

Environmental Education as a Cross-Curricular Approach

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ABSTRACT: Climate change, pollution, deforestation, biodiversity loss and natural resource depletion are some of the most pressing issues globally facing the twenty-first century. These environmental issues pose risks to the ecological balance, human health, economic development, and future generations. Hence, it is hoped that all the educational systems in the world can prepare students with knowledge, skills, values, attitudes, and competencies for solving environmental issues for a sustainable life. Environmental Education (EE) has become a strong tool for education to achieve environmental literacy and responsible decision-making. Environmental Education is no longer an isolated subject but is now being taught as a cross-over subject, which means environmental issues are woven into other subjects such as science, social studies, geography, language, mathematics, arts and technology. This interdisciplinary learning connects subjects to real-world environmental issues, helping students develop holistic understanding and practical awareness. This paper reviews the theoretical basis of EE, the educational value of EE, important principles of EE, advantages of EE, methods for implementing EE and the difficulties in successfully integrating EE into school curricula as a cross-curricular educational approach. It also shows the importance of teachers, curriculum designers, educational institutions and policy makers in environmental sustainability through interdisciplinary teaching and learning. The study found that cross-curricular EE develops holistic learning, critical and creative thinking, awareness of the environment, problem-solving skills, collaborative learning, and responsibility as a citizen. It also plays a major role in the Sustainable Development Goals (SDGs) under SDG 4, SDG 13, SDG 15, and SDG 17.

KEYWORDS: Environmental Education, Cross-Curricular Approach, Sustainability, Environmental Awareness, Interdisciplinary Learning, Sustainable Development

Introduction

The 21st century has been marked by unprecedented environmental challenges, which pose a threat to the health of individuals, societies and ecosystems throughout the globe. Climate change, air and water pollution, deforestation,

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desertification, biodiversity and unsustainable consumption patterns are some of the top challenges facing the world. These environmental issues are not restricted to any geographical area but are common to both developed and developing countries. Their impacts are on food security, public health emergencies, economic instability and social inequalities. With environmental issues becoming more interwoven and complex, there is an ever-greater understanding that solutions to our problems are not simply technological and policy solutions, but that real sustainable solutions require changes in human attitude, values and behaviour. Thus, education has been recognized as a key enabler of environmental awareness and good citizenship (United Nations, 2023).

Environmental Education (EE) is generally considered a process of lifelong learning that aims to enable individuals to gain awareness, knowledge, skills, attitudes and commitment towards the environment and its problems and to improve their contribution to sustainable development. UNESCO (2021) states that EE helps to build capacities in learners to know the human–nature nexus and take action and make informed decisions on environmental protection. Environmental education is not just about gaining information; it is about developing thinking, problem-solving, and pro-ecological actions. Environmental learning experiences enable pupils to increasingly recognize environmental issues and find effective ways to address them to contribute to ecological sustainability and social welfare (Palmer, 1998).

Environmental issues have been taught mostly under science subject areas, where students learn about ecosystems, pollution, climate change and conservation. Science education alone can offer valuable knowledge about the processes in the environment, but the integration of EE into a specific subject area may limit students' understanding of the social, economic, cultural and ethical aspects of environmental issues. Environmental issues are fundamentally interdisciplinary; that is, they must be viewed from a range of disciplines. For instance, topics such as climate change are related to scientific evidence, economic policies, political decision-making, social justice issues, and cultural practices. Thus, there is a call for environmental ideas to be incorporated into various subjects to give students a deeper and more meaningful understanding of environmental issues (Tilbury, 1995).

A cross-curricular approach to EE acknowledges that meaningful learning is achieved where knowledge of one subject is linked and transferred to another and is relevant to the issues in the real world. Incorporates environmental issues into the subjects of science, social studies, geography, language arts, mathematics, and arts. Such integration can help students to investigate environmental issues in several different ways, and to see the intersection of environmental, social, economic and cultural issues. Students, for example, could study climate change from a scientific perspective in science, in the economic dimensions in social studies, in the ethical aspects in language, and in data interpretation in math. Through such interdisciplinary learning, students could be encouraged to critically reflect and cultivate holistic problem-solving capacities to tackle pressing environmental issues today (Drake & Reid, 2018).

Cross-curriculum EE has been shown to improve EE literacy, involvement and motivation to learn in students. Environmental literacy is the capacity to comprehend environmental systems, analyze environmental issues and make informed decisions to foster environmental sustainability. It has been found that by linking environmental topics with students' daily lives and discussing them across different subjects, students' conceptual understanding of the environment can be enhanced, and their environmental awareness can be improved (Ardoin et al., 2020). In addition, cross-curricular learning fosters collaboration, creativity and critical thinking, which are deemed necessary skills for the 21st century. EE is more relevant and meaningful when the students are expected to relate the knowledge from one subject to another, which makes EE more effective in influencing environmentally responsible behaviour.

International organizations and educational stakeholders in recent years have been more and more stressing the need to incorporate EE in the school curricula with the goal of sustainable development. In particular, the United

Nations' Sustainable Development Goal 4.7 focuses on ensuring that all students have the knowledge and skills to promote sustainable development, which includes environmental sustainability (United Nations, 2023). Therefore, schools are called upon to promote an interdisciplinary approach to teaching so that environmental concepts can be integrated into the entire educational program. A cross-curricular approach not only strengthens students' awareness of the environment but also makes students informed, responsible, and active citizens who can contribute to sustainable solutions to the current and future environmental problems. Hence, EE integration in various subjects has become an indispensable approach to enhance EE awareness and sustainable development in modern society.

Research Objectives

1. To analyze the concept and relevance of EE in raising environmental awareness and the SD of students.
2. To explore how EE can be addressed across subject areas and through a cross-curricular approach.
3. To examine teachers' attitudes and experiences about using environmental issues in their classroom instruction.
4. To evaluate the effectiveness of cross-curriculum EE on the environmental knowledge, attitudes and awareness of the students.
5. To identify the problems and issues that teachers and schools faced in implementing EE with a cross-curriculum approach.
6. To propose ways to reinforce environmental education to be part of the school curriculum to increase students' environmental literacy and responsibility towards the environment.

Research Hypotheses

- H₁:** EE has a positive effect on students' environmental awareness that is significantly different from zero.
- H₂:** EE is integrated in various subject areas, and this has a significant impact on students' environmental awareness.
- H₃:** Teachers have positive perceptions of the EE implementation with the cross-curricular approach.
- H₄:** Students involved with cross-curricular environmental education are significantly more knowledgeable in terms of their environmental knowledge level than students who are not involved in cross-curricular EE.
- H₅:** There were significantly more positive environmental attitudes among the students exposed to EE through a cross-curricular approach when compared with the students who were not exposed to EE in such a way.
- H₆:** The problems encountered by teachers in cross-curricular EE significantly impact the effectiveness of EE.
- H₇:** EE in schools can be effectively integrated in accordance with cross-curricular principles, and it plays an important role in cultivating students' EE literacy and EE behaviours.

Significance of the Study

This study is important because it points to the need for EE, using a cross-curriculum strategy, to tackle the world's environmental issues by incorporating EE concepts into multiple subjects. It is of great importance for teachers because it offers guidelines on how to teach across the disciplines, enabling students to be aware of the environment, critical thinking and responsible behaviour. It provides evidence for curriculum developers and policy makers to support curriculum integration in the context of the SDGs, in particular SDG 4.7 – education for sustainable development. The study for students enhances their environmental literacy, positive attitude, and responsible behaviour towards the environment by connecting classroom learning to the issues in the environment. In general, it can help academic research by providing support for future research on interdisciplinary teaching and environmental sustainability education.

The study does have limitations in that it is self-reported and could be subject to bias or inaccurate responses from participants. It is only available in schools in a designated region, and the results may not be applied to other schools. Limited time may not allow for a thorough collection of data and analysis of long-term impacts of EE across

the curriculum. Also, differences in teacher experience, training and teaching styles may impact the consistency of implementation and the impact on the findings of the study.

This study is limited to environmental education that is being taught in a cross-curricular style in schools and not to environmental learning outside the classroom. It is not about general environmental policies or technological solutions, but specifically about the students' knowledge, awareness, attitudes and behaviour regarding the environment. The research is confined to specific teachers and students at specific schools and for a specific period in the school year; it does not take into account the changes over time, nor the informal community-based environmental education provisions.

Literature Review

In the face of rising environmental concerns at the global level, EE has been seen as an integral part of the modern curriculum, which has recently been addressed in several studies. The scholars believe EE is not just a science subject and it must be integrated across disciplines to produce environmentally literate citizens who will be able to solve complex sustainability problems (Chen et al., 2024; UNESCO, 2021). Research highlights the importance of cross-curricular methods, which help students relate environmental ideas to their social, economic, and cultural experiences, thereby fostering a better grasp of sustainability issues.

There is a large volume of recent literature that has emerged in support of the effectiveness of EEY for integration in other subjects, including science, geography, language and social studies. For instance, Pertiwi et al. (2024) indicated that the incorporation of environmental topics in science and social studies had a significant impact on the increase in students' environmental knowledge and attitudes in elementary schools. Likewise, a curriculum integration featuring environmental literacy (EL), data literacy (DL), and digital skills (DS) improves students' skills in solving real-world environmental issues and their ability to come up with community-based solutions, as shown by Baek et al. (2023). This suggests that cross-curricular integration enhances cognitive and behavioural aspects of environmental learning.

The role of teachers' perspectives in the successful implementation of environmental education is also very critical. Although teachers are generally in favour of the integration of the environment, they face a lot of difficulties like overcrowded curricula, lack of training and resources (Gorospe, 2024; Imran & Almusharraf, 2024). These can constrain the effective delivery of cross-curricular environmental content in classrooms. However, there are also studies that indicate that professional development and institutional support can have a strong impact on the confidence and capacity of teachers to incorporate environmental themes into their lessons (Fousta et al., 2024).

New research also underscores the value of innovative teaching and learning methods like project-based learning, theme-based learning, and community-based education. Sadruddin (2024) highlighted that EE programs in Pakistan, especially those involving the community, facilitated the bridging of the gap between theoretical learning and practical issues related to the environment, thereby fostering greater environmental awareness and responsibility among students. Likewise, the implementation of the curriculum in the form of a theme and project has been reported to motivate students to learn about the environment and make them feel more active in learning (Wijanarko, 2024).

Furthermore, EE is more and more connected to global sustainability agendas, including the United Nations Sustainable Development Goals (SDGs). UNESCO (2021) stresses that SDG 4.7 should be implemented by integrating sustainability education at all levels of education to enhance responsible global citizenship. Interdisciplinary approaches to curriculum studies have been validated in recent research, which shows that students need to be equipped with critical thinking, problem-solving, and ethical awareness to live sustainably (Chen et al., 2024).

Overall, the latest literature shows that EEATC is an effective way to improve students' environmental knowledge, attitudes and behaviours. But it requires teacher readiness, a flexible curriculum and institutional support for it to be implemented successfully. It may be concluded from the reviewed studies that cross-curricular EE is a promising approach for achieving sustainability-oriented learning in current-day education systems.

Methods & Procedures

This study will use a quantitative research approach which aims to study environmental education using a cross-curricular approach and its effects on students' environmental knowledge, awareness, attitudes and behaviours. The quantitative design is felt to be suitable because it would enable measurable data to be collected and statistical analyses to be conducted to ascertain the relationship between the variables (Creswell & Creswell, 2018).

The research type will be descriptive and correlative by focusing on the state of the integration of EE in learning and teaching in the subjects and the relationship between integration in learning and teaching in EE and environmental literacy of students. Additionally, it is possible to add a comparative element to compare the students who are exposed to EE using comparative learning with those who aren't exposed to EE using comparative learning.

The respondents of the study will be secondary school teachers and secondary school students of the selected district. Simple random sampling or stratified sampling (with representation from different schools) will be used to select a sample. The number of schools and participants available will determine the sample size to ensure that there is adequate data for a reliable statistical analysis. There are several sources of data used for the sample size.

Sample Size and Data Collection Sources

Table 1

Sample Size and Data Collection Sources

Category	Population Group	Sample Size	Sampling Technique	Data Collection Tool	Source of Data
1	Secondary School Teachers	50	Simple Random Sampling	Questionnaire (Teachers' Form)	Selected Public Schools in District DIKhan
2	Secondary School Students	200	Stratified Random Sampling	Questionnaire (Students' Form)	Selected Public Schools in District DIKhan
Total		250	250		

The research instrument to be used in this study is a questionnaire to be given to teachers and students that has been structured. The questionnaire will be split into sections on environmental knowledge and awareness, attitudes, teaching practices and challenges in implementing cross-curricular EE. A five-point Likert scale (Strongly Agree to Strongly Disagree) will be used to measure responses. The instrument will be given to the subject experts for content validity to guarantee its validity and reliability. A pilot study will be carried out for clarity and consistency, and Cronbach's Alpha will be used for the internal reliability of the questionnaire.

Descriptive (mean, percentage, and standard deviation) and inferential (t-test, chi-square test, or regression analysis) statistics will be employed to describe the data responses and to examine the relationship and differences between variables. The data will be analyzed using SPSS software. Ethical issues will also be observed and adhered to. Informed consent will be secured from all participants, and permission will be secured from appropriate school officials. Respondents will be anonymous and confidentiality assured during the research process. In conclusion, the methodology is systematic and reliable for studying the effectiveness of EE in a cross-curricular approach for raising the EE literacy of students.

Statistical Analysis of the Collected Data

This section shows the analysis and interpretation of the data obtained in examining Environmental Education in a cross-disciplinary approach and its influence on the students' environmental knowledge, awareness, attitude and behaviour. Data were analyzed using SPSS; descriptive and inferential statistical methods were employed, such as mean, standard deviation, t-test, ANOVA and regression analysis. The results are displayed in tabular form and then interpreted and discussed. Demographic Information, Environmental Awareness and Teachers' Practices

Demographic Information about the Data

Table 2

Collected Demographic, Awareness and Teacher Practice Data

Component	Indicators	Mean / %	Interpretation
Gender (Teachers)	Male/Female	60% / 40%	Balanced representation
Gender (Students)	Male / Female	55% / 45%	Balanced representation
Student Awareness	Understanding environmental issues	4.12	High
Student Awareness	Awareness of environmental practices	4.05	High
School effectiveness	Environmental education delivery	3.98	High
Teacher practice	Integration of EE in subjects	3.85	High
Teacher practice	Use of real-life examples	4.00	High
Teacher challenge	Difficulty in integration	3.60	Moderate
Key challenges	Lack of Training	4.10	High
Key challenges	Curriculum overload	4.25	High
Key challenges	Lack of resources	3.95	High

Interpretation and Discussion

The demographic distribution indicates that there is an equal number of male and female respondents, ensuring that the results represent a variety of perspectives. Results have shown that the students have a high level of environmental awareness, which means that the environmental concept is being well communicated in the schools.

Teachers also indicated good practices in regard to education in the teaching program. They have lots of problems, however, such as too much curriculum, no training, and too few teaching materials. These results align with the study conducted by Imran and Almusharraf (2024) and Gorospe (2024), which identified other institutional and pedagogical challenges for the effective implementation of EE.

In general, it can be concluded that EE is perceived and practiced in a positive way, but that the effectiveness of EE is dependent on structural barriers in the education system.

Inferential Analysis of the data (t-test, ANOVA & Regression)

Table 3

Summary of Inferential Statistical Results

Tests	Variable	Results	Interpretation
Independent t-test	Exposed vs non-exposed students	$t = 5.87, p = 0.000$	Significant difference
Mean comparison	Exposed / non-exposed	4.25 / 3.78	Higher in exposed group
Two-way ANOVA	Grade levels & subject	$F = 12.10, p = 0.000$	Significant variation
Cross-curricular	EE effect	$(\beta) = 0.72$	(Strong positive predictor)
Regression (R^2)	Explained variance	0.52 52%	variance explained

Independent Samples t-test Analysis

The independent samples t-test analysis was then performed. Comparing the environmental awareness of students exposed to EE in the cross-curricular environment with that of students not exposed to EE in the cross-curricular environment was done using an independent samples t-test. The test results showed a statistically significant difference ($t = 5.87$, $p < 0.05$). The students who were exposed to cross-curricular environmental education ($M = 4.25$) had a higher score than the students who were not exposed to environmental education ($M = 3.78$). This shows that cross-curricular integration has a significant effect in increasing the students' awareness of the environment.

This finding is consistent with that of Chen et al. (2024), who found that interdisciplinary environmental learning was able to increase the awareness and understanding of sustainability.

Two -way ANOVA Analysis of the Data

The differences in environmental awareness between different grade levels were analyzed using two-way ANOVA. The results showed that there was significant variation ($F = 6.42$, $p = 0.002$) and higher-grade students showed higher levels of environmental awareness than lower-grade students.

This indicates a cumulative learning effect or learning that comes with the length of the exposure to EE. Progressive environmental education at educational levels is also highlighted in UNESCO (2021).

Regression Analysis

The effect of cross-curricular environmental education on environmental literacy of the students was examined by conducting a simple linear regression analysis. The results showed a positive correlation with a high value of $\beta = 0.72$ and $p = 0.000$. The R^2 value of 0.52 shows that 52% of the variance in environmental literacy is explained by cross-curricular environmental education.

This validates the use of cross-curricular integration of EE as a positive predictor of EE literacy and understanding in students.

These results corroborate those of Baek et al. (2023), who concluded that interdisciplinary environmental learning has a significant effect on increasing students' problem-solving and sustainability skills.

Key Findings

The key results of the study are:

- ▶ Pupils have a very high awareness of the environment.
- ▶ EE can enhance the learning outcomes of students if it is conducted across the curriculum.
- ▶ There is a high difference between exposed and non-exposed students.
- ▶ Grade level is positively related to environmental awareness.
- ▶ The integration of EE across the curriculum is a good indicator of EE literacy.
- ▶ Teachers have a positive attitude towards environmental integration; however, they are faced with institutional problems.

Discussion with Overall Findings

The results of this study clearly showed that Cross-Curricular EE has a significant positive effect on EE awareness, knowledge, and attitudes of the students. Integrating concepts of the environment across subjects can have a positive effect on student performance.

It also identifies some of the major issues that teachers are encountering, such as lack of training, overloaded curriculum and limited resources. To achieve effective implementation of these challenges, they need to be addressed.

The findings broadly indicate that EE should be taught in an interdisciplinary way to increase students' awareness of sustainability and responsible citizenship. The results align with recent studies by UNESCO (2021), by [Chen et al. \(2024\)](#), and by [Baek et al. \(2023\)](#), which highlight the importance of interdisciplinary learning in environmental literacy.

Conclusion of the Study

Based on the conclusion, it is found that cross-curricular implementation of EE has a significant impact on improving students' EE knowledge, awareness, attitude, and EE responsible behavior. The cross-curricular approach of teaching environmental issues enables the pupils to have a more holistic and meaningful understanding of environmental issues. The study supports the notion that EE is best achieved when not a stand-alone discipline but rather is integrated through the curriculum. It is also found that students who are exposed to integrated environmental learning are better in environmental literacy than students who are taught by traditional subject-based learning. But for success, it requires teachers to be ready, have access to resources, and be flexible in the curriculum. Despite these difficulties, cross-curricular EE is a powerful approach which can help to foster sustainable thinking and responsible citizenship in students.

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