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Ecobricks as an Educational Solution for Ecoliteracy Learning in Primary Schools

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Abstract. Plastic waste management in Indonesia, especially at the elementary school level, is an important issue that requires serious attention. This study aims to examine the effectiveness of using ecobricks as an ecoliteracy learning medium in elementary schools, with a focus on improving students' knowledge, attitudes and skills towards plastic waste management. This study used a mixed method approach with a triangulation design, combining quantitative and qualitative data. Quantitative data was obtained through pretests-posttests and questionnaire to measure changes in students' knowledge and attitudes, while qualitative data was collected through activity observations and interviews with classroom teachers to gain deeper insights into the learning outcomes. The results showed a significant increase in students' ecoliteracy knowledge and attitudes after participating in ecobrick learning. The majority of students showed increased engagement during the activities and there were positive changes in their behavior regarding plastic waste management. The implication of this study is that ecobrick-based learning can be an effective method in improving students' understanding, attitude and environmentally friendly behavior. However, there is still a need to strengthen the communication aspect and consistency of environmentally friendly behavior to ensure a sustainable impact on students.

Keywords: *ecobrick; ecoliteracy; plastic waste management*

INTRODUCTION

Plastic waste management in Indonesia has become a serious concern for the government, as evidenced by the issuance of Law Number 18 of 2008 concerning Waste Management which emphasizes the importance of sustainable waste management. In addition, Presidential Regulation Number 83 of 2018 targets a 70% reduction in plastic waste in the ocean by 2025. This effort shows that waste management, especially plastic waste, is a national program that requires active involvement from all levels of society. Therefore, there is a need for awareness efforts related to the implementation of plastic waste management (Widiastutie et al., 2025).

The education sector has a strategic role in supporting these goals. One form of real contribution to the world of education is by integrating sustainability issues, including plastic waste management, into the learning process. Research by Rahmawati (2022) shows that the direct involvement of students in plastic waste management activities can increase students' awareness and responsibility for the environment from an early age. This is very relevant to be applied at the elementary school level as an initial phase of character formation and values of concern for the environment.

Implementation in the field, especially in the elementary school environment, still faces various challenges. There are several schools that do not have an effective waste management

system such as the case study at SD Inpres Palsatu and SD Negeri Palsatu shows that the condition of waste disposal facilities in the two schools is not qualified with a percentage of only 20% (Villya Ariyani Lay et al., 2024). Another study also found the fact that plastic waste in one of the elementary schools in the city of Jambi was not managed properly which led to the emergence of environmental and health problems (Hidayati et al., 2023). According to Aziz et al (2022) the problem of high plastic waste in the city of Bekasi and the lack of students' understanding of ecoliteration.

The results of direct observation obtained in the field show that 2nd grade students of State Elementary School in the city of Bandung are used to producing waste in its place, it's just that they are still not used to sorting organic and inorganic waste, so there needs to be an effort to provide education related to environmental literacy. This statement is strengthened by the results of research from Maulana et al (2021) that Adiwiyata school still experiences obstacles in sorting waste and does not have environmentally friendly habits.

These studies further strengthen the reasons related to the need for creative methods that can improve the ecoliteracy of elementary school students. The problem related to the lack of education on plastic waste management is also strengthened by other research that states that there is no availability of interesting and suitable learning media for elementary school students in grades 1-2 related to plastic waste management (Basiroen et al., 2021)**.**

Environment-based learning is increasingly gaining attention in an effort to increase awareness of ecoliteracy among students, especially elementary school students. One of the approaches that is developing is the use of ecobricks, which are plastic bottles filled with residual waste such as food waste that cannot be recycled. Research by Ardiansari et al., (2024) mentioned that ecobricks have proven to be successful in forming the character of caring for the environment of students with real results in the form of recycled products. This is in line with the findings put forward by Aprilian & Zulfahmi, (2024) which states that ecobricks are able to foster children's independence and responsibility towards the environment.

which states that ecobricks are able to foster children's independence and responsibility towards the environment (Kurniasari et al., 2024). The above research is also strengthened by research from Khoirunnisa et al. (2021) which mentions that ecobricks are able to foster the character of love for the environment for children. The above studies are also strengthened by the results of research from Utomo et al. (2023) which states that there is an increase in knowledge related to plastic waste management through the ecobrick method.

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The problem of plastic waste is increasing day by day and has not been balanced with the ecoliteracy of students, especially elementary school students. The researcher sees the need to present an educational and applied learning approach to form the character of caring for the environment. The solution offered is the use of ecobricks as a learning medium that not only improves cognitive aspects, but also shapes students' attitudes and skills. According to Suminto (2017) ecobricks are creative efforts in managing plastic waste by extending their useful life and turning them into useful objects to reduce pollution and the impact of plastic toxins.

This study differs from previous research in that it integrates ecobricks directly in classroom learning activities with an interactive and real-action approach. Ecobrick media uses simple materials that are easy to obtain in the environment around the school (Aryanto et al., 2019) so it is easy to apply by any class level, including the lower class.

Based on this, this study aims to determine the effectiveness of the implementation of ecobricks as an educational medium in learning ecoliteracy in elementary schools. Its main focus is to improve students' knowledge, attitudes, and skills towards plastic waste management as well as encourage their active participation in environmental conservation.

METHODOLOGY

Type and Dsign

This research is a mixed method research with a triangulation design that combines quantitative and qualitative approaches in a balanced manner to obtain a comprehensive picture of the effectiveness of ecobrick activities as an educational solution in ecoliteracy learning in elementary schools. The quantitative approach is carried out through the provision of pretests-posttests and questionnaire to 2nd grade elementary school students to measure the improvement of understanding of ecoliteracy concepts and attitudes. Qualitative data was obtained through observation of learning activities carried out by competent external parties in the field of basic education, as well as interviews with classroom teachers to obtain homeroom teachers' perspectives on the learning process and outcomes.

The research will be carried out in March 2025 at one of the State Elementary Schools in the city of Bandung. The researcher was directly involved in the educational practice of plastic waste management through ecobrick activities, accompanied by homeroom teachers. The instruments used include pretest and posttest questions, observation sheets and interview guides.

Data and Data Sources

The data of this study includes quantitative data and qualitative data. Quantitative data in the form of pretest and posttest results of students were used to determine the improvement of understanding of ecoliteracy concepts and attitudes before and after ecobrick learning interventions. Qualitative data was obtained from direct observation during the learning process and interviews with classroom teachers after the learning process was completed to strengthen the results obtained from quantitative data.

The data sources in this study are grade 2 students totaling 25 students in one of the State Elementary Schools in the city of Bandung as respondents to ecobrick activities, competent internal observers in the field of basic education as parties who make observations to assess the objectivity of the research, while interviews are used to explore the views of homeroom teachers regarding student involvement, behavior change, and the effectiveness of ecobrick activities.

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Data analysis in this study was carried out by combining quantitative and qualitative analysis techniques. Quantitative data obtained from the results of the pretest-posttest and quesionneir were analyzed using the SPSS application. The initial stage of analysis includes a test of data normality and the data shows that the data is not distributed normally. Therefore, the analysis was continued by using the non-parametric Wilcoxon Signed-Rank Test to see the significance of the difference in pretest and posttest scores and to determine the improvement in students' understanding and behavior of ecoliteracy concepts and attitudes after participating in ecobrick activities.

Qualitative data from observations and interviews were analyzed in a qualitative descriptive manner. Observations were analyzed by calculating the average scores of five aspects of student activity on a scale of 1-4, then categorized into levels of activity, namely: excellent, good, adequate, and less which represent the variation in student activity during the learning process. Group behavior observations were summarized based on four indicators of

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involvement in ecobrick activities, while individual observations were conducted on five randomly selected students, the level of activity was assessed by observers based on direct observation. Observer comments include the activeness, focus, participation and cooperation of students during ecobrick activities. These comments were then analyzed thematically to identify emerging patterns of student behavior.

Interview data from homeroom teachers were analyzed using thematic analysis techniques to identify homeroom teachers' views regarding changes in students' habits in disposing of waste, changes in students' awareness of the importance of recycling plastic waste, and the influence of ecobrick learning on students' ecoliteracy attitudes. The results of these interviews are used to strengthen and deepen the interpretation of quantitative findings and observations.

RESULTS AND DISCUSSION

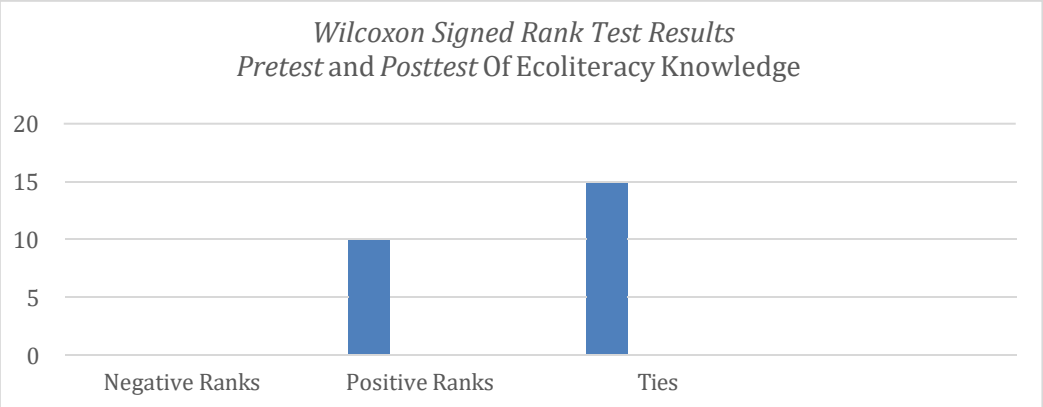
Results of Pretest and Posttest of Student Ecoliteracy Knowledge

Table 1. *Shapiro-Wilk Test Results*

Variable	Shapiro-Wilk Sig.	Conclusion
Ecoliteracy Knowledge Pretest	< 0.001	Not normal
Ecoliteracy Knowledge Posttets	< 0.001	Not normal

The results of the normality test showed that the significance value (Sig.) for the pretest and posttest data of ecoliteracy knowledge based on the Shapiro-Wilk test was < 0.001, which means that the data was not normally distributed. The Shapiro-Wilk test was chosen because the data count was less than 50, which is as many as 25 students. Therefore, the next analysis does not use parametric tests such as paired t-tests, but rather uses a more appropriate non-parametric test, namely the Wilcoxon Signed Rank Test to see the difference between pretest and posttest.

Diagram 1. *Wilcoxon Signed Rank Test Results*



The bar chart above illustrates the results of the comparative analysis of students' ecoliteracy knowledge pretest and posttest scores using the Wilcoxon Signed Rank Test. Based on the data, there were no students who experienced a decrease in posttest scores compared to the pretest (Negative Ranks = 0). A total of 10 students experienced an increase in grades (Positive Ranks), while 15 students had fixed or unchanged grades between pretest and posttest (Ties). These results show that some students experience improvement after learning, while others remain, without any decrease in grades.

Tabel 2. *Wilcoxon Signed Ranks Test Results*

Statistics	Value
Z	-2,825
Sig. (Asymp. Sig. 2-tailed)	0,005

Based on the results of the Wilcoxon Signed Ranks Test, a statistical value of Z was obtained of -2.825 with a significance value (Asymp. Sig. 2-tailed) of 0.005. Because the significance value is less than 0.05, it can be concluded that there is a significant difference between the pretest and posttest scores of students' ecoliteracy knowledge. These results show that the learning provided has a significant effect on improving the ecoliteracy knowledge of elementary school students.

Result Quesionare of Students' Ecoliteracy Attidudes

Tabel 2. *Shapiro-Wilk Test Result*

Variable	Shapiro-Wilk Sig.	Conclusion
Pretest Ecoliteracy Attitude	< 0.001	Not normal
Posttest Ecoliteracy Attitude	< 0.001	Not normal

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The results of the normality test showed that the significance value (Sig.) for the pretest and posttest data of ecoliteracy knowledge based on the Shapiro-Wilk test was < 0.001, which means that the data was not normally distributed. The Shapiro-Wilk test was chosen because the data count was less than 50, which is as many as 25 students. Therefore, the next analysis does not use parametric tests such as paired t-tests, but rather uses a more appropriate non-parametric test, namely the Wilcoxon Signed Rank Test to see the difference between pretest and posttest.

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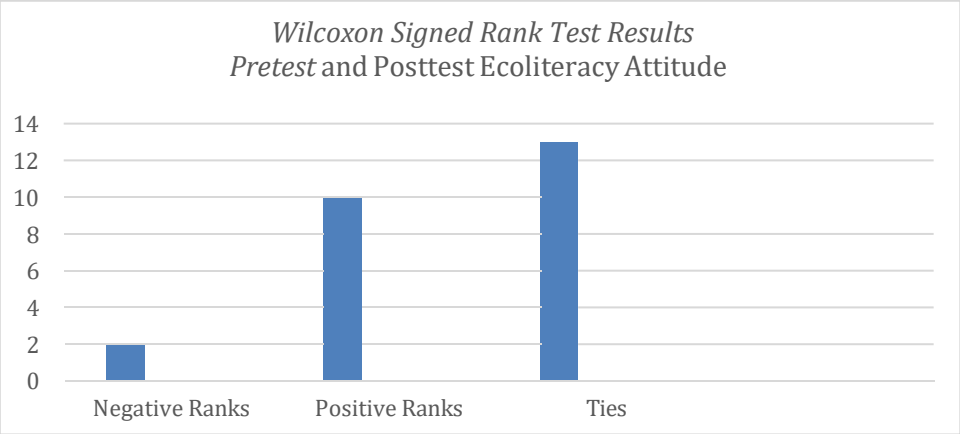

The bar chart above illustrates the results of a comparative analysis of pretest and posttest scores of students' ecoliteracy attitudes using the Wilcoxon Signed Rank Test. Based on the data, as many as 2 students experienced a decrease in posttest scores compared to (Negative Ranks). A total of 10 students experienced an increase in grades (Positive Ranks), while 13 students had fixed or unchanged grades between pretest and posttest (Ties). These results show that some students experience improvement after learning, while others remain, without any decrease in grades.

Table 2. *Wilcoxon Signed Rank Test Results*

Statistics	Value
Z	-2,528
Sig. (Asymp. Sig. 2-tailed)	0,011

Based on the results of the Wilcoxon Signed Ranks Test on the data of pretest and posttest students' ecoliteracy attitudes, a statistical value of Z was obtained of -2.528 with a significance value (Asymp. Sig. 2-tailed) of 0.011. Since the significance value is less than 0.05, it can be concluded that there is a significant difference between pretest and posttest

scores. These results show that there is a change in students' ecoliteracy attitudes after being treated, with a significant tendency to increase.

Observations

Based on the results of observations of student activity in learning activities of ecobrick making, it can be concluded that the level of student activity in general is very good. This is indicated by the majority of the aspects observed, such as paying attention to the teacher's explanations, participating in the creation of ecobricks, working with friends, as well as showing enthusiasm, all of which earned the category of "excellent". Meanwhile, the activeness aspect of asking or answering teachers' questions obtained a "good" category, which indicates that even though students have been actively involved in activities, their verbal involvement still needs to be improved. Thus, project-based learning such as ecobricks has been proven to be able to encourage students' physical and social activity, but still requires strengthening in the aspects of communication and verbal interaction.

In the aspect of student behavior in plastic waste management, the observation results show that most of the student groups have shown good to very good behavior. The indicators of self-carrying behavior of plastic waste obtained the highest scores across the group, reflecting the high awareness and responsibility of individuals towards the activity. Meanwhile, other indicators such as filling plastic bottles neatly and finishing ecobricks to full also showed good results, although with little variation between groups. The behavior of disposing of garbage in the right place still shows inconsistencies, which indicates the need for further coaching to instill discipline and the habit of disposing of garbage properly as part of the formation of a character of caring for the environment.

Meanwhile, the results of individual observations of five students showed that most students had a high level of activity, but the quality of participation varied. Some students show activeness accompanied by focus and the ability to work together, while others tend to be active but lack focus and often play around during activities. In addition, there are also students who are quite active but show a tendency to work individually without meaningful social involvement. These findings indicate that student activeness in learning not only needs to be improved in terms of quantity, but also in terms of quality, especially in terms of focus, discipline, and collaboration. Therefore, project-based learning strategies need to be designed comprehensively in order to form meaningful activeness and support the holistic strengthening of students' character.

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Interviews

The results of interviews with homeroom teachers showed that there was a positive change in students' awareness of waste management, especially after ecobrick learning. Before this program was implemented, students were generally used to throwing garbage in its place, but did not have the habit of sorting garbage. Although there are still some students who are less disciplined, especially when throwing away snack waste, ecobrick learning is starting to form new, more responsible behaviors. Students showed initiative by putting plastic waste in bottles to be used as ecobricks, and they even began to reprimand friends who threw garbage carelessly. This signifies the growth of social control and collective consciousness among students.

Awareness of plastic waste recycling and students' interest has begun to appear before ecobrick learning because of relevant extracurricular activities. However, after the ecobrick activities were carried out, there was a more real enthusiasm, although it was not yet fully visible due to the situation during the month of Ramadan which limited student activities. Some students even expressed creative ideas such as making chairs out of ecobricks, and began to show interest in involving families in recycling activities. This indicates that learning is starting to have an impact on the affective and social realms of students.

Overall, the homeroom teacher stated that ecobrick learning contributes to improving students' ecoliteracy. Children become more enthusiastic about environmental efforts and begin to show positive attitudes such as voluntarily cleaning classrooms. However, the main challenge faced is how to instill awareness and consistency, both among students and teachers. To strengthen the effectiveness of learning, it is recommended that there be tangible evidence of students' work that can be a trigger for further motivation. Thus, the ecobrick approach is not only a learning medium, but also a means of forming a character to care for the environment in a sustainable manner.

DISCUSSIONS

The results of this study show that the use of ecobricks as an ecoliteracy learning medium in elementary schools is effective in improving students' ecoliteracy knowledge and attitudes. The results of the pretest and posttest analysis showed a significant increase in students' ecoliteracy knowledge (table 1). Prior to using ecobrick media, students' understanding of plastic waste management was relatively low, which may be due to the lack of knowledge and involvement of students in practical waste management activities in schools (Rubini et al.,

2024). Previous research has shown that project-based teaching that engages students directly in practical activities has a greater impact on shaping their understanding (Al-Kamzari & Alias, 2025).

The results of the Wilcoxon Signed Rank Test showed a significant difference between the pretest and posttest scores of students' ecoliteracy knowledge (Z = -2.825, p = 0.005). These findings confirm that learning with ecobrick media is able to increase students' understanding of the importance of plastic waste management and sustainability. Previously, students were often unaware of the devastating impact of plastic waste, but by involving them in practical activities such as ecobrick making, they can see firsthand how plastic waste can be turned into useful and sustainable products. This is in accordance with research by Fadjarajani dan As'ari (2021), which states that the introduction of the concept of ecoliteracy through real activities can deepen students' understanding of waste management and sustainability (Ariyani et al., 2024).

In addition, the results of the Wilcoxon Signed Rank Test on students' ecoliteracy attitudes showed significant changes (Z = -2.528, p = 0.011), which reflects that ecobrick-based learning not only changes students' knowledge but also shapes their attitudes towards the environment. Most of the students showed an increase in attitudes that were more concerned about plastic waste management after participating in this activity. Previous research has also supported these findings, suggesting that environment-based learning can encourage students to develop a more caring attitude towards sustainability and environmental preservation(Ali et al., 2019).

The results of observations regarding student activity during ecobrick making activities showed that the majority of students were very enthusiastic and actively participated. They work together in groups to collect plastic waste, fill it into bottles, and create ecobricks. This liveliness shows that students feel more engaged when they can be directly involved in activities relevant to environmental issues. This is in line with research by Rupavijetra et al, (2022), which states that practical activities such as ecobrick making can increase student engagement in learning related to the environment (Silvia Rahayu et al., 2024).

However, although students' activeness in physical activity is excellent, observations show that students' verbal engagement, especially in asking questions and discussing, still needs to be improved. Some students tend to be more passive in communicating and more focused on the physical task at hand. This suggests that although activities such as ecobrick making increase students' physical activity, there is a need to strengthen their communication skills to

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deepen understanding and discussion of environmental issues. In this case, an approach that involves group discussions and reflection on ecobrick outcomes can be a good addition to increase students' verbal engagement (Wahyuningrum et al., 2019).

When it comes to waste management behavior, most students show positive changes in carrying their own waste and filling ecobrick bottles neatly. However, there is a slight inconsistency in the behavior of throwing garbage in the right place. Some students are still not used to sorting waste properly, which suggests that although awareness about plastic waste management is increasing, consistency in the implementation of eco-friendly habits still requires further attention. Silvia Rahayu et al. (2024) It also noted that although students' awareness of waste management has increased, the habit of disposing of waste properly still needs to be built more consistently (Putri et al., 2022).

Interviews with homeroom teachers show positive changes in students' social behavior, especially in terms of social control. Some students began to remind their friends to dispose of garbage in its place or even reprimanded friends who threw garbage carelessly. This shows that ecobrick-based activities not only affect students' understanding and attitude towards the environment, but also shape their social character to be more responsible for the cleanliness and sustainability of the environment in schools. This is in line with research by (Amelia et al., 2019), found that environment-based learning, such as ecobricks, can develop students' social awareness of the importance of waste management in the community (Az-Zahra et al., 2024).

Overall, the results of this study show that ecoliteracy learning using ecobricks is very effective in improving students' knowledge, attitudes, and behaviors related to plastic waste management. This learning has a significant impact, not only in the cognitive aspect of students, but also in shaping their attitudes and behaviors towards environmental issues. However, to ensure a sustainable impact, further strengthening is needed in aspects of verbal communication and consistency of students' environmentally friendly behavior.

CONCLUSION

The use of ecobricks as an ecoliteracy learning medium is effective in improving students' knowledge, attitudes, and behaviors towards plastic waste management. The results showed a significant increase in students' understanding, high activeness in activities, as well as positive changes in their attitudes and behaviors towards the environment. Nonetheless, the consistency of environmentally friendly behaviors, such as sorting waste, still needs further strengthening.

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