

## PROBLEM AND PROJECT-BASED LEARNING AS AN EFFECTIVE ENVIRONMENTAL EDUCATION (EE) METHODS: A CASE OF TEXTBOOK DEVELOPMENT IN MEDAN CITY SCHOOLS

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### Abstract

Environmental education (EE) is a tool for educating people about the environment, and EE textbooks are an essential resource for this purpose. This book was created by a group of elementary, middle, and high school teachers in the Medan City area who had yet to gain experience in textbook writing. A combination of problem and project-based learning (PBL and PjBL) by triggering teachers to develop a textbook for EE was carefully conducted. The project took three years, during which the teachers worked on conceptualizing and setting goals, selecting themes, creating the content, and designing teaching materials. Initially, the teachers conducted a poll which acted as a PBL approach to identify the most pressing environmental issues faced by the people of Medan City. This poll showed that waste management was the most crucial issue, followed by problems related to rivers, wastewater, waste disposal, and floods. The teachers then wrote chapters as a part of the PjBL approach for the EE book based on the identified issues and aligned with the EE curriculum. Over three years, the teachers tested the book with their students, evaluated the results, and revised it accordingly. The final questionnaire results showed that the experience of creating an EE book was valuable to the teachers and inspired them to consider making more EE resources in the future.

**Keywords:** *Deli River; environmental education; environmental leader; problem-based learning; project-based learning*

### Introduction

The urgency of addressing global environmental challenges has led educational institutions to re-evaluate their curricula and incorporate environmental education (EE) into their programs. Integrating EE into formal education has become increasingly important as the impact of human activity on the planet becomes more

apparent (Reid, 2019). EE and sustainable development are now considered essential components of a well-rounded education. The goal of EE in education is not only to increase awareness of environmental issues but also to equip students with the skills and knowledge they need to create positive change in the world (Fekih Zguir et al., 2021). By incorporating EE into the programs, students can be ready to act as leaders of change who will be responsible for addressing global environmental challenges.

EE is a multifaceted concept that spans from basic primary education to higher education, regardless of the area of knowledge. Despite the

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absence of a simple or agreed definition for EE, it encompasses a clear and defined core that promotes the need for a behavioural change towards the environment, regardless of the teaching approach or didactic strategy utilized (Acosta Castellanos et al., 2020). There is an intricate link between the environment and various biological, physical, social, cultural, and socioeconomic factors, underscoring the importance of awareness and providing tools for sustainable decision-making (Pace et al., 2023). EE must empower students to understand the environment and generate action strategies to protect it. Many schools face the challenge of integrating the environment into their functions since EE is often ignored in several countries' primary and secondary education (Seikkula-Leino et al., 2021). Therefore, incorporating EE into schools' curricula and practices is crucial.

Problem-based learning (PBL) and project-based learning (PjBL) are two student-centered learning approaches that emphasize critical thinking, problem-solving, and real-world application of knowledge (Sukackè et al., 2022). PBL is a teaching and learning method that focuses on solving complex problems in real-life contexts. In PBL, students work collaboratively to identify problems, generate hypotheses, gather and analyze data, and draw conclusions. The instructor plays a facilitator role, guiding students through the process and providing support as needed. PBL emphasizes the development of critical thinking, problem-solving, and communication skills, as well as content knowledge (Ali, 2019; Indriyani Rachman et al., 2021; Tell and Hoveskog, 2022). PjBL, on the other hand, is an approach to teaching and learning that involves students in designing, planning, and execution of projects that are related to real-world problems or challenges. PjBL emphasizes the development of project management skills, as well as critical thinking, problem-solving, and collaboration. In PjBL, students are often given a degree of

autonomy to design their projects, which may involve research, experimentation, and analysis (Aminatun and Oktaviani, 2019; Farrow et al., 2022). Both PBL and PjBL share some similarities, such as focusing on real-world problems and emphasizing collaboration and critical thinking. However, PjBL tends to focus more on the project, while PBL focuses on the problem-solving process (Sukackè et al., 2022). Both approaches are effective in promoting deep learning, engagement, and motivation in students. They are often used in STEM fields, as well as in social sciences and humanities.

Medan City is one of Indonesia's cities experiencing rapid population growth, which has resulted in a surge of environmental problems. One such issue is the pollution of the Deli River, which runs through Medan City and originates in Deli Serdang. The river suffers from water and waste pollution, as reported by (Susanti, 2018). However, low environmental awareness among the residents of Medan City makes it challenging to address these problems (Aldhila et al., 2021). The city also faces a waste problem, with waste piling up along the Deli River and in illegal dumping sites. Moreover, the city grapples with flooding, traffic congestion, and a lack of public awareness about maintaining a clean environment, among the most critical problems (I Rachman et al., 2021).

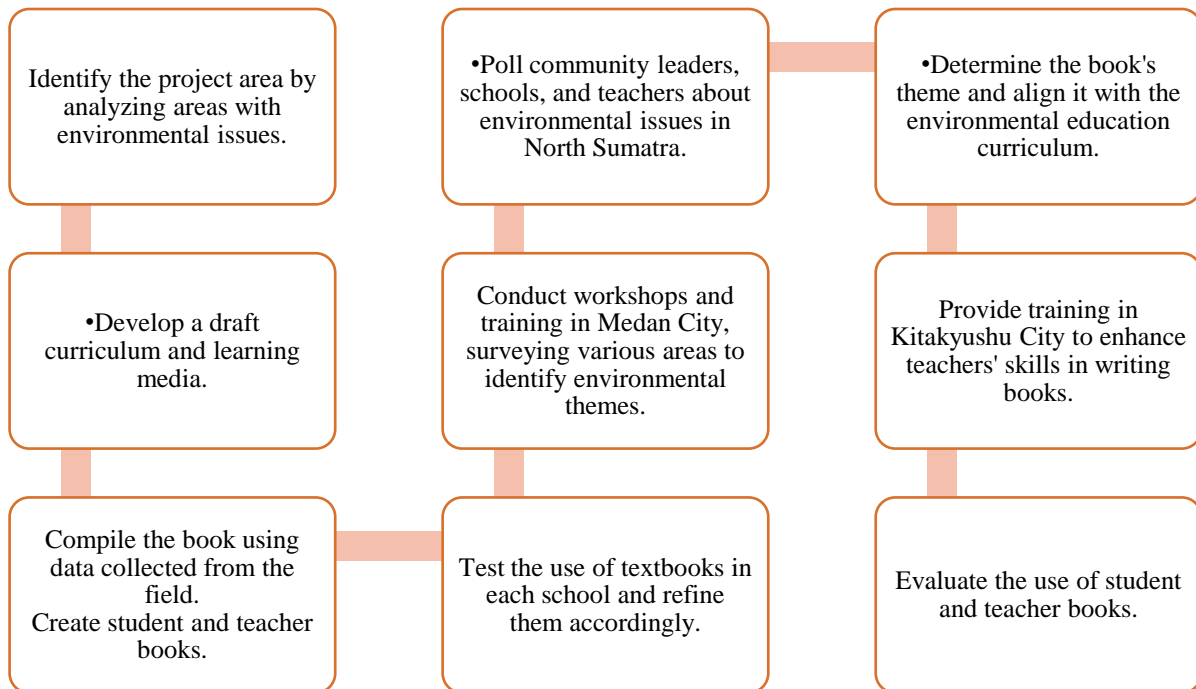
EE is one way to tackle environmental problems, but what kind of education model can effectively address the issues Medan City faces? Therefore, it is essential to create textbooks and learning media that act as part of the PBL-PjBL methods that provide guidance on EE materials and teaching techniques for educators. Unfortunately, few experienced teachers are available to write such books, and some teachers willing to write books may lack the necessary guidance. A comprehensive work project is required to produce an EE textbook from scratch. This book's production aims to help

address the shortage of teaching materials on EE and improve teachers' ability to create their own textbooks.

### Research Methodology

The research project begins with problem-based learning (PBL) where the teachers invite stakeholders to generate the environmental problems. An opinion poll was conducted with 40 people: traditional stakeholders, community leaders, school principals, and teachers, including 10 elementary school teachers, 5 junior high school teachers, and 10 high school teachers. The results of this opinion poll will be processed using text mining to determine the theme of environmental problems in the field. 40 people were asked about their environmental problems, and the data were analyzed using text

mining, which generated 265 words related to the environment. Therefore, to gain the teachers' knowledge related to successful implementation of EE, the teachers were invited to Japan. This effort is part of an experience exchange between the schools, teachers, and students. It is to develop a new environmental leader (EL) when they returned to Medan City. This also aimed to provide an overview and comparison of EE development in Japan and Indonesia. After the EL understand and gain an overview of EE applied in Japan, it will be easier for the EL team to formulate an environment-based curriculum adapted to the culture of the people of North Sumatra to be applied in schools. The ELs were also given training on how to learn with the plan-do-check-act (PDCA) method.



**Figure 1.** Methodological framework

The production of this textbook, JICA funded, is one of the initiatives under the cooperation program between the University of North

Sumatra and The University of Kitakyushu. Over three years, teachers from five schools, ranging from elementary to high school, were

involved in the project to create EE textbooks. Every month, workshops were conducted to develop EE textbooks for students and teacher guidebooks. The teachers' activities were continually monitored throughout the research process, including planning, drafting, testing, and evaluation. To assess whether this project can establish a sustainable system/structure to manage EE and awareness activities for students and the community, questionnaires were distributed to 25 EL teachers. All data generated during the project are processed and analyzed using qualitative analysis. Fig. 1 provides the framework for creating EE textbooks.

## Result and Discussion

### *Polling and Workshop Results*

The polling resulted in six most frequent words, which were then identified: waste (48 times), disposal (21 times), carelessly (16 times),

household (16 times), trash can (12 times). From the results, it can be concluded that the environmental problems faced by the community are related to household waste being disposed of in random places along the Deli River. From the interviews with EL teachers who attended the EE training in Kitakyushu, they all reported gaining new knowledge related to environmental learning, getting new ideas, and being inspired. Some argue that the success of Kitakyushu City as an environmentally friendly city is due to the power of education in schools and communities. A visit to Kitakyushu City opened new ideas, broadened teachers' insights when writing books, and made them more communicative, including using learning media. The visit to Kitakyushu City aimed to learn how the city provides EE lessons to students and the public. Fig. 2 shows the EL workshop for teachers in Kitakyushu, Japan.



**Figure 2.** Environmental Leader (EL) workshops for teachers in Kitakyushu Japan

### *Textbooks Development*

In order to add insight to the teachers, several activities related to the textbook developments were done. The teachers were asked to write the material, surveys, and learn from the experiences after visiting several places such as waste banks, compost houses, wastewater treatment plants (WWTP), water supply companies, and landfills along the Deli River. The teachers also interviewed local

communities, resource persons, and stakeholders. The teachers made EE books according to the areas where they teach. Table 1 shows the textbooks' themes in different levels of education. The textbooks focused on the Deli River's history, current river functions, identification of river water quality, polluted river environment, river conservation, domestic wastewater treatment, and flood.

**Table 1.** Thematic list of textbooks in different levels of education

No	Name of School	EE Theme
1	Elementary School first grade	The theme of this elementary school book focuses more on learning about rivers. Because this elementary school is very close to the river. History of the river, the role of the river, the function of the river, Animals and plants in the river, waste in the river, types of waste
2	Elementary School second grade	The themes for second grade of elementary schools are primarily about the history of rivers, river overflows, waste in rivers, river functions, types of rivers, the role of rivers, managing domestic waste
3	Junior High School	Middle school themes about types of rivers, the role of rivers, waste in rivers, river management, floods, wastewater, the role of the community, use of the Joukasou, visits to wastewater treatment plants (WWTP), water supply companies, and landfills, animals, and plants in the river
4	Senior High School first grade	High school theme, about the types of rivers, the role of rivers, waste in rivers, river management, floods, community role wastewater, use of joukasou, visits to wastewater treatment plants (WWTP), water supply companies, and landfills, plants and river plants, compost, biopore, floods, and the role of the community in managing green areas
5	Senior High School second grade	High school theme, about the types of rivers, the role of rivers, waste in rivers, river management, floods, community role wastewater, use of joukasou, visits to wastewater treatment plants (WWTP), water supply companies, and housing

The teacher selected a theme based on the chapter and then identified the sub-theme before creating a storyline. This activity is conducted every two months, where teachers gather and produce books based on their collected data. The photos presented in Fig. 3 depict the teachers working on creating the book, which was carried

out at the Graha Kirana Building, one of the NGOs that participated in the book-making project. During the book-making process, the teacher creates an initial draft that includes an introduction, an explanation of the theme, the use of media, assignments, and evaluations.

**Fig. 3.** Textbook writing activities

#### *Evaluation of Textbooks*

The teacher's guidebook is a compilation of the evaluation results from the trial of student textbooks. During the trial, teachers take notes on the learning process, identify media and

teaching method deficiencies, and provide feedback on assignments and evaluations. These notes are recorded and used to create the teacher's guidebook, designed to support teachers using the student EE books to teach EE.

The revision and printing process for the teacher's guidebook takes approximately 7 months. The book is valuable for other teachers to use. Following data collection through polling survey on waste problems in the field, teacher interviews were conducted after the book trial. It was discovered that the teacher wished to create textbooks on other themes and that the student knowledge test results were promising.

Through this project, the implementation of EE programs for students and the community can continuously improve their knowledge, awareness, and attitude. A test on the knowledge and attitudes of elementary, middle, and high school students was conducted. The knowledge and attitude questions were adapted from the EE textbook compiled by the teacher EL. The knowledge and attitude of elementary and junior high school students were found to be similar. However, there was a difference in knowledge and attitude scores between high school and junior high, as well as high school and elementary school.

Since the beginning of the project, the EL teacher and the Kitakyushu City team have developed a plan to create an EL book. They started by conducting an opinion poll to identify environmental problems in the Deli River and then developed a theme to be included in the textbook that aligned with the elementary, middle, and high school curriculum and EE subject matter. However, due to the pandemic, the meetings for making the textbook were held online. They have been holding weekly meetings to continue creating teaching materials, and the textbooks are expected to be finished in March 2021, followed by testing at the beginning of April. The questionnaire results show that ELs have gained an understanding of how to create textbooks, teach EE, and feel capable of being agents of change. After the completion of the student books and teacher guidebooks, questionnaires were distributed to teachers to evaluate their experience in creating the books.



**Figure 4.** Trial of EE Book

This EE textbook was tested for one year in each school, with 30 grade 2 students involved. The book was tested based on chapters, with weekly meetings for 2-hour lessons over the course of a year. The trial results showed increased students' knowledge after studying EE using the PBL method. One of the discussion themes in the junior high school EE book are rivers and their surroundings. Students were assigned to analyze the condition of the river using the PBL method

from upstream, middle, and downstream perspectives. As a result, students drew pictures of the current and future river conditions, shown in Figure 5. The questionnaire distributed to the 25 teachers involved in making EE textbooks revealed that teachers with no prior experience writing books were interested in trying again after the training. Based on the PjBL methods done to the teachers as EL, they also gained valuable knowledge on how to make books.



**Fig. 5.** Students' drawings analyze the condition of the upstream, middle and downstream of a river

Incorporating elements of both PBL and PjBL can effectively provide students with a more engaging and meaningful learning experience (Wiek et al., 2014). As in this case, the teachers are trained using PBL and PjBL approaches, they are more likely to engage in the learning process. Therefore, the environmental problems can be solved by developing textbooks which are relevant to their lives and interests. Besides, teachers can create projects that are relevant and meaningful and require students to apply their knowledge and skills in real-world contexts. As environmental problems are complex, both approaches used in this research project can help them develop important communication and collaboration skills (Farrow et al., 2022; Indriyani Rachman et al., 2021; Sukackè et al., 2022).

### Conclusions

The success of the project in creating teaching materials is strongly supported by the role of the school and the teachers involved in the project-based activities, which provides teachers with experience in making books. Difficulties in bookmaking activities were encountered at the beginning of the writing process. Teachers had to determine the narrative, link pictures, and select appropriate learning media. However, the teachers became more skilled in making textbooks and finding information over time. The PjBL and PBL approach was successful when the teachers as part of the EL visited Kitakyushu City and saw real examples of EE implementation. They learned how to plan, teach, and evaluate EE, especially in river-related materials. After attending a workshop on textbook creation and completing their textbooks, the teachers wanted to try creating

books with other themes. This study shows that implementing PBL-PjBL approaches successfully improves the EL's environmental knowledge, especially the teachers of the Medan City schools.

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