Journal of Academic Biology and Biology Education
Vol. 2, No. 2, December 2025, pp. 264~280
ISSN: 3062-9705, DOI: 10.37251/jouabe.v2i2.3291

Fostering Environmental Awareness Through Environmental Learning: A Cross-Country Study in Zambia, Brunei Darussalam, and Nigeria

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Article Info

Article history:

Received Oct 27, 2025
Revised Nov 26, 2025
Accepted Dec 19, 2025
Online First Dec 26, 2025

Keywords:

Behavioral Transformation
Education for Sustainable Development
Environmental Awareness
Environmental Citizenship
Environmental Learning

ABSTRACT

Purpose of the study: This study examines the implementation of Environmental Learning in fostering environmental awareness and behavioral transformation among elementary school students across different developing-country contexts. The study addresses the limited comparative research on environmental learning practices and behavioral outcomes in diverse socio-cultural and educational settings.

Methodology: A qualitative multi-site case study design was employed in three public elementary schools located in Lusaka (Zambia), Bandar Seri Begawan (Brunei Darussalam), and Calabar (Nigeria). Participants consisted of 90 students aged 9–11 years and six teachers selected through purposive sampling. Data were collected through classroom observations, semi-structured interviews, and document analysis. Trustworthiness was ensured through triangulation, member checking, expert validation (CVI = 0.91), and intercoder reliability procedures (Cohen's Kappa = 0.86). Data were analyzed using thematic analysis and cross-case comparison.

Main Findings: The findings indicate that Environmental Learning effectively promotes environmental awareness, environmental responsibility, and sustainable behavioral practices. Students demonstrated positive behavioral changes, including proper waste disposal, environmental cleanliness, resource conservation, and active participation in environmental activities. Cross-country analysis revealed contextual differences in implementation. In Zambia, environmental learning emphasized community participation and local environmental challenges; in Brunei Darussalam, implementation was supported by stronger institutional policies and sustainability-oriented school programs; while in Nigeria, community engagement played a central role despite infrastructure limitations.

Novelty/Originality of this study: his study contributes to environmental education literature by providing comparative evidence from three developing countries and demonstrating how environmental learning promotes behavioral transformation through constructivist, experiential, socio-cultural, and environmental citizenship processes.

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1. INTRODUCTION

Environmental concern has emerged as a significant focus in education worldwide due to the increasing severity of environmental degradation across many regions [1], [2]. As a key instrument for social transformation, education contributes substantially to developing students' attitudes, values, and behaviors toward environmental stewardship from an early age [3], [4]. Through meaningful learning experiences, students can gain a deeper understanding of the interdependence between humans and nature, as well as the necessity of preserving ecological balance. In response to growing environmental challenges, educational institutions in numerous countries have incorporated environmental topics into their curricula to support the principles of sustainable development [5], [6]. This initiative aligns with the Sustainable Development Goals (SDGs), particularly Goal 4 (Quality Education) and Goal 13 (Climate Action), both of which highlight the essential role of education in promoting environmental awareness and encouraging sustainable practices within society.

The Environmental Learning model is considered an effective learning approach for developing environmental awareness and responsibility in students [7], [8]. This model emphasizes direct experience, observation of the surrounding environment, and active student involvement in solving environmental problems. Learning focuses not only on knowledge but also on developing environmentally conscious attitudes and behaviors [9], [10]. In its implementation, students are encouraged to understand various environmental issues through contextual activities relevant to everyday life [11], [12]. This approach supports the implementation of the SDGs, particularly in developing a generation that is aware of environmental sustainability and able to participate in preserving nature.

Developing countries such as Zambia, Brunei Darussalam, and Nigeria place significant emphasis on developing environmental education as part of efforts to maintain the sustainability of natural resources. In Zambia, environmental education has begun to focus on strengthening public awareness of natural resource management and environmental conservation [13], [14]. Brunei Darussalam places sustainability education as a key component of its national education system to develop an environmentally responsible generation [15], [16]. Meanwhile, Nigeria faces various environmental challenges that require enhanced environmental education in schools [17], [18]. This academic collaboration from various countries demonstrates a global commitment to supporting the achievement of the SDGs through strengthening environmental education in schools.

Implementing the Environmental Learning model in the learning process requires systematic planning to optimally achieve environmental education goals. Teachers play a crucial role in designing learning activities that actively engage students in environmental activities [19], [20]. Learning can be conducted through discussions, field observations, hands-on practice, or environmentally-based projects that encourage student participation [21], [22]. These activities help students understand the impact of human behavior on the environment and the importance of preserving nature. Environmentally-oriented learning also supports SDG Goal 12, which focuses on responsible consumption and production, by fostering environmentally conscious behavior in students [23], [24].

Students' environmental awareness can be strengthened when learning activities provide authentic experiences that are closely connected to their everyday lives. The school setting serves as an effective medium for cultivating responsible habits, including maintaining cleanliness, managing waste properly, and utilizing resources efficiently [25], [26]. Through the Environmental Learning model, students are encouraged to recognize environmental issues within their surroundings and work collaboratively to develop appropriate solutions. Learning experiences that promote teamwork and social responsibility further contribute to enhancing students' understanding of the importance of environmental conservation [27], [28]. Such efforts are consistent with the objectives of the Sustainable Development Goals (SDGs), which emphasize active community involvement in fostering a healthy and sustainable environment. Beyond the implementation of instructional activities, assessment constitutes an essential component of the Environmental Learning model. Evaluation is carried out to measure the effectiveness of the model in improving students' environmental awareness [29], [30]. This process extends beyond assessing cognitive achievement and also examines students' attitudes and behaviors related to environmental stewardship in their daily lives. To achieve a comprehensive evaluation, teachers may employ a variety of assessment methods, including observations, project-based assessments, interviews, and reflective activities that encourage students to evaluate their own learning experiences [31], [32]. Effective assessment practices can support schools in advancing the SDGs by reinforcing environmental character education and promoting the development of a sustainable school culture.

The existing literature has demonstrated that environmental education and environmental learning can improve students' environmental awareness, literacy, and pro-environmental attitudes. However, several important gaps remain. Most previous studies have been conducted within a single country or specific educational context, limiting understanding of how environmental learning is implemented across different social, cultural, and environmental settings [33], [34]. Comparative studies involving developing countries are still limited, despite the fact that these countries face diverse environmental challenges and educational conditions [35], [36]. Previous research has predominantly focused on cognitive outcomes, environmental literacy, or environmental beliefs, while limited attention has been given to examining how environmental

learning contributes to students' behavioral transformation and the development of environmentally responsible practices [37], [38]. Therefore, there remains a need for cross-country research that explores the implementation, learning processes, and behavioral outcomes of environmental learning in different developing-country contexts. This study addresses these gaps by examining environmental learning practices in Zambia, Brunei Darussalam, and Nigeria and analyzing how such practices foster environmental awareness and behavioral change among elementary school students.

The novelty of this study extends beyond its multi-country scope by offering a comparative analysis of environmental learning practices in three developing countries that differ in their social, cultural, and environmental contexts. While previous research has largely concentrated on environmental knowledge, literacy, or attitudes within a single educational setting, the present study explores both the implementation of environmental learning and its influence on shaping students' environmentally responsible behaviors across diverse national contexts [39], [40]. In addition, this research provides empirical evidence regarding the connection between contextualized environmental learning experiences and the development of pro-environmental behavior among elementary school students. By drawing comparative insights from Zambia, Brunei Darussalam, and Nigeria, the study enriches the existing literature on environmental education in developing countries and generates practical implications for policymakers and educators seeking to advance the Sustainable Development Goals (SDGs), particularly those related to quality education, environmental awareness, and sustainable development.

The importance of this study stems from the growing prevalence of global environmental challenges, including climate change, pollution, ecosystem degradation, and the limited environmental awareness exhibited by younger generations. These issues highlight the necessity of implementing more effective environmental education approaches that can cultivate environmentally responsible attitudes and behaviors among students from an early age [41], [42]. Educational institutions, particularly schools, occupy a pivotal position in promoting environmental awareness through learning experiences that are active, contextualized, and sustainable. Nevertheless, environmental education in many schools remains predominantly theoretical, with insufficient emphasis on translating knowledge into meaningful behavioral change. Consequently, this study is significant because it seeks to examine how the Environmental Learning model is planned, implemented, and evaluated in fostering students' environmental awareness. By exploring these aspects, the research aims to provide a deeper understanding of the effectiveness of environmental learning in encouraging pro-environmental attitudes and behaviors within educational settings.

Given the various global environmental issues and the importance of strengthening environmental education in schools, implementing the Environmental Learning model is a strategic step in fostering environmentally conscious character in students [26], [43]. This learning model is expected to provide contextual, active learning experiences that are oriented toward developing real-world behaviors in environmental preservation. However, the implementation of the Environmental Learning model in schools still requires more in-depth study, particularly regarding the implementation, execution, and evaluation processes in fostering students' environmental awareness. Therefore, this research was conducted to comprehensively analyze the implementation of the Environmental Learning model in learning. The primary objective of this research was to understand the process of implementing, executing, and evaluating the Environmental Learning model in fostering environmental awareness in students.

2. RESEARCH METHOD

2.1. Research Approach and Type

This research adopted a qualitative multi-site case study approach to investigate the implementation of the Environmental Learning model in promoting environmental awareness among elementary school students in Zambia, Brunei Darussalam, and Nigeria. A qualitative methodology was chosen because it allows for a comprehensive exploration of participants' experiences, perspectives, behaviors, and educational practices within real-life contexts [44], [45]. By utilizing a multi-site case study design, the researchers were able to compare environmental learning practices across three countries with different educational, social, and environmental characteristics, thereby identifying both common patterns and contextual variations. Rather than emphasizing hypothesis testing or statistical analysis, the study sought to understand the processes through which environmental learning was carried out, the ways students engaged with learning activities, and how environmental awareness was reflected in their behaviors and experiences. The research was informed by a constructivist paradigm, which views knowledge as being developed through social interaction and lived experience [46], [47]. Accordingly, environmental awareness was explored through multiple sources of evidence, including classroom and school observations, semi-structured interviews, and document analysis collected from participants at the three study sites. This approach enabled a richer understanding of how environmental learning contributes to the development of environmentally responsible attitudes and practices among students.

2.2. Research Location and Sample

The study was carried out in three elementary schools located in Lusaka, Zambia; Bandar Seri Begawan, Brunei Darussalam; and Calabar, Nigeria. These schools were purposively selected because they had incorporated environmental-based learning into both their instructional activities and student character development programs. The research specifically examined how the Environmental Learning model was implemented to promote environmental awareness among elementary school students [48], [49]. Participants included fourth-grade students and teachers who were actively engaged in environmental learning activities within their respective schools. The selection of the research sites was also guided by the diverse social, cultural, and environmental contexts represented by the three countries. Such variation provided an opportunity to explore environmental learning practices across different settings and to obtain a more comprehensive understanding of how the Environmental Learning model contributes to the development of environmental awareness among elementary school students.

The selected schools were public elementary schools that had actively implemented environmental education programs and environmental learning activities for at least two years prior to the study. The schools were chosen purposively because they represented different socio-cultural and environmental contexts within developing countries and demonstrated institutional commitment to environmental awareness initiatives [50], [51]. The selection of these schools enabled comparative exploration of environmental learning practices across diverse educational settings. The participants consisted of fourth-grade students aged between 9 and 11 years and teachers directly involved in environmental learning activities. Fourth-grade students were selected because they had sufficient cognitive and social development to participate actively in environmental learning programs and to articulate their learning experiences during interviews.

The population in this study was all elementary school students and teachers at the three schools selected, with a total population of 186 students and 12 teachers. The sample consisted of 90 students and 6 teachers, selected purposively based on their active involvement in environmental learning implementation at school. The student sample was distributed equally across the three research sites, consisting of 30 students from Lusaka (Zambia), 30 students from Bandar Seri Begawan (Brunei Darussalam), and 30 students from Calabar (Nigeria). In addition, two teachers from each school participated in the study, resulting in a total of six teacher participants. Among the student participants, 46 were female and 44 were male, providing relatively balanced gender representation across the research sites.

The sampling technique used was purposive sampling, which involves selecting samples based on specific considerations in line with the research objectives [52], [53]. The sample criteria included student active participation in environmental learning activities and involvement in the school's environmental awareness program. Meanwhile, the teachers selected as samples were teachers who directly implemented the Environmental Learning model in the classroom learning process.

Table 1. Participant Characteristics

Research Site	Students (n)	Teachers (n)	Age Range (Years)	Female	Male
Lusaka, Zambia	30	2	9–11	15	15
Bandar Seri Begawan, Brunei Darussalam	30	2	9–11	16	14
Calabar, Nigeria	30	2	9–11	15	15
Total	90	6	9–11	46	44

2.3. Data Collection Techniques

Data were collected through observations, interviews, and document analysis to obtain comprehensive and credible information regarding the implementation of the Environmental Learning model in fostering students' environmental awareness. Observations were conducted directly during learning activities in the selected elementary schools located in Lusaka, Zambia; Bandar Seri Begawan, Brunei Darussalam; and Calabar, Nigeria. During these observations, the researchers examined teacher and student interactions, students' participation in environmental activities, the utilization of instructional media, and the condition of the school environment. In addition, attention was given to identifying factors that facilitated or constrained the implementation of environmental learning practices [54], [55]. To ensure a thorough understanding of the learning process, observations were carried out repeatedly and within natural classroom and school settings. This prolonged engagement enabled the researchers to capture authentic educational practices and gain a comprehensive understanding of how the Environmental Learning model was implemented across the three schools. The observational data provided valuable insights into the ways environmental education was integrated into daily learning activities and how students demonstrated environmental awareness through their participation and behavior.

Semi-structured interviews were conducted with school principals, six teachers, and 90 students who were selected through purposive sampling. The interviews explored various aspects of the Environmental Learning model, including its planning, implementation, and evaluation. Particular attention was given to

instructional strategies employed by teachers, students' learning experiences, and perceived changes in environmental awareness and behavior following participation in environmental learning activities [56], [57]. This approach allowed participants to share detailed insights while ensuring that key themes relevant to the study objectives were consistently addressed.

In addition to observations and interviews, document analysis was employed to collect and examine relevant materials, including teaching modules, lesson plans, student assessment records, photographs of learning activities, and other supporting documents. These documentary sources served to complement and validate the information obtained through observations and interviews, thereby enhancing the completeness and accuracy of the research data. To strengthen the trustworthiness of the findings, data were gathered from multiple sources and methods, including classroom observations, semi-structured interviews, and documentary evidence. The use of these diverse sources enabled methodological triangulation and facilitated the cross-verification of information provided by students, teachers, and school administrators across the three research sites. This triangulation process contributed to a more robust and credible understanding of how the Environmental Learning model was implemented and how it influenced students' environmental awareness.

2.4. Data Analysis Techniques

Data analysis was carried out continuously throughout the research process, beginning with data collection and continuing until all relevant information had been gathered. The study employed the interactive data analysis framework developed by Miles and Huberman, which consists of three interconnected stages: data reduction, data display, and conclusion drawing/verification [58], [59]. Data were collected through observations, interviews, and document analysis conducted in elementary schools located in Lusaka, Zambia; Bandar Seri Begawan, Brunei Darussalam; and Calabar, Nigeria. During the data reduction stage, the researchers organized, selected, and refined the collected information to focus on data that were directly relevant to the research objectives. Particular attention was given to evidence related to the planning, implementation, and evaluation of the Environmental Learning model and its role in fostering students' environmental awareness. The data were subsequently categorized into thematic groups, including environmental learning activities, student participation and engagement, instructional strategies employed by teachers, and factors that facilitated or hindered the implementation of environmental learning programs [60], [61]. This process enabled the researchers to identify meaningful patterns and concentrate on the most significant information emerging from the three research sites.

The subsequent stages of analysis involved data display and conclusion drawing/verification. After the data had been reduced and categorized, they were systematically organized into descriptive narratives to facilitate interpretation and to reveal relationships among the various findings. The data were presented according to the results obtained from each research site, enabling the researchers to illustrate the implementation of the Environmental Learning model and the ways in which students participated in environmental learning activities within different educational contexts [62], [63]. Next, conclusions were drawn through a continuous process of data interpretation and verification, comparing the results of observations, interviews, and documentation. This verification process aims to ensure the validity and consistency of the data, ensuring that the research results provide an accurate and in-depth picture of the implementation of the Environmental Learning model in fostering environmental awareness in students.

Cross-case analysis was conducted after individual site analysis to identify recurring themes, contextual differences, and common patterns across the three countries. The findings were then interpreted comparatively to understand how environmental learning practices contributed to environmental awareness within different educational and socio-cultural contexts. First, open coding was conducted to identify meaningful units from interview transcripts and observation notes. Second, axial coding was applied to group similar codes into broader categories. Finally, selective coding was conducted to develop overarching themes representing environmental learning implementation and environmental awareness development across the three research sites.

2.5. Trustworthiness of the Data

To ensure the validity and reliability of the qualitative findings, several trustworthiness procedures were applied. First, triangulation was conducted through the use of multiple data sources, including observations, semi-structured interviews, and documentary evidence [64], [65]. Second, member checking was performed by returning interview summaries to participating teachers for confirmation of accuracy and interpretation. Third, peer debriefing was conducted with two experts in environmental education and qualitative research to review the coding process and thematic categorization.

To assess the consistency of qualitative coding, an intercoder agreement procedure was conducted involving two independent reviewers. The level of agreement reached 0.86 using Cohen's Kappa coefficient, indicating a high level of coding reliability [66], [67]. Furthermore, the content validity of the interview and observation protocols was evaluated by three experts in environmental education, resulting in a Content Validity

Index (CVI) of 0.91, indicating excellent content validity. These procedures enhanced the credibility, dependability, and confirmability of the research findings.

2.6. Research Procedures

This research procedure was conducted through four stages: orientation, data collection, data analysis, and data presentation. During the orientation stage, the researcher obtained research permits, coordinated with school officials in Lusaka, Zambia; Bandar Seri Begawan, Brunei Darussalam; and Calabar, Nigeria, and prepared research instruments in the form of observation guidelines, interviews, and documentation. The data collection stage involved observation, interviews, and documentation with 90 students and 6 teachers selected using a purposive sampling technique. Interviews were conducted with school principals, teachers, and students to obtain information regarding the implementation, implementation, and evaluation of the Environmental Learning model in fostering environmental awareness in students [68], [69]. In addition, the researcher also conducted direct observations of environmental learning activities in the schools.

The data analysis stage involved checking, categorizing, and analyzing data from observations, interviews, and documentation according to the research focus. The analyzed data was then presented in a systematic narrative format for ease of understanding. The data presentation aims to provide an overview of the implementation of the Environmental Learning model in fostering environmental awareness in students at the three research locations [29], [42]. A summary of the research procedure is shown in Figure 1.

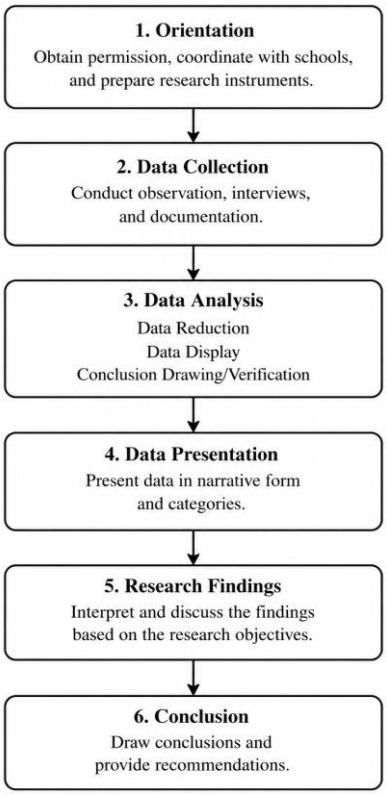

Figure 2. Research Procedure

3. RESULTS AND DISCUSSION

After explaining the background of Environmental Education, which uses the Environmental Learning model to foster environmental awareness, a discussion of learning, barriers, and supporting factors in its implementation is necessary. In their research, the researchers divided the learning into four points: planning, implementation, evaluation, and supporting and inhibiting factors, which will be outlined as follows:

3.1. The Process of Implementing the Environmental Learning Model to Cultivate Environmental Awareness in Students

The results of the study indicate that the implementation of the Environmental Learning model in elementary schools in Lusaka, Zambia; Bandar Seri Begawan, Brunei Darussalam; and Calabar, Nigeria was carried out through environmental observation activities, group discussions, waste management practices, and school greening. Teachers prepared learning tools and environmental-based activities tailored to the conditions of each school. Based on the results of observations, students appeared more active and enthusiastic when

learning was carried out directly through environmental practices compared to conventional learning in the classroom. In addition, students began to show concern for the cleanliness of the school environment through activities to maintain classroom cleanliness and dispose of trash properly. Teacher 1 from Lusaka, Zambia stated that:

> "*In implementing the Environmental Learning model, I often invite students to learn directly in the school environment so they can understand the material in a real way. When students are invited to observe the conditions of their surroundings, they appear more active in asking questions and discussing compared to when learning is only done in the classroom. I see students starting to understand the importance of maintaining environmental cleanliness through simple activities such as cleaning the schoolyard and sorting waste. In addition, students are also becoming more concerned about classroom cleanliness and are starting to get into the habit of disposing of waste properly. I think this learning model is very helpful in building environmental awareness in students from an early age.*"

Teacher 2 from Lusaka, Zambia explains:

> "*I implemented the Environmental Learning model by involving students in practical environmental activities such as planting plants and cleaning the school grounds. Through these activities, students appeared more enthusiastic and eager to participate in the learning process. I also noticed that students understood the material more easily when they directly participated in the activities rather than simply listening to the teacher's explanation. In group activities, students were able to work together and help each other complete the assigned environmental tasks. After several sessions of learning, I began to see changes in student behavior, as they became more concerned about the cleanliness of the school environment.*"

Teacher 3 from Bandar Seri Begawan, Brunei Darussalam said:

> "*In environmental education, I invite students to participate in simple waste management and recycling activities at school. Students appear very engaged when asked to directly sort organic and inorganic waste. I find that practical activities like this help students understand the importance of environmental protection better than theoretical learning alone. Furthermore, students are getting used to reducing their use of single-use plastics while at school. I believe the Environmental Learning model is capable of developing positive environmental habits in students*."

Teacher 4 from Bandar Seri Begawan, Brunei Darussalam said:

> "*I implement environment-based learning by connecting subject matter to the students' surrounding environment. When learning takes place outside the classroom, students appear more active and understand the material more easily. I also assign group assignments, such as observing the school environment, to help students learn to work together and take responsibility. Through these activities, students are beginning to show concern for plants and the cleanliness of the school environment. I've seen changes in student behavior, as they become accustomed to caring for the environment without constant reminders*."

Teacher 5 from Calabar, Nigeria stated:

> "*I use the Environmental Learning model to help students understand the impact of environmental pollution on everyday life. During the learning process, students are invited to observe the condition of the school environment and discuss the waste problems they encounter. I see that students become more aware of the importance of maintaining cleanliness after participating in these activities. Furthermore, students have begun to actively participate in school cleaning activities, which are held regularly every week. I believe environmental learning is very effective in fostering students' awareness and responsibility for the environment.*"

Teacher 6 from Calabar, Nigeria explains:

> "*The implementation of the Environmental Learning model makes students more involved in the learning process because they learn directly through environmental activities. I saw students become more disciplined in maintaining the cleanliness of the classroom and school environment after participating in environmental-based learning. During practical activities, students also appeared more active in discussions and reminding each other to maintain cleanliness. Furthermore, some students began to practice environmentally conscious habits not only at school but also at home. I believe this learning model is very helpful in developing an environmentally conscious character in elementary school students*."

Based on interviews with six teachers, it can be concluded that the implementation of the Environmental Learning model has a positive impact on the learning process and fosters environmental awareness in students. Teachers stated that environmental-based learning makes students more active, enthusiastic, and understands the material more easily because they are directly involved in environmental practices [54], [70]. Activities such as environmental observation, waste management, reforestation, and group work increase student participation and a sense of responsibility for the cleanliness of the school environment. Furthermore, teachers observed changes in student behavior, as they began to practice maintaining cleanliness, disposing of trash properly, and reducing the use of plastic waste in the school environment. Therefore, the Environmental Learning model is considered effective in fostering environmental awareness and character in elementary school students [49], [71].

Based on observations and limited interviews with 90 students in the study sample, the majority responded positively to the implementation of the Environmental Learning model. Most students stated that environmental-based learning was more engaging because it involved direct practice and observation of the school environment. These results show that the application of the Environmental Learning model is able to increase student involvement and concern for the environment.

3.2. Process of Implementing the Environmental Learning Model in Learning

The Environmental Learning model is implemented through preliminary activities, core activities, and closing activities. In the initial stage, the teacher provides motivation and relates the learning material to the students' surrounding environment. Next, students engage in observation, group discussions, waste management practices, planting, and school environmental cleaning activities [72], [73]. The teacher acts as a facilitator, guiding students throughout the learning process. Based on observations, students demonstrate active participation during environmental learning activities and are able to work well in groups. Teacher 1 from Lusaka, Zambia stated:

> "*During the lesson, I began by explaining the learning objectives and relating them to the school's environmental conditions. Afterward, I invited students to directly observe the school environment to identify any problems. I observed that students became more engaged when asked to share their observations and discuss them with their peers. Practical activities, such as cleaning the school environment, also helped students better understand the importance of maintaining cleanliness. I believe that learning that directly involves students makes the learning process more effective.*"

Teacher 2 from Lusaka, Zambia explains:

> "*I implement environmental learning through group activities so students can work together to complete assigned tasks. In these activities, students practice planting plants and cleaning the school grounds together. I've seen students become more enthusiastic when given the opportunity to learn outside the classroom, rather than just listening to theoretical explanations. Furthermore, students become more confident in expressing their opinions during discussions. This type of learning helps students understand the importance of environmental responsibility.*"

Teacher 3 from Bandar Seri Begawan, Brunei Darussalam said:

> "*During the lesson, I used various media and practical activities to help students understand environmental material more easily. Students were encouraged to sort*

waste and recycle used items into simple, useful products. I found the students very engaged in these activities because they could learn while practicing directly. Furthermore, students became more aware of the importance of reducing plastic use in schools. I believe these practical activities significantly assist students in understanding environmental material."

Teacher 4 from Bandar Seri Begawan, Brunei Darussalam said:

"*During the lesson, I engaged students in discussions about various environmental issues they encountered around the school. After the discussion, students were asked to identify simple solutions they could implement to maintain a clean and healthy school environment. I observed that students became more active in asking questions and expressing their opinions during the lesson. Furthermore, they demonstrated good cooperation during group activities. Environmental-based learning allows students to be more directly involved in the learning process.*"

Teacher 5 from Calabar, Nigeria stated:

"*I implemented environmental learning by combining discussion, observation, and practical activities on school cleanliness. Throughout the learning process, students were very engaged when asked to observe the condition of their surroundings. I saw that they began to understand the negative impact of waste on health and the cleanliness of the school environment. Furthermore, students became more disciplined in maintaining classroom cleanliness after participating in environmental learning activities. I believe this learning activity significantly helps students understand the importance of environmental protection from an early age.*"

Teacher 6 from Calabar, Nigeria explains:

"*In implementing the Environmental Learning model, I provide more hands-on activities to keep students from getting bored during the lesson. Students are encouraged to regularly participate in reforestation and clean-up activities with their peers. I've seen these activities make students more active and develop a sense of responsibility for the school environment. Furthermore, students are starting to remind each other to maintain cleanliness and not litter. I believe that implementing environmental-based learning can foster positive environmental habits in students*."

Based on interviews with six teachers, it can be concluded that the Environmental Learning model was implemented through learning activities that actively involved students, such as environmental observations, group discussions, waste management practices, reforestation, and school cleaning activities. Teachers stated that practice-based learning made students more enthusiastic, engaged in discussions, and easily understood environmental material. Furthermore, student involvement in environmental activities helped foster attitudes of cooperation, responsibility, and concern for the cleanliness of the school environment [25], [74]. Teachers also observed changes in student behavior, with students becoming more disciplined in maintaining cleanliness and more aware of the importance of environmental conservation. Therefore, the implementation of the Environmental Learning model was deemed effective in creating an active, contextual, and effective learning process in fostering environmental awareness in students.

Many students actively participated in discussions, collaborative activities, and environmental practices during the learning process. Furthermore, most students appeared to work well together during group activities and demonstrated a sense of responsibility for the environmental tasks assigned by their teachers. Observations also showed that students became more confident in expressing their opinions and observations during the learning process. Therefore, the implementation of the Environmental Learning model was deemed effective in creating active, contextual learning and increasing student engagement in preserving the school environment.

3.3. Evaluation Process of the Environmental Learning Model in Cultivating Environmental Awareness in Students

Evaluation of the Environmental Learning model is carried out continuously through observations of student behavior, project assignment assessments, group discussions, and learning reflections. Teachers assess not only students' knowledge but also changes in their attitudes and behaviors toward the environment during the learning process [75], [76]. Based on the research results, most students showed positive changes in maintaining

a clean school environment and became more active in participating in environmental activities. Furthermore, students began to practice environmentally conscious behaviors such as disposing of trash properly, maintaining classroom cleanliness, and reducing the use of plastic waste at school. Teacher 1 from Lusaka, Zambia stated:

> "*I conducted a learning evaluation by observing student behavior during environmental activities at school. I observed that after participating in environmental-based learning, students began to practice maintaining classroom cleanliness without constant reminders. Furthermore, students became more active in participating in routine school cleanliness activities. I considered changes in student behavior as an indicator of successful environmental learning. In my opinion, evaluation should not only be based on grades, but also on changes in students' attitudes toward the environment.*"

Teacher 2 from Lusaka, Zambia explains:

> "*During the evaluation process, I assessed student engagement during environmental practice activities and group discussions. I observed that students began to develop a sense of responsibility for the cleanliness of the school environment after participating in the lesson. Furthermore, students demonstrated good cooperation during group activities such as cleaning the schoolyard and planting plants. I also assessed students based on their active participation in expressing opinions and providing solutions to environmental problems. In my opinion, environmental learning evaluations should encompass both student knowledge and behavior*."

Teacher 3 from Bandar Seri Begawan, Brunei Darussalam said:

> "*I conducted evaluations through project assignments and direct observation of students' habits at school. After participating in environmental learning, students began to understand the importance of reducing plastic use and maintaining a clean classroom environment. I noticed that some students started bringing their own water bottles and reducing plastic waste at school. Furthermore, students became more active in classroom recycling activities. I believe these small changes in behavior demonstrate an increased environmental awareness among students*."

Teacher 4 from Bandar Seri Begawan, Brunei Darussalam said:

> "*In my learning evaluation, I focused more on observing changes in students' attitudes toward the environment after participating in environmental-based learning activities. I saw that students were becoming accustomed to caring for plants and school facilities without being told. Furthermore, students were becoming more active in reminding their peers to keep the classroom clean. I found that the practical activities and environmental projects significantly helped students understand the importance of environmental protection. I believe that environmental learning evaluations need to be conducted continuously so that changes in student behavior can be clearly seen.*"

Teacher 5 from Calabar, Nigeria stated:

> "*I conducted an evaluation by observing student participation during learning activities and school environmental cleanup activities. After the learning activities, I observed that students had become more disciplined in disposing of trash properly and maintaining classroom cleanliness. Furthermore, students began to understand the negative impacts of waste on health and the school environment. I based my assessment on students' active participation in environmental activities and their ability to work collaboratively in groups. I believe that environmental learning has successfully helped students develop an awareness of environmental protection from an early age.*"

Teacher 6 from Calabar, Nigeria explains:

> "*During the evaluation process, I observed changes in student behavior during the environmental learning activities. I observed that students became more concerned about the condition of the school environment and began to practice maintaining cleanliness independently. Furthermore, students became more active in participating in regular school greening and cleaning activities. I believe that these environmental practices positively influenced students' attitudes and sense of responsibility towards the environment. I believe that ongoing evaluation of environmental learning is necessary to ensure continued development of student behavior changes.*"

Based on interviews with six teachers, it can be concluded that the evaluation of the Environmental Learning model was conducted through observations of student behavior, project assessments, student participation in environmental activities, and changes in student attitudes toward school cleanliness. Teachers stated that after participating in environmental-based learning, students demonstrated positive behavioral changes, such as maintaining classroom cleanliness, disposing of trash properly, reducing plastic use, and actively participating in school greening and cleaning activities. Furthermore, students became more responsible and aware of their own environmental concerns. Teachers assessed that the evaluation of environmental learning focused not only on knowledge but also on changes in students' attitudes and behaviors in their daily lives [77], [78]. Therefore, the evaluation of the Environmental Learning model was deemed effective in measuring and fostering environmental awareness among elementary school students.

3.4. Cross-Country Differences in Environmental Learning Implementation

Although environmental learning was implemented in all three research sites, notable differences were identified in terms of implementation strategies, cultural influences, environmental policy support, and school infrastructure. In Zambia, environmental learning was strongly connected to local environmental challenges, particularly waste management, water conservation, and ecosystem preservation. Learning activities frequently involved outdoor experiences and community participation, reflecting the need to address environmental issues directly affecting local communities.

In Brunei Darussalam, environmental learning was supported by stronger institutional policies and structured school programs related to sustainability education. Environmental activities were often integrated into school management practices, including recycling initiatives, school greening programs, and environmental campaigns supported by educational authorities. In Nigeria, environmental learning was characterized by active student participation and community engagement despite limitations in environmental infrastructure. Teachers frequently adapted learning activities to local conditions and emphasized environmental responsibility through practical actions and collaborative projects involving students and local communities.

Table 2. Comparative Findings Across Research Sites

Aspect	Zambia	Brunei Darussalam	Nigeria
Main Environmental Focus	Waste management and conservation	Sustainability and school environmental programs	Community environmental responsibility
Learning Activities	Outdoor learning and community projects	Structured school-based environmental programs	Collaborative environmental projects
Cultural Influence	Local environmental challenges	Institutional environmental culture	Community participation culture
Policy Support	Moderate	Strong	Moderate
School Infrastructure	Basic environmental facilities	Well-developed environmental facilities	Limited but functional facilities
Student Participation	High	High	High
Behavioral Change	Evident through conservation practices	Evident through sustainable school habits	Evident through community-oriented environmental actions

The findings indicate that environmental learning contributed not only to students' environmental awareness but also to observable behavioral transformation across the three research sites. Students

demonstrated environmentally responsible practices such as proper waste disposal, maintaining classroom cleanliness, participating in school clean-up activities, conserving water, and applying environmentally friendly behaviors at home. These findings suggest that environmental learning extends beyond cognitive acquisition and supports the development of sustainable behavioral habits. The observed changes indicate that students increasingly perceived themselves as active contributors to environmental stewardship rather than passive recipients of environmental knowledge.

These findings can be interpreted through Constructivist Learning Theory, which posits that learners actively construct knowledge through interaction with their environment. Environmental learning activities, including school gardening, environmental observation, waste management projects, and community-based environmental initiatives, provided authentic learning experiences that enabled students to connect theoretical concepts with real-world environmental challenges [19], [43]. Rather than learning environmental concepts abstractly, students developed understanding through direct engagement with environmental issues relevant to their daily lives. This experiential process appears to have facilitated deeper conceptual understanding and stronger personal commitment to environmentally responsible behavior.

The effectiveness of environmental learning can also be explained through Experiential Learning Theory. Students were not merely exposed to environmental information but were actively involved in concrete experiences, reflection, and practical application. Repeated participation in environmental activities allowed students to observe the consequences of environmental actions, reflect on their experiences, and apply newly acquired knowledge in both school and home environments. This process helps explain why environmental learning was associated with behavioral transformation rather than solely increased environmental knowledge.

Furthermore, the findings support socio-cultural perspectives on learning, which emphasize that knowledge and behavior are shaped through social interaction and participation in community practices. Across all three countries, environmental awareness developed through collaboration among students, teachers, and local communities [42], [79]. However, the nature of these interactions differed according to local contexts. In Zambia, environmental learning was closely linked to everyday environmental challenges such as waste management and resource conservation. In Brunei Darussalam, environmental learning was strengthened by institutional support, sustainability-oriented school policies, and structured environmental programs. In Nigeria, community engagement and collective participation played a more prominent role in fostering environmental responsibility. These differences demonstrate that environmental learning is influenced by socio-cultural and institutional contexts while maintaining similar educational outcomes.

The findings also contribute to the concept of environmental citizenship. Environmental citizenship extends beyond environmental literacy by encouraging individuals to recognize their responsibilities toward environmental sustainability and to take action for environmental protection [38], [80]. Students in this study demonstrated environmental citizenship through responsible environmental practices, participation in environmental initiatives, and growing awareness of the relationship between human behavior and environmental quality. Such findings suggest that environmental learning can contribute to the formation of environmentally responsible identities from an early age.

From a policy perspective, the study highlights the importance of environmental governance and institutional support in shaping environmental education practices. Schools operating within stronger sustainability policy frameworks, particularly those observed in Brunei Darussalam, demonstrated more structured implementation of environmental learning and greater institutional support [15], [81]. In contrast, schools in Zambia and Nigeria relied more heavily on teacher initiatives and community participation to sustain environmental learning activities [82], [83]. These findings indicate that environmental policies, school infrastructure, and community involvement collectively influence the effectiveness and sustainability of environmental education programs.

The findings further align with the Education for Sustainable Development framework, which emphasizes the integration of knowledge, values, attitudes, and behaviors necessary for sustainable living. Environmental learning in Zambia, Brunei Darussalam, and Nigeria facilitated not only environmental understanding but also the development of sustainable behavioral practices. This suggests that environmental learning can serve as an effective pedagogical strategy for advancing Sustainable Development Goals, particularly SDG 4 (Quality Education), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action).

A major contribution of this study lies in its comparative examination of environmental learning across three developing-country contexts with distinct socio-cultural, environmental, and policy characteristics. Unlike many previous studies that focus primarily on environmental knowledge or attitudes within a single educational setting, this study demonstrates how environmental learning contributes to behavioral transformation through experiential engagement, social interaction, and contextual learning processes [40], [80]. The cross-country findings further reveal that while implementation strategies vary according to local conditions, environmental learning consistently promotes environmental awareness, environmental citizenship, and sustainable behavioral practices among elementary school students.

The findings of this study are supported by several previous international studies showing that environment-based learning can increase students' awareness and participation in environmental conservation. The research was conducted by Ardoin et al., [84] explains that environmental education involving direct experience (experiential learning) can significantly increase students' ecological awareness and environmentally friendly behavior. In addition, research Otto & Pensini [85] shows that student involvement in environmental activities such as nature observation and waste management practices can shape an attitude of environmental responsibility from an early age. Other research conducted by Lestari et al., [86] also found that environmental project-based learning can improve collaborative skills, social awareness, and sustainability awareness in students. Thus, the results of this study reinforce previous findings that the Environmental Learning model is effective in developing environmental knowledge, attitudes, and behaviors in elementary school students.

The novelty of this research lies in the cross-country study conducted in three different regions: Lusaka, Zambia; Bandar Seri Begawan, Brunei Darussalam; and Calabar, Nigeria. This research not only discusses the process of implementing the Environmental Learning model but also comprehensively analyzes the implementation and evaluation of environmental learning from the perspectives of teachers and students. Furthermore, this research integrates environmental education approaches with the global context and the objectives of the Sustainable Development Goals (SDGs), specifically SDG 4 (Quality Education), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action). Unlike many previous studies that primarily report improvements in environmental knowledge or attitudes, this study highlights how environmental learning facilitates behavioral transformation through experiential engagement, social interaction, and contextual learning experiences. The cross-country evidence further demonstrates that despite differences in socio-cultural and environmental contexts, environmental learning consistently promotes active participation, environmental responsibility, and sustainable behavioral practices among elementary school students.

This research has a positive impact on the development of environmental education in elementary schools, particularly in developing environmentally conscious character in students through practice-based learning and direct experience. The research results show that the Environmental Learning model can increase student engagement in learning, foster a sense of environmental responsibility, and foster positive habits such as maintaining cleanliness and reducing plastic waste. More broadly, this research can also serve as a reference for schools and educational policymakers in designing environmental education programs that support sustainable development. Furthermore, the results demonstrate the importance of integrating environmental education into the school curriculum to prepare a generation with ecological awareness and social responsibility for the global environment. Therefore, this research has practical implications for strengthening sustainable education in both developing and developed countries.

However, this study has several limitations. The study was conducted in only three elementary schools in Zambia, Brunei Darussalam, and Nigeria, so the results cannot be broadly generalized to all educational contexts in various countries. Furthermore, this study used a qualitative approach with a limited sample size, so the results focus more on in-depth understanding of the phenomena studied than on broad statistical measurements. Another limitation is the data collection process, which relies heavily on observations and interviews, potentially introducing subjectivity from both informants and researchers. This study also failed to measure the long-term impact of implementing the Environmental Learning model on changes in student behavior outside the school environment. Therefore, further research is recommended to use a mixed methods approach with a wider area coverage and sample size to obtain more comprehensive and representative results.

4. CONCLUSION

This study demonstrates that the Environmental Learning model effectively fosters environmental awareness and promotes positive behavioral transformation among elementary school students in Zambia, Brunei Darussalam, and Nigeria. Students showed increased environmental responsibility through practices such as proper waste management, environmental cleanliness, resource conservation, and active participation in environmental activities. Although the implementation of environmental learning varied across the three countries due to differences in socio-cultural contexts, environmental policy support, and school infrastructure, the findings consistently indicate that environmental learning contributes to the development of environmentally responsible behaviors and sustainable habits among students.

From a theoretical prspective, this study contributes to the growing body of environmental education literature by demonstrating how environmental awareness is developed through the interaction of constructivist, experiential, socio-cultural, and environmental citizenship processes. The findings extend previous research by showing that environmental learning promotes behavioral transformation not merely through knowledge acquisition but through direct environmental engagement, social interaction, and contextual learning experiences. Furthermore, the cross-country comparative evidence provides a broader understanding of how environmental learning operates within different developing-country contexts.

Practically, the findings suggest that schools should adopt more experiential and context-based environmental learning approaches that actively involve students in environmental observation, waste management, conservation activities, and community engagement. Teachers should be encouraged to integrate environmental issues into daily learning activities and provide opportunities for students to apply environmental knowledge in real-life situations. Such approaches can strengthen environmental awareness while simultaneously developing students' responsibility, collaboration, and critical thinking skills.

From a policy perspective, the study highlights the need for stronger institutional and governmental support for environmental education programs. Educational authorities should integrate environmental learning more systematically into elementary school curricula, provide adequate environmental learning resources and infrastructure, and encourage partnerships between schools and local communities. Policymakers should also align environmental education initiatives with the principles of Education for Sustainable Development (ESD) and the Sustainable Development Goals (SDGs), particularly SDG 4 (Quality Education), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action). Future studies may also employ mixed-methods or longitudinal designs to generate more comprehensive evidence regarding the effectiveness of environmental learning across diverse educational contexts.

ACKNOWLEDGEMENTS

The authors would like to express their sincere gratitude to all schools, teachers, and students in Lusaka, Zambia; Bandar Seri Begawan, Brunei Darussalam; and Calabar, Nigeria who participated and supported this research. The authors also thank all parties who contributed to the implementation of this study and the completion of this article.

AUTHOR CONTRIBUTIONS

Conceptualization, M.K.N., M.M., and A.E.; Methodology, M.K.N. and M.M.; Validation, M.M. and A.E.; Formal Analysis, M.K.N.; Investigation, M.K.N., M.M., and A.E.; Resources, M.M. and A.E.; Data Curation, M.K.N.; Writing – Original Draft Preparation, M.K.N.; Writing – Review & Editing, M.M. and A.E.; Visualization, M.K.N.; Supervision, M.M.; Project Administration, M.K.N. and A.E. All authors have read and agreed to the published version of the manuscript.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

USE OF ARTIFICIAL INTELLIGENCE (AI)-ASSISTED TECHNOLOGY

Not applicable.

REFERENCES

[1] S. K. Yadav *et al.*, "Environmental education for sustainable development," in *Natural Resources Conservation and Advances for Sustainability*, Elsevier, 2022, pp. 415–431. doi: 10.1016/B978-0-12-822976-7.00010-7.

[2] I. Elegbede, R. Matti-Sanni, O. Moriam, and I. Emily Osa, "Sustainability education and environmental awareness," in *Encyclopedia of Sustainable Management*, Cham: Springer International Publishing, 2023, pp. 1–9. doi: 10.1007/978-3-030-02006-4_128-1.

[3] M. Imran, N. Almusharraf, M. Sayed, and A. Abdellatif, "Education for a austainable future: The impact of environmental education on shaping sustainable values and attitudes among students," *Eng. Pedagog.*, vol. 14, no. 6, pp. 155–171, 2025, doi: 10.12737/2173834.

[4] A. Faganel and B. Kovač, "Inquiring and strengthening the environmental awareness among elementary school children," *Int. J. Innov. Learn.*, vol. 37, no. 4, pp. 439–473, 2025, doi: 10.1504/IJIL.2025.146510.

[5] P. M. A. Castellanos and A. Queiruga-Dios, "From environmental education to education for sustainable development in higher education: a systematic review," *Int. J. Sustain. High. Educ.*, vol. 23, no. 3, pp. 622–644, Feb. 2022, doi: 10.1108/IJSHE-04-2021-0167.

[6] A. M. Corpuz, T. C. S. Andres, and J. M. Lagasca, "Integration of environmental education (Ee) in teacher education orograms : Toward sustainable curriculum greening," *Probl. Educ. 21st Century*, vol. 80, no. 1, pp. 119–143, 2022, doi: 10.33225/pec/22.80.119.

[7] D. Murzyn, T. Mroczek, M. Czyżewska, and K. Jezierska, "Environmental awareness and responsibility: A machine learning analysis of polish university students," *Sustain.*, vol. 17, no. 19, pp. 1–31, 2025, doi: 10.3390/su17198577.

[8] S. Suralin, "Integrating environmental education to form environmental care characters in schools," *Adv. Community Serv. Res.*, vol. 1, no. 2, pp. 47–56, 2023, doi: 10.60079/acsr.v1i2.335.

[9] S. Yadav, "Cultivating Sustainable Behavior and Critical Consciousness Towards the Environment," in *The Impact of Climate Change and Sustainability Standards on the Insurance Market*, Wiley, 2023, pp. 333–348. doi: 10.1002/9781394167944.ch21.

[10] S. K. Shah, T. Zhongjun, A. Sattar, and Z. XinHao, "Consumer's intention to purchase 5G: Do environmental awareness, environmental knowledge and health consciousness attitude matter?," *Technol. Soc.*, vol. 65, p. 101563, May 2021, doi: 10.1016/j.techsoc.2021.101563.

[11] N. M. Ardoin and J. E. Heimlich, "Environmental learning in everyday life: Foundations of meaning and a context for change," *Environ. Educ. Res.*, vol. 27, no. 12, pp. 1681–1699, 2021, doi: 10.1080/13504622.2021.1992354.
[12] L. Misqa, W. Oviana, Z. Hayati, and M. Jannah, "Improving student learning outcomes in mathematics learning through a contextual teaching and learning approach in elementary schools," *J. Indones. Prim. Sch.*, vol. 1, no. 2, pp. 19–26, 2024, doi: 10.62945/jips.v1i2.34.
[13] P. N. Monde, M. Muchanga, and L. Mweemba, "Strategic environmental education framework for sustainable ecosystems management in Lusaka District, Zambia," *Int. J. Humanit. Soc. Sci. Educ.*, vol. 10, no. 3, pp. 110–117, 2023, doi: 10.20431/2349-0381.1003011.
[14] W. Sikwibele and L. Chipatu, "Management of Zambia'S chongwe river catchment through environmental education.," *Am. J. Environ. Stud.*, vol. 4, no. 1, pp. 38–53, 2021, doi: 10.47672/ajes.747.
[15] Z. H. Zamri, N. Ahmad, L. S. Shamsu, and A. Masum, "Human rights to a sustainable environment and environmental Law: A critical examination of social ovements in Brunei and ASEAN," in *SSRN Electronic Journal*, 2025, pp. 379–401. doi: 10.2139/ssrn.5195067.
[16] A. R. Dariah, A. M. Rani, Y. Sundaya, and R. Abdullah, "Sustainable business practices in Indonesia and Brunei Darussalam: awareness or innovation?," *Discov. Sustain.*, vol. 6, no. 1, pp. 1–16, 2025, doi: 10.1007/s43621-025-01028-9.
[17] A. Babalola and D. S. Olawuyi, "Advancing environmental education for sustainable development in higher education in nigeria: Current challenges and future directions," *Sustain.*, vol. 13, no. 19, pp. 1–14, 2021, doi: 10.3390/su131910808.
[18] F. Jimoh, T. S. M, and A. H. Dahiru, "Health education approaches in tackling environmental chalenges in Nigeria," *Kantagora J. if Intellect. Discourse*, vol. 3, no. 2, pp. 107–118, 2025, doi: 10.5281/zenodo.17471194 Despite.
[19] R. Brahma, "Innovations in teaching and learning for environmental education," *J. Am. Inst.*, vol. 2, no. 2, pp. 210–224, 2025, doi: 10.71364/kxrd4r73.
[20] A. Chrysomalidou, I. Takos, I. Spiliotis, and P. Xofis, "Factors that influence the teachers' involvement in outdoor, nature-Based educational activities and environmental education programs," *J. Zool. Bot. Gard.*, vol. 7, no. 1, pp. 1–23, 2025, doi: 10.3390/jzbg7010003.
[21] R. M. AlAli and A. A. Al-Barakat, "Assessing the effectiveness of environmental approach-based learning in developing science process skills and cognitive achievement in young children," *Educ. Sci.*, vol. 14, no. 11, pp. 1–18, 2024, doi: 10.3390/educsci14111269.
[22] A. Meryantie, N. Huda, V. M. T. L. Tobing, and M. Muhajir, "Implementation of TBL with constructivist and discovery learning approaches to enhance eco-literacy of homeschooling students," *J. Inov. Teknol. Pendidik.*, vol. 12, no. 3, pp. 307–316, 2025, doi: 10.21831/jitp.v12i3.85855.
[23] S. W. Al Idrus, R. Rahmawati, and A. Kadir, "Analysis of students environmental attitudes as a contribution to the sustainable development goals (SDGs)," *J. Pijar Mipa*, vol. 20, no. 7, pp. 1347–1353, 2025, doi: 10.29303/jpm.v20i7.9015.
[24] F. R. da Silva and F. Gerhard, "Do responsible consumption and production and climate policies influence an individual's environmentally oriented consumption and anti-consumption?," *Rev. Adm. Contemp.*, vol. 29, no. 2, pp. 1–20, 2025, doi: 10.1590/1982-7849rac2025240257.en.
[25] N. Khasana, D. I. Pambudi, and N. Masaei, "Implementing effective strategies to foster environmental care character among students," *Int. J. Learn. Reform. Elem. Educ.*, vol. 2, no. 02, pp. 86–94, 2023, doi: 10.56741/ijlree.v2i02.312.
[26] M. B. Khofi, "The green school concept in elementary schools as an effort to form sustainable sehavior and environmental awareness," *Al-Adzka J. Ilm. Pendidik. Guru Madrasah Ibtidaiyah*, vol. 14, no. 2, pp. 206–225, 2024, doi: 10.18592/aladzkapgmi.v14i2.14412.
[27] R. Silva, C. Farias, and I. Mesquita, "Cooperative learning contribution to student social learning and active role in the class," *Sustain.*, vol. 13, no. 15, pp. 1–18, 2021, doi: 10.3390/su13158644.
[28] S. A. R. Khan, Z. Yu, and M. Umar, "How environmental awareness and corporate social responsibility practices benefit the enterprise? An empirical study in the context of emerging economy," *Manag. Environ. Qual. An Int. J.*, vol. 32, no. 5, pp. 863–885, Jul. 2021, doi: 10.1108/MEQ-08-2020-0178.
[29] H. R. Perea, A. R. Piedrahita, and Ó. E. T. Alzate, "Models of environmental awareness: exploring their nature and role in environmental education – a systematic review," *Heliyon*, vol. 11, no. 13, pp. 1–24, 2025, doi: 10.1016/j.heliyon.2025.e43679.
[30] A. Khoiri, W. Sunarno, S. Sajidan, and S. Sukarmin, "Analysing students' environmental awareness profile using strategic environmental assessment," *F1000Research*, vol. 10, pp. 1–27, 2021, doi: 10.12688/f1000research.51523.2.
[31] G. Pan, V. Shankararaman, K. Koh, and S. Gan, "Students' evaluation of teaching in the project-based learning programme: An instrument and a development process," *Int. J. Manag. Educ.*, vol. 19, no. 2, pp. 1–11, 2021, doi: 10.1016/j.ijme.2021.100501.
[32] R. S. Siregar, "Improving the arabic writing skills of students through the application of contextual learning methods at dayah irsyadul abidin qurani," *Indones. J. Educ. Soc. Humanit.*, vol. 2, no. 1, pp. 358–369, 2025, doi: 10.62945/ijesh.v2i1.726.
[33] C. Reddy, "Environmental education, social justice and teacher education: Enabling meaningful environmental learning in local contexts," *South African J. High. Educ.*, vol. 35, no. 1, pp. 161–177, 2021, doi: 10.20853/35-1-4427.
[34] J. K. Debrah, D. G. Vidal, and M. A. P. Dinis, "Raising awareness on solid waste management through formal education for sustainability: A developing countries evidence review," *Recycling*, vol. 6, no. 1, pp. 1–21, 2021, doi: 10.3390/recycling6010006.
[35] S. Zarei and S. Mohammadi, "Challenges of higher education related to e-learning in developing countries during COVID-19 spread: a review of the perspectives of students, instructors, policymakers, and ICT experts," *Environ. Sci. Pollut. Res.*, vol. 29, no. 57, pp. 85562–85568, 2022, doi: 10.1007/s11356-021-14647-2.

[36] A. Amoah and T. Addoah, "Does environmental knowledge drive pro-environmental behaviour in developing countries? Evidence from households in Ghana," *Environ. Dev. Sustain.*, vol. 23, no. 2, pp. 2719–2738, Feb. 2021, doi: 10.1007/s10668-020-00698-x.
[37] N. D. Napitupulu, I. Novianti, I. Iduard, R. Rutmiyanti, I. Ibrahim, and K. S. Embatau, "Environmental literacy in middle school: Ecological knowledge, cognitive skills, environmental affect, and pro-environmental behavior," *J. Eduscience*, vol. 12, no. 2, pp. 281–296, 2025, doi: 10.36987/jes.v12i2.6691.
[38] A. Suhendar *et al.*, "Eco-literacy and sustainable citizenship: The role of the school environment in shaping responsible environmental behavior," *Sekumpul J. Multidiscip. Educ. Sci.*, vol. 1, no. 1, pp. 12–19, 2023, doi: 10.62568/jomes.v1i1.13.
[39] K. J. Masemene and S. B. Msezane, "Exploring environmental literacy components in promoting sustainable behaviour: A case study of rural primary schools," *J. Educ. Gift. Young Sci.*, vol. 9, no. 3, pp. 233–249, 2021, doi: 10.17478/jegys.980968.
[40] R. Yusuf and I. Fajri, "Differences in behavior, engagement and environmental knowledge on waste management for science and social students through the campus program," *Heliyon*, vol. 8, no. 2, pp. 1–14, 2022, doi: 10.1016/j.heliyon.2022.e08912.
[41] B. Yang, N. Wu, Z. Tong, and Y. Sun, "Narrative-based environmental education improves environmental awareness and environmental attitudes in children aged 6–8," *Int. J. Environ. Res. Public Health*, vol. 19, no. 11, pp. 1–19, 2022, doi: 10.3390/ijerph19116483.
[42] I. Karachalios and N. Manesis, "Fostering environmental awareness in primary school students: Evaluating the impact of a waste management education program," *Eur. J. Educ. Stud.*, vol. 12, no. 4, pp. 77–94, 2025, doi: 10.46827/ejes.v12i4.5886.
[43] C. N. Agbor, M. . Etan, R. . Akuji, and C. . Ogbor, "Methods of teaching environmental education for sustainability," *Int. J. Econ. Environ. Dev. Soc.*, vol. 2025, no. 2, pp. 209–233, 2025.
[44] M. M. Leko, B. G. Cook, and L. Cook, "Qualitative methods in special education research," *Learn. Disabil. Res. Pract.*, vol. 36, no. 4, pp. 278–286, Nov. 2021, doi: 10.1111/ldrp.12268.
[45] T. Muzari, G. N. Shava, and S. Shonhiwa, "Qualitative research paradigm, a key research design for educational researchers, processes and procedures: A theoretical overview," *Qual. Res. Paradig.*, vol. 2, no. 01, pp. 14–20, 2022.
[46] D. Mohajan and H. Mohajan, *Constructivist grounded theory: A new research approach in social science*, no. 114970. 2022.
[47] L. Rodríguez-Labajos, C. S. Thomson, and G. O'Brien, "Applying constructivist grounded theory in co-production research: A case study exploring its potential and lessons for construction management research," *Constr. Manag. Econ.*, vol. 39, no. 5, pp. 369–382, 2021, doi: 10.1080/01446193.2021.1894654.
[48] G. P. Ambawono, B. Budiono, and E. Poerwanti, "Fostering Environmental Awareness Through School-Based Programs: A Case Study of the Adiwiyata Initiative in Indonesian Elementary Education," *AL-ISHLAH J. Pendidik.*, vol. 17, no. 4, pp. 6871–6883, Dec. 2025, doi: 10.35445/alishlah.v17i4.7785.
[49] R. Fatahidin, "Ecopedagogic model: A teacher's approach to implementing learning in elementary schools to foster students' critical awareness of the environment," *Subang Int. J. Gov. Account.*, vol. 3, no. 1, pp. 39–42, 2025.
[50] T. S. Ezeudu and E. K. Chukwudubem, "Exploring socio-cultural factors in the context of Urban environmental management in Nigeria," *Int. J. Res. Innov. Soc. Sci.*, vol. VII, no. X, pp. 282–300, 2023, doi: 10.47772/IJRISS.2023.701025.
[51] M. A. Altassan, "Sustainable leadership and green HRM: Fostering environmentally responsible organizational cultures," *Sustain.*, vol. 17, no. 20, pp. 1–19, 2025, doi: 10.3390/su17209331.
[52] O. Tajik, J. Golzar, and S. Noor, "Purposive sampling," *Int. J. Educ. Lang. Stud.*, vol. 2, no. 2, pp. 1–9, 2024.
[53] E. I. Obilor, "Convenience and purposive sampling techniques: Are they the same?," *Int. J. Innov. Soc. Sci. Educ. Res.*, vol. 11, no. 1, pp. 1–7, 2023.
[54] T. T. D. Susanto, S. Zahrah, M. Z. Prtama, J. Aisyah, and A. Kurniawan, "Improving the quality of education through environmentally based learning," *Perspekt. Ilmu Pendidik.*, vol. 38, no. 1, pp. 47–56, 2024, doi: 10.21009/pip.381.5.
[55] A. Husin, H. Helmi, Y. K. Nengsih, and M. Rendana, "Environmental education in schools: sustainability and hope," *Discov. Sustain.*, vol. 6, no. 41, pp. 1–11, 2025, doi: 10.1007/s43621-025-00837-2.
[56] S. Kazazoglu, "Environmental education through Eco-literacy: Integrating sustainability into english language teaching," *Sustain.*, vol. 17, no. 5, pp. 1–23, 2025, doi: 10.3390/su17052156.
[57] B. Algurén, "Toward behavioral learning outcomes: A case study of an experiential learning approach and students' self-reported facilitators and barriers for pro-environmental behavior," *Int. J. Sustain. High. Educ.*, vol. 26, no. 9, pp. 265–280, Dec. 2025, doi: 10.1108/IJSHE-01-2025-0063.
[58] R. Takbir, R. Dewi, and F. A. Baso, "Lecturer's strategies in teaching speaking during COVID-19 pandemic," *Indones. J. Psycholinguist.*, vol. 2, no. 1, pp. 25–29, 2023, doi: 10.56983/ijp.v2i1.483.
[59] B. Cahyanto, "Implementation of deep learning for strengthening reading literacy in elementary school," *Ghancaran J. Pendidik. Bhs. dan Sastra Indones.*, vol. 7, no. 1, pp. 219–235, 2025, doi: 10.19105/ghancaran.v7i1.18892.
[60] S. Loots, F. Strydom, and H. Posthumus, "Learning from students: Factors that support student engagement in blended learning environments within and beyond classrooms," *J. Student Aff. Africa* , vol. 11, no. 2, pp. 73–88, 2023, doi: 10.24085/jsaa.v11i2.4897.
[61] J. Li and E. Xue, "Dynamic interaction between student learning behaviour and learning environment: Meta-analysis of student engagement and its influencing factors," *Behav. Sci. (Basel).*, vol. 13, no. 1, pp. 1–15, 2023, doi: 10.3390/bs13010059.
[62] Y. Herlanti, S. Nobira, Y. Kuboki, and Q. Qumilaila, "Online lesson study design: Integrating environmental issues with science learning to enhance students' environmental literacy," *Int. J. Lesson Learn. Stud.*, vol. 14, no. 1, pp. 27–40, Feb. 2025, doi: 10.1108/IJLLS-08-2024-0169.

[63] J. van de Wetering, P. Leijten, J. Spitzer, and S. Thomaes, "Does environmental education benefit environmental outcomes in children and adolescents? A meta-analysis," *J. Environ. Psychol.*, vol. 81, p. 101782, Jun. 2022, doi: 10.1016/j.jenvp.2022.101782.
[64] M. C. Schlunegger, M. Zumstein-Shaha, and R. Palm, "Methodologic and data-analysis triangulation in case studies: A scoping review," *West. J. Nurs. Res.*, vol. 46, no. 8, pp. 611–622, 2024, doi: 10.1177/01939459241263011.
[65] S. Bhalla, N. Bahar, and K. Kanapathy, "Pre-testing semi-structured interview questions using expert review and cognitive interview methods," *Int. J. Bus. Manag.*, vol. 7, no. 5, pp. 11–19, Oct. 2023, doi: 10.26666/rmp.ijbm.2023.5.2.
[66] K. S. Tan, Y. C. Yeh, P. S. Adusumilli, and W. D. Travis, "Quantifying interrater agreement and reliability between thoracic pathologists: Paradoxical behavior of cohen's kappa in the presence of a high prevalence of the histopathologic feature in lung cancer," *JTO Clin. Res. Reports*, vol. 5, no. 1, pp. 1–8, 2024, doi: 10.1016/j.jtocrr.2023.100618.
[67] M. L. Coleman, M. Ragan, and T. Dari, "Intercoder reliability for use in qualitative research and evaluation," *Meas. Eval. Couns. Dev.*, vol. 57, no. 2, pp. 136–146, Apr. 2024, doi: 10.1080/07481756.2024.2303715.
[68] A. Baharuddin S, S. Saihan, and L. Usriyah, "Green school initiatives: Cultivating environmental awareness in elementary education," *J. Educ. Res. Pract.*, vol. 3, no. 1, pp. 50–68, Jan. 2025, doi: 10.70376/jerp.v3i1.285.
[69] P. R. Herros, M. S. Hanafi, and I. Rusdiyani, "The implementation of principal policies and the role of teachers in fostering students' environmental awareness through the kurasaki habit at Cibadak 05 public elementary school," *Int. J. Community Engagem. Payungi*, vol. 5, no. 1, pp. 79–86, 2025, doi: 10.58879/ijcep.v5i1.82.
[70] L. Sugiastutih, A. Restian, and Kuncahyono, "Fostering student enthusiasm in ecoprint pounding as an environment-based learning technique," *J. Pendidik. Teor. Penelitian, dan Pengemb.*, vol. 10, no. 5, pp. 211–218, 2025, doi: 10.17977/jptpp.v10i5.25873.
[71] B. Setiawan, A. Barokah, D. N. Hafifah, and V. Iasha, "Enhancing environmental awareness through STEAM-based learning with ESD principles in elementary education," *Int. J. Educ. Learn. Stud.*, vol. 1, no. 1, pp. 1–12, 2025, doi: 10.64421/ijels.v1i1.1.
[72] R. Beach, "Teachers and students use of systems thinking about their participation in school environmental clubs," *J. Adolesc. Adult Lit.*, vol. 67, no. 1, pp. 22–31, 2023, doi: 10.1002/jaal.1299.
[73] M. M. AR, S. Sama, and K. Aini, "The implementation of ecoliteracy as a learning resource to improve environmental care attitudes in elementary schools," *Mimb. Sekol. Dasar*, vol. 10, no. 1, pp. 122–134, 2023, doi: 10.53400/mimbar-sd.v10i1.50333.
[74] T. Mutia, L. Y. Irawan, Sumarmi, R. Meilitasari, and R. R. Prasad, "The relationship between the adiwiyata program based on environmental activities and students' environmental care attitudes in supporting green schools," *Int. J. Sustain. Dev. Plan.*, vol. 20, no. 1, pp. 25–31, Jan. 2025, doi: 10.18280/ijsdp.200103.
[75] E. Erwinsyah, "Environmental knowledge, attitudes, and practices for behavior change of university students: The case of Indonesia," *J. STEAM Educ.*, vol. 5, no. 2, pp. 181–192, 2022, doi: 10.55290/steam.1075516.
[76] M. C. Ruiz-Jiménez, R. Martínez-Jiménez, A. Licerán-Gutiérrez, and E. García-Martí, "Students' attitude: Key to understanding the improvement of their academic RESULTS in a flipped classroom environment," *Int. J. Manag. Educ.*, vol. 20, no. 2, pp. 1–11, 2022, doi: 10.1016/j.ijme.2022.100635.
[77] N. D. Orbanić and N. Kovač, "Environmental awareness , attitudes , and behaviour of preservice preschool and primary school teachers," *J. Balt. Sci. Educ.*, vol. 20, no. 3, pp. 373–388, 2021, doi: 10.33225/jbse/21.20.373.
[78] S. Sousa, E. Correia, J. Leite, and C. Viseu, "Environmental knowledge, attitudes and behavior of higher education students: A case study in Portugal," *Int. Res. Geogr. Environ. Educ.*, vol. 30, no. 4, pp. 348–365, Oct. 2021, doi: 10.1080/10382046.2020.1838122.
[79] D. C. Finger *et al.*, "The importance of international collaboration to enhance education for environmental citizenship," *Sustain.*, vol. 13, no. 18, pp. 1–17, 2021, doi: 10.3390/su131810326.
[80] N. M. Ardoin, A. W. Bowers, and M. Wheaton, "Leveraging collective action and environmental literacy to address complex sustainability challenges," *Ambio*, vol. 52, no. 1, pp. 30–44, 2023, doi: 10.1007/s13280-022-01764-6.
[81] F. Alam, H. Abdul Rahman, K. Y. Y. Kok, and K. H. Abdul-Mumin, "Exploring sustainability of educational environment among health science students at the largest public University in Brunei Darussalam: A convergent mixed-methods study," *Sustain.*, vol. 15, no. 17, pp. 1–15, 2023, doi: 10.3390/su151712714.
[82] E. I. Ezepue *et al.*, "Evaluating the local language dimensions for effective teaching and learning sustainability in the secondary education system in southeast Nigeria: Results from a small-scale study," *Sustain.*, vol. 15, no. 9, pp. 1–18, 2023, doi: 10.3390/su15097510.
[83] E. S. Lufungulo, J. Jia, and K. Mwila, "Exploring factors of open educational resources (OER) in Zambian community schools: A qualitative study," *Soc. Sci. Humanit. Open*, vol. 11, p. 101465, 2025, doi: 10.1016/j.ssaho.2025.101465.
[84] N. M. Ardoin, A. W. Bowers, and E. Gaillard, "Environmental education outcomes for conservation: A systematic review," *Biol. Conserv.*, vol. 241, p. 108224, Jan. 2020, doi: 10.1016/j.biocon.2019.108224.
[85] S. Otto and P. Pensini, "Nature-based environmental education of children: Environmental knowledge and connectedness to nature, together, are related to ecological behaviour," *Glob. Environ. Chang.*, vol. 47, pp. 88–94, Nov. 2017, doi: 10.1016/j.gloenvcha.2017.09.009.
[86] H. Lestari, M. Ali, W. Sopandi, and A. R. Wulan, "The ESD-oriented RADEC model: To improve students sustainability consciousness in elementary schools," *Pegem J. Educ. Instr.*, vol. 12, no. 2, pp. 93–102, Jan. 2022, doi: 10.47750/pegegog.12.02.11.