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The role of ecobrick workshops in raising plastic pollution awareness and encouraging intent for behavioral change

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ABSTRACT

Plastic pollution is a critical environmental issue, threatening wildlife, ecosystems, and human health. This study examines the effectiveness of ecobrick workshops in fostering plastic pollution awareness and strengthening intention to adopt sustainable behaviors among Malaysian, Indonesian, and Japanese students who took part in ecobrick workshops. A Likert-scale survey was used to collect responses from 30 workshop participants. Results indicate a significant increase in participants' awareness of plastic pollution (93.6%) and their perceived ability to reduce plastic waste (96.8%) following the workshops. Most of the students (87.1%) agreed that ecobricks are easy enough to be done at home, but only 54.8% of them were willing to do it at home. The workshops convinced 87.1% of the students that they are capable of minimizing plastic pollution and compelled 70.9% of the students that it is not difficult to reduce plastic waste. Collaborative work between students from different countries provided the opportunities for them to recognize a shared commitment to environmental preservation, highlighting the emergence of a global citizenship mindset transcending national boundaries. The workshops effectively conveyed the importance of sustainable development goals, further reinforcing participants' sense of collective responsibility. This research underscores the potential of experiential learning initiatives, such as ecobrick workshops, in promoting global citizenship and addressing environmental challenges across diverse contexts.

Keywords: environmental education, global citizenship, sustainability education

INTRODUCTION

Since the introduction of bakelite, the first synthetic plastic in 1907, the cheap and versatile qualities of plastic have rendered it very useful in many fields such as home appliances, food packaging, medical instruments and construction. For this reason, global plastic production has reached more than 450 million tons compared to just two million tons in 1950 (Ritchie et al., 2023). The sheer volume of plastic production has led to improper management of plastic waste, causing serious environmental issues. Plastic waste that are not recycled, incinerated or kept in sealed landfills become environmental pollutants. It is estimated that more than 10% of the global plastic waste generated found its way into aquatic environments (Borrelle et al., 2020). Annually, up to 2.7 million tons of plastic waste end up in the oceans (Meijer et al., 2021), posing an immediate threat to wildlife and ecosystems. Without immediate intervention, such a volume of plastic added to the world's aquatic environments would displace an equal volume of water, shrinking aquatic habitats, increasing the risk of floods, and aggravating global warming (Iroegbu et al., 2020). These phenomena result in widespread negative impacts on livelihood, such as endangering individuals and communities, destroying properties, and straining healthcare facilities and resources, government budgets, and the insurance industry.

Raising concern on the pervasive global challenges on human livelihood and the environment has prompted the consolidated global efforts to achieve a long list of targets in the sustainable development goals (SDGs) that prioritize sustainable and healthy earth for all. The plastic pollution issue has changed the way that people discuss climate change, the ocean, and environmental sustainability (Shen et al., 2020). As activism against plastic pollution is gaining momentum across the world, global leaders, governments, and other interested parties are working together to develop a comprehensive solution to the plastic pollution problem.

People's behavior on management of plastic waste can be influenced by their level of concern, attitudes and knowledge (Hartley et al., 2015). In this perspective, the role of society in creating and distributing scientific knowledge can improve the environmental mindset and reduce the dumping of plastics in the environment (Oliveira et al., 2019). To mobilize societal participation in combating plastic pollution, environmental education can serve as a low cost yet effective agent of social change (Sur et al., 2018). The number of educational programs in school is only growing to increase awareness and more responsible behaviors among young people (Dalu et al., 2020; Hartley et al., 2018). Young people can act as informal educators within their families and among their peers (Kusumawati et al., 2020). Beach clean-ups, magazine articles and television programs have been reported to be successful in educating the public about the marine pollution (Williams & Rangel-Buitrago, 2019). Participation of the public in citizen science, particularly in terms of plastic studies have even resulted in scientific publications (Camins et al., 2020; Syberg et al., 2020).

Ecobricks for Environmental Education

Ecobricks have gained much attention in plastic waste management (Kulathiaka & Abesinghe, 2023) through its application as construction materials (Brunette et al., 2021; Jha & Kewate, 2024; Li, 2022). In the context of environmental education, ecobricks serve as a tangible tool through which students can actively participate in the process of recycling and repurposing plastic waste. This engagement not only enhances their awareness of plastic pollution but also empowers them with the skills to create usable building materials from waste. The process of making ecobricks–collecting, cleaning, and compacting plastic waste into bottles–teaches students valuable lessons in resourcefulness, creativity, and responsibility (Afifah & Rafiah, 2020). These activities foster a sense of ownership and accountability, encouraging students to adopt sustainable practices in their daily lives.

Moreover, the educational use of ecobricks can stimulate interest in broader environmental issues and inspire future actions towards sustainability. By witnessing the transformation of waste into something useful, students can better appreciate the potential for innovative solutions in addressing environmental challenges (Aqil et al., 2023). This experiential learning approach not only solidifies theoretical knowledge but also promotes critical thinking and problem-solving skills. Through the integration of ecobricks into environmental education, schools can cultivate a culture of sustainability, where students are motivated to become proactive stewards of the environment, contributing to a more sustainable and resilient future.

Ecobricks project is gaining traction in Malaysia as more schools are embracing it as a practical approach to teach children about environmental sustainability (Lai, 2023). The environmental benefits of making ecobricks should not be underestimated. Research suggests that the production of 1 kg of virgin plastic typically requires about 1.7 to 2.0 kg of petroleum feedstock (Al-Salem et al., 2009; Hopewell et al., 2009). Since ecobricking involves the repurposing of post-consumer plastic waste without the need for industrial reprocessing, it circumvents the production of an equivalent amount of new plastic and the associated consumption of fossil fuels. However, it is important to consider that plastic recycling processes themselves consume energy and materials, which diminishes the net environmental benefit. The CO_2 emissions from producing recycled plastic can be up to 50% lower than those from virgin plastic. Yet, variations exist depending on the type of plastic, processing technologies, and regional energy mixes. Additionally, recycling inefficiencies may result in 1 kg of raw plastic waste yielding less than 1 kg of usable recycled plastic (Geyer et al., 2017). In terms of carbon emissions, estimates for virgin plastic production range from 2.5 to 3.5 kg CO_2 per kg of plastic (Andrady, 2011), while recycled plastic production emits approximately 1.1 to 1.8 kg CO_2 per kg (Hopewell et al., 2009; Material Economics, 2018). Therefore, ecobricking, which does not involve remanufacturing processes, could potentially avoid emissions within this range. Given these variables, a more conservative and representative estimate would be that ecobricking 100 kg of plastic may avoid between 250 to 350 kg of CO_2 emissions, depending on the type and origin of plastic material being diverted from the waste stream. Reduction in carbon dioxide emission can help to mitigate global warming which affects crops yield, leading to food security issues.

Existing studies on ecobricking have primarily focused on enhancing students' knowledge, creativity and ecoliteracy (Afifah & Rafiah, 2020; Aqil et al., 2023; Santi at al., 2023). However, few studies have examined its role as an educational tool to instill a sense of responsibility and empowerment in individuals. Despite its growing adoption in education for sustainability, there is limited research dedicated to elucidating how ecobrick workshop can be conducted effectively and investigating its contribution in empowering students to act against plastic pollution. This study addresses this gap by evaluating the impact of ecobrick workshops on participants' awareness of plastic pollution and their willingness to adopt sustainable practices. Unlike previous research, which often assumes that providing environmental knowledge translates directly into action, this study investigates the extent to which hands-on participation in ecobricking fosters perceived self-efficacy and behavioral intent.

By addressing these gaps, this study contributes to the growing body of knowledge on community-driven sustainability initiatives and offers insights into how interactive, solution-oriented workshops can enhance environmental stewardship. The findings have implications for educators, policymakers, and environmental organizations seeking to design more effective engagement strategies to combat plastic pollution.

Problem Statement

The need for efficient and sustainable remediation solutions to combat plastic pollution using today's science and technology is urgent (Schmaltz et al., 2020). Current technologies for resolving plastic pollution fall under two categories of prevention or collection of plastic pollution. Most emerging technologies were developed to collect plastic scattered in the environment (Schmaltz et al., 2020). Although the large-scale popularization and implementation of these

Table 1. Questionnaire structure

Section	Content	Number of items
A	Demography	3
B	Workshop conduct	5
C	Awareness	3
D	Motivation to act	5

Table 2. Workshop structure

Part	Content	Duration (minute)
1	Introduction to ecobrick	20
2	Making ecobrick product	60
3	Presentation of ecobrick product	20
4	Quiz & summary	20

technologies can retard plastic pollution, the financial feasibility and costs are barriers, especially in some developing countries.

Environmental education can provide a feasible yet low-cost pathway, to engage society in plastic pollution prevention. A socio-economic model based on World Bank data estimated that inadequately managed plastic waste will decrease by 34% if education on plastic pollution is put to good use (Cordier et al., 2021). Environmental education to mitigate plastic pollution was proposed to be included in the first nine years of education (Soares et al., 2021). Undoubtedly, the contribution of environmental education in providing a permanent solution at low cost to plastic pollution from the perspective of environmental awareness and actual pro-environmental behavior should be taken seriously.

Research Objectives

Specifically, the research was intended to achieve the following objectives:

(a) to explore students' opinion about the ecobrick workshop,

(b) to assess how the workshop has influenced students' awareness about plastic pollution, and

(c) to analyze students' motivation to reduce plastic waste after joining the ecobrick workshop

METHODOLOGY

This is a qualitative study to evaluate the effectiveness of the ecobrick workshop in improving students' attitude and motivation to reduce plastic waste. Respondents in this study were students who took part in the ecobrick workshop.

A survey questionnaire has been prepared to collect responses from the workshop participants. The questionnaire consists of 17 items in four sections (**Table 1**). There is also an open-ended item for workshop respondents to provide open-ended responses.

A two-hour workshop on making ecobricks was carried out based on a four-part structure (**Table 2**). At the beginning of the workshop, students were briefed on the issue of plastic pollution, i.e., the harm plastic pollution is causing to the natural environment, particularly to wildlife and human health. To reduce the impact of plastic pollution, ecobrick was introduced as a simple method that does not require high

Figure 1. Students making ecobricks with used plastic bottles and plastic bags (Source: Field study)

Figure 2. Stools made from ecobricks (Source: Field study)

technology to prevent plastic waste from polluting the environment. Students were also given instruction on how to make ecobrick and shown some examples of objects that they could construct using the ecobricks. After the introduction to ecobrick, students worked in groups and were given 60 minutes to make ecobricks out of used plastic bottles, plastic bags and wrappers they brought from home (**Figure 1**).

Students had to compact as many plastic bags as possible into empty plastic bottles to make ecobricks hard. When the ecobricks were ready, they had brainstorming to think of what they could make using the ecobricks and finally used ecobricks to make stools that could really be used as seats (**Figure 2**).

Each group showed their ecobrick stools and shared their experience working with ecobricks. To reinforce the intended message on plastic pollution at the end of the workshop, students were given an online quiz and reminded of the danger of plastic pollution and their responsibilities to reduce plastic waste in their daily lives.

At the end of the workshop, students filled in the questionnaire prepared on Google Form. Students' responses were analyzed descriptively in percentage. Open-ended responses were analyzed thematically as recommended by Naeem et al. (2023). Thematic analysis was used as it often leads to new insights and understanding (Thomas, 2006). During the analysis, researchers' own preconceptions were

Table 3. Workshop structure

		Frequency (N)	Percentage (%)
Gender	Male	14	46.7
	Female	16	53.3
Nationality	Malaysian	8	26.7
	Indonesian	14	46.7
	Japanese	8	26.7

avoided as it may cause interference with the identification of key themes (Patton, 2015). Such preconception-free evaluation corresponds well with inductive research for theories or concepts to be developed from the responses provided by the participants.

FINDINGS & DISCUSSION

Respondents of this study consist of 16 female students and 14 male students, aged between 11 to 17 years old, from different nationalities (**Table 3**).

The workshop has achieved its primary objective as 93.6% of the students agreed that they have learnt how to cut down on plastic waste (**Table 4**). The students also found the workshop interesting (96.7%) implying that the structure and delivery of the workshop was appealing to them. The making ecobricks was not difficult for them. Less than 10% of participants thought it was difficult. Used plastic bottles and plastic bags needed for the workshop could be obtained easily too.

This workshop also managed to raise students' awareness about plastic pollution (93.6% agreement) and their responsibility to reduce plastic waste (96.8% agreement). Awareness is the first step in addressing any environmental issue, including plastic pollution. By understanding the magnitude and consequences of plastic pollution, individuals and communities become more conscious of their actions and their impacts on the environment. Generally, people recognize society's important role in raising awareness and to develop mitigation strategies. Higher perception was reported by women and participants with a higher level of school education (Soares et al., 2021). Awareness programs educate people about the sources of plastic pollution, how it affects wildlife, ecosystems, and human health. This foundational knowledge is crucial for fostering a sense of urgency and responsibility. When individuals are aware of the problem, they are more likely to make informed decisions that contribute to reducing plastic waste, such as choosing reusable products over single-use plastics.

It is interesting to note that while 87.1% of participants could make ecobricks, only 54.8% of them would do it at home. This is consistent with other research findings, reporting that knowledge alone is not sufficient to prompt changes in environmental behavior. Tiwi (2006) noted that knowledge contributes little to improving environmental attitudes. Correct environmental knowledge has been shown to predict pro-environmental choices (Levine & Strube, 2012). However, another study indicated otherwise (Murugan, 2019). Clearly, change in the desired pro-environmental behavior is influenced by various complex factors. Gifford and Nilsson (2014) identified 18 personal and social factors that may affect change in environmental behavior. In fact, some pro-environmental behavior was prompted by non-environmental-related intentions such as saving money or improving health. Sociodemographic factors, situational characteristics and trust in sources of environmental information also play significant role in making changes in environmental behavior (Barr, 2007; Díaz et al., 2020).

There is higher agreement among participants that ecobrick-making can be carried out in school (93.6%). This seems to suggest that environmental education is expected to happen within formal education setting instead of informal setting at home. Students could enjoy the company of friends and benefit from teacher-facilitated activities (Afifah & Rofiah, 2020; Aqil et al., 2023). The expectation that environmental education should take place in school could stem from parents' reluctance to inculcate pro-environmental lifestyle at home (Lai, 2023). However, parents play a very critical role in habituating pro-environmental behavior among children from a young age (Keong et al., 2023).

Following the workshop, 87.1% of participants expressed willingness to reduce plastic pollution, suggesting a perceived readiness to act on environmental issues. However, as no pre-

Table 4. Participants' responses on workshop conduct, awareness, and motivation to act

		Responses (%), n = 30				
		SD	D	NS	A	SA
Workshop conduct						
1	I learned how to reduce plastic waste from this workshop.	0.0	0.0	6.5	35.5	58.1
2	The Ecobrick Workshop is interesting.	0.0	0.0	3.2	54.8	41.9
3	The instructions given were clear.	0.0	0.0	0.0	58.1	41.9
4	The materials needed were difficult to find.	29.0	48.4	16.1	6.5	0.0
5	Making ecobrick was a difficult activity.	19.4	48.4	25.5	3.2	3.2
Awareness						
6	This workshop raises my awareness about plastic pollution.	0.0	0.0	6.5	45.2	48.4
7	This workshop teaches me to be responsible in reducing plastic pollution.	0.0	0.0	3.2	48.4	48.4
Motivation to act						
8	I can make ecobrick at home.	0.0	0.0	12.9	41.9	45.2
9	I will make ecobrick at home.	0.0	0.0	45.2	38.7	16.1
10	Making ecobrick can be carried out in school	0.0	0.0	6.5	45.2	48.4
11	From this workshop, I learned that I am capable of reducing plastic pollution.	0.0	0.0	12.9	51.6	35.5
12	Reducing plastic waste is a difficult thing to do.	16.1	54.8	16.1	6.5	6.5

Note. SD: Strongly disagree; D: Disagree; NS: Not sure; A: Agree; & SA: Strongly agree

Table 5. Thematic analysis of open-ended responses

	Theme	Code	Transcripts
1	Increased awareness and knowledge	Knowledge gain	*"Thank you so much for the entire committee for the wonderful learning and we gained knowledge on reducing plastic waste and pollution as well."*
		Learning benefits	*"I learnt how to reduce plastic and how to make something from plastic waste."*
2	Positive emotion	Enjoyment	*"It's a very fun activity."* *"The workshop is really interesting."*
		Satisfaction	*"It was a very enjoyable experience and provided many benefits for me and many people."*
3	Practical application and creativity	Creative outputs	*"With ecobrick we can make sofa, small chair, and other things."* *"This thing can make our creativity increase and decrease for reducing plastic waste."*
		Practical projects	*"Do ecobrick project in school."*
4	Promotion of environmental responsibility	Environmental awareness	*"Good program to spread awareness about plastic pollution."*
		Global citizenship	*"From this ecobrick I learn many things like the benefit of ecobrick is saving earth, global warming, R3 from waste material."*
5	Suggestions for improvement	Novelty	*"For the suggestions … maybe we can try other things like something new."*
		Incentives	*"Maybe you can make this program more interesting with giving a present if we finish the task first (my suggestion)."*

workshop survey was conducted, this finding may not reflect an actual increase in motivation. Participation in this workshop can be a meaningful childhood experience to have a positive impact on pro-environmental behavior later in their lives (Broom, 2017).

Analysis of open-ended responses have identified five main themes, as summarized in **Table 5**. Many participants expressed that the workshop significantly enhanced their understanding of plastic pollution and how to mitigate it. Participants frequently mentioned enjoyment and positive feelings towards the workshop. There were several mentions of the practical uses of ecobricks and the creativity involved in the process. Some participants highlighted the importance of the workshop in promoting sustainable behavior and environmental responsibility. There were also participants who provided constructive feedback and suggestions for future workshops.

The thematic analysis of the responses indicates that the ecobrick workshop was largely successful in raising awareness about plastic pollution, enhancing creativity, and promoting sustainable behaviors among participants. Positive emotional responses and practical applications of the workshop's teachings were frequently mentioned, along with constructive feedback to further improve engagement and effectiveness. The participants' feedback underscores the workshop's potential in fostering a sense of global citizenship and collective responsibility towards environmental preservation.

Several implications can be derived from the findings of this study. The increase in awareness and perceived ability to reduce plastic waste indicates the effectiveness of experiential learning in environmental education. This suggests that practical, hands-on activities like ecobrick workshops can significantly enhance environmental literacy among students. The moderate willingness to make ecobricks at home suggests that while awareness is a critical first step, additional motivational strategies may be needed to convert awareness into consistent sustainable behavior. The workshops also hold the potential to foster a global citizenship mindset, which is crucial for addressing transnational environmental issues. This indicates that international collaboration in educational programs can enhance students' sense of global responsibility. The findings support the integration of experiential learning activities into school curricula to promote sustainable practices. Policymakers and educators should consider incorporating such workshops to foster long-term behavioral change.

CONCLUSION

This study underscores the role of ecobrick workshops in raising awareness about plastic pollution and enhancing the intention to adopt sustainable behaviors among students from Malaysia, Indonesia, and Japan. The findings revealed that the workshops were effective in increasing participants' awareness (93.6%) and their perceived ability to reduce plastic waste (96.8%). Despite the high perceived ease of making ecobricks (87.1%), the willingness to do so at home was moderate (54.8%), highlighting a gap between awareness and action. Collaborative international participation fostered a sense of global citizenship, emphasizing shared responsibility towards environmental preservation. The workshops also effectively conveyed the importance of environmental sustainability, reinforcing participants' collective responsibility.

The ecobrick workshops have demonstrated potential in promoting environmental awareness and sustainable behaviors among students. By addressing the gap between awareness and action and fostering a sense of global citizenship, such initiatives can play a crucial role in combating plastic pollution and achieving SDGs. Future efforts should focus on enhancing motivation, broadening the scope of activities, and fostering long-term behavioral change through comprehensive educational strategies and community engagement.

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