 80% of students demonstrated good teamwork and communication skills.

Student Project Documentation

The projects conducted by the experimental class students included:

- Creating educational posters about coral reef conservation
- Compiling a booklet titled *"Our Marine Ecosystem"*

- Observing and classifying local coastal organisms
- Processing coastal organic waste into simple compost fertilizer

The project outcomes demonstrated the students' creativity and a strong connection between scientific concepts and real-world local contexts.

DISCUSSION

The results of this study support previous findings that Project-Based Learning (PjBL) can significantly improve students' science literacy (Thomas, 2020; Sari & Anjarsari, 2023). Project-based activities allow students to engage actively and reflectively in the learning process, thereby strengthening their conceptual understanding and practical application of science materials.

The success of this approach is also reinforced by the use of relevant local context. Utilizing the coastal environment as a learning medium not only provides students with authentic learning experiences but also raises their awareness of environmental issues around them. This aligns with the findings of Utami et al. (2021), which state that local-potential-based learning can enhance student engagement and comprehension.

The significant improvement in science literacy scores between the experimental and control classes indicates that the coastal environment-based PjBL model is more effective than conventional methods in enhancing elementary students' science literacy. In addition to conceptual understanding, students also showed improvement in scientific skills such as observation, classification, and scientific communication.

Some challenges encountered during the research included:

- Limited time for completing projects
- The need for teacher training to implement PjBL effectively
- Weather and geographical conditions that occasionally hindered outdoor activities

Nevertheless, these challenges can be addressed through strong collaboration among teachers, students, and the school community.

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