



## Effect of Environmental Remediation Packages for Environmental Consciousness among Secondary School Students in Sokoto Metropolis, Sokoto State, Nigeria

EZEAMAGU, Mary Ugochukwu<sup>1</sup>

[maryezeamagu@gmail.com](mailto:maryezeamagu@gmail.com)  
[Ezeamagu.ugochukwu@ssu.edu.ng](mailto:Ezeamagu.ugochukwu@ssu.edu.ng)  
08068978255

UMAR, Bilkisu Mani<sup>1</sup>

[bilkisumani@gmail.com](mailto:bilkisumani@gmail.com)  
08107377341

SANI, Zainab Gandi<sup>1</sup>

[zeegandee@gmail.com](mailto:zeegandee@gmail.com)  
08065467655

<sup>1</sup>Sokoto State University, Sokoto State, Nigeria

### Abstract

*The purpose of this research was to find out if environmental remediation methodology can improve environmental consciousness among secondary school students in Sokoto metropolis. Quasi control-experimental group pre-posttest model was employed were 313 students from intact classes of SS2 formed the sample of the study from all public secondary schools within Sokoto metropolis. Students' Performance Test on Pollution (SPTP) with a reliability index of 0.78 was the instrument used for data collection. Descriptive statistics and independent sample t-test were used to analyzed the data (P=0.05). Utilizing environmental remediation packages was found to increase students' environmental consciousness. Result also showed no significant difference between male and female environmental consciousness when taught using environmental remediation packages. To improve environmental consciousness among secondary school students, it was recommended that stakeholders should include environmental remediation as an instructional methodology in the Nigerian secondary school curriculum.*

**Keyword:** Environmental Remediation; Environmental Consciousness; and Secondary School Students.

### Introduction

Environmental remediation refers to the different strategies and techniques that are utilized in neutralizing pollution and restoring the health of the environment and it's environ. It involves cleaning-up methods, such as, in-situ and off-situ chemical treatment, bio-remediation, catalytic converters, thermal remediation among others. Environmental remediation in schools play a great role in the teaching and learning process. It helps in enhancing students' comprehension, focus and minimizes distractions thereby producing vibrant, sound and efficient students with a sense of responsibility and environmental consciousness leading to students' environmental stewardship (Meng, Zhang & Lian, 2025). A school environment with minimized or controlled pollution paves way for smooth learning process and attainment of teaching and learning objectives, it helps in attaining economic growth and environmental sustainability when proper waste management strategy is employed such as waste reuse and waste decomposition (Socolovsky, Louisias, Alsulami, Petty & Trivedi, 2025). As environmental remediation is an act of cleaning up of waste and harmful substances, it also deals with the removal, treatment and containment of pollution and contaminants from the soil, ground water and even indoors (De souse & Almeida, 2025). According to Adamu and Abdullahi (2024), environmental education programme on students' environmental awareness and behavior is essential for effective environmental literacy especially using the environmental education kit.

Environmental remediation often starts from assessing health and ecological risk involved in the remediation exercise, which will guide the sampling and chemical analysis to be done. Environmental remediation is categorized into two; ex-situ and in-situ. Ex-situ is done by removing the affected soil and contaminated groundwater while in-situ method involves treating the contamination without removing the soil and groundwater. Approaches to environmental remediation include



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soil excavation and disposal, solidification and stabilization, soil-vapor extraction, permeable reactive barriers, monitored natural attenuation, bioremediation-phytoremediation, chemical oxidation, in-situ thermal desorption among others (Jnj Environmental, 2025). Environmental remediation plays a significant role in promoting public health and maintaining the overall environment, the process allows a reverse the anthropogenic impacts on the land and enable better land productivity and boost the ecosystem (Cactus, 2024). Environmental remediation also helps in improving aesthetics by transforming abandoned lands into parks, green spaces which will beautify the neighborhood, increase the land value, and serve as a source of income thereby improving the economy (Hull's environmental services, 2023). However, some soil remediation techniques are associated with negative impacts on the environment including changes in edaphic conditions and toxic by-products (Biabani, Ferrari & vaccari, 2023). According to Sysco environmental (2024), securing healthy learning environment is paramount, considering the amount of time students and teachers spend in the classroom. Environmental remediation is concerned with assessing the quality of the environment to define ways of reducing pollution (Stein & kerle, 2008). Latham & Jennings (2022) showed that remediation efforts significantly reduced lead in school drinking water in New York City.

### **Statement of the Research Problem**

It has been observed that most public secondary schools' environment in Sokoto Metropolis-Nigeria are found littered in waste, comprising of gutters, stagnant water, used papers, food particles, used containers and plastics, human faeces, solutions from laboratory activities; air pollution as a result of uncleaned toilets and over populated classrooms among others. These pollutants are injurious to health of staff, students and neighbouring communities and also impede academic activities and students' performance. In an attempt to solve this problem a bunch of effort were made. It was reported by Auwal (2021) that the Sokoto State government in its attempt to improve secondary schools' environment established orchards and gardens in twenty-one (21) secondary schools in the State. Yusuf, Abbas & Kabiru (2022) conducted a study to find out the level of water sanitation and hygiene services in public secondary schools in Sokoto State, Sahabi (2024) also carried out research to assess plastic waste management among secondary schools in Gwadabawa local government area of Sokoto State. However, more needs to be done, this study therefore aimed at organizing and carrying out different environmental remediation packages/activities which will equip students with hands-on activities which are age-appropriate for public secondary schools in Sokoto metropolis- Nigeria to increase their environmental consciousness.

### **Objectives of the study**

1. To find the difference in students' environmental consciousness mean score between those taught using discussion methods and those guided using environmental remediation packages in Sokoto Metropolis- Nigeria;
2. To identify the difference between male and female students' environmental consciousness Mean performance on the basis of environmental remediation packages in Sokoto Metropolis-Nigeria.

### **Research Questions**

1. Is there any difference in students' environmental consciousness mean scores between those taught using discussion methods and those guided using environmental remediation packages in Sokoto Metropolis- Nigeria?
2. Does a difference exist between male and female students' environmental consciousness Mean performance on the basis of environmental remediation packages in Sokoto Metropolis-Nigeria?

### **Hypotheses**

1. There a no significant difference in students' environmental consciousness mean scores between those taught using discussion methods and those guided using environmental remediation packages in Sokoto Metropolis- Nigeria
2. There is no significant difference between male and female students' environmental consciousness mean performance on the basis of environmental remediation packages in Sokoto Metropolis-Nigeria?

### **Methodology**

The study employed quasi experimental design. It is made up of control-experimental group in a pretest- treatment- posttest model. The population of the study comprised of all public secondary school students in Sokoto Metropolis-Nigeria, which are majorly hausa-fulani by tribe and are Muslims by religion with an average age of 15years. The study was delimited to SS2 students and the topic air and land pollution. Multistage sampling technique was used. Four secondary schools were randomly sampled from all public schools within the metropolis; two all-boys and two all-girls randomly assigned to control and experimental groups. Intact classes of SS2 was chosen conveniently as the topic air and land pollution and its



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remediation is taught at that level. Participants of the study is made up of 313 students of which 223 are male and 90 females. The control group is made up of one male school and one female school, it was treated the topic air and land pollution for a period of six (6) weeks using discussion method. The experimental group was treated the same content using environmental remediation packages. Environmental Remediation activity schedules was designed and used as treatment for students in the experimental group. It is made up of age appropriate environmental remediation activities suitable for secondary school students under the guidance and supervision of the instructor. Students' Performance Test on Pollution (SPTP) was the instrument for data collection. It is a researcher designed 15-items 4-options objective test drawn from the environmental remediation activity schedules. SPTP was validated by experts in test and measurement and experienced secondary school teachers. To test its reliability, test-retest method was used on a pilot study of 30 students from Government Girls' Secondary School Runjin Sambo who were among the population of the study and an index of 0.78 was obtained using Pearsons' Product Moment Correlation Coefficient (PPMCC).

Participants of the study were grouped into control and experimental group, SPTP was administered to both groups as pre-test before treatment to ascertain the homogeneity of the groups, then the experimental groups were taught air and land pollution using environmental remediation packaged/activities while the control group was taught using discussion method for a period of six weeks. SPTP used again as post-test to find out which of the group lead to more environmental consciousness among the students. Data collected was analyzed using descriptive statistics of means and standard deviations and t-test of independence at 0.05 level of significance. All statistical analyses were carried out using the software Statistical Package for Social Science (SPSS)

## Presentation of Results

### Research Question 1

Is there any difference in students' environmental consciousness mean scores between those taught using discussion methods and those guided using environmental remediation packages in Sokoto Metropolis- Nigeria?

**Table 1: Mean performance of students Between Discussion Method and Environmental Rem. Packages**

S/N	Variable Name	Mean	Std. Deviation	Decision
1	Discussion Method	15.25	4.04	There is difference
2	Environmental Rem. Package	22.06	3.88	

### Field work, 2025

Table 1 presented the descriptive statistics of students' environmental consciousness mean performance for those taught using the discussion method and those taught using environmental remediation packages. The result showed that students who were taught using the discussion method, recorded a lower mean score compared to students who were taught using environmental remediation packages. The mean difference further suggests that students taught with environmental remediation packages demonstrated better environmental consciousness than their counterparts in the control group.

Give a brief description of the statistics in Table 1 and show whether the analysis really answers the research question or not.

### Research Question 2

Does a difference exist between male and female students' environmental consciousness Mean performance on the basis of environmental remediation packages in Sokoto Metropolis-Nigeria?

**Table 2: Mean performance Between Male and Female Students through Environmental Rem. Packages**

S/N	Variable Name	Mean	Std. Deviation	Decision
1	Male	21.97	4.21	There is difference
2	Female	22.29	2.95	

### Field work, 2025

Table 2 presents the descriptive statistics of male and female students' environmental consciousness mean performance based on the environmental remediation packages. The result shows that both male and female students recorded relatively similar mean scores. However, female students had a slightly higher mean performance compared to their male



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counterparts. The small mean difference indicates that the variation in environmental consciousness performance between male and female students exposed to environmental remediation packages is minimal.

### Hypothesis 1

There a no significant difference in students' environmental consciousness mean scores between those taught using discussion methods and those guided using environmental remediation packages in Sokoto Metropolis- Nigeria

**Table 3: Independent Samples t-Test of Students' Environmental Consciousness Mean Performance on Discussion Method and Environmental Remediation Packages**

S/N	Variable	Mean	F	T	Df	P-value	Decision
1	Disc, Method	15.25					
2	Env. Rem.	22.06	6.011	-15.203	311	0.000	H1 Rejected

### Field work, 2025

Table 3 shows the independent samples t-test result comparing students' environmental consciousness mean performance between those taught using the discussion method and those taught using environmental remediation packages. The result revealed a calculated t-value of -15.203 with a degree of freedom of 311 and a p-value of 0.000, which is less than the 0.05 level of significance. This indicates that there is a statistically significant difference between the mean performances of the two groups. Students taught using environmental remediation packages recorded a higher mean score than those taught using the discussion method. Consequently, the null hypothesis was rejected

### Hypothesis 2

There is no significant difference between male and female students' environmental consciousness mean performance on the basis of environmental remediation packages in Sokoto Metropolis-Nigeria

**Table 4: Independent Samples t-test Analysis of Gender Difference in Post-test Mean Scores on Env Rem.**

S/N	Gender	Mean	F	t-value	df	P-value	Decision
1	Male	115					
2	Female	48	2.03	-0.489	161	0.156	Ho <sub>2</sub> Accepted

### Field work, 2025

## Discussion of Findings

Findings from hypothesis 1 indicate that students taught using the environmental remediation packages demonstrated considerably higher environmental consciousness mean performance compared to those taught using the traditional discussion method. This descriptive outcome aligns with recent empirical evidence by Adamu and Abdullahi (2024) suggesting that instructional approaches that actively engage students with real-world environmental problems and experiential learning tasks tend to produce better learning outcomes than conventional teacher-centred strategies. For example, pedagogical strategies that involve collaborative, contextually grounded activities have been shown to enhance students' environmental knowledge and pro-environmental attitudes more effectively than lecture-based methods, as these strategies stimulate critical thinking and active engagement with content (Xiong, & Zhu, 2025). Similarly, integrating innovative and learner-centred practices in environmental education has been associated with improved comprehension and application of ecological concepts, which supports the superiority of remediation-oriented instruction observed in this study (Muhammed, 2024). This study's findings suggest that when students are provided with structured materials and tasks that highlight environmental issues and remediation, they may develop deeper awareness and reflective thought about environmental phenomena compared to peers exposed to discussion-only methodologies

The findings related to hypothesis 2 revealed that there was no significant difference between male and female students' environmental consciousness mean performance when taught using the environmental remediation packages. Although slight variations were observed in the mean scores of male and female students, these differences were not substantial enough to indicate a gender-based performance gap. This outcome is consistent with recent empirical studies which suggest that learner-centered and activity-based instructional approaches tend to minimize gender disparities in learning outcomes. For instance, Okorie and Ahmed (2021) reported that when students are exposed to structured environmental education



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interventions that emphasize practical engagement and problem-solving, gender differences in achievement become negligible. Similarly, a study by Zhao, Li, and Wang (2022) found that remediation-based environmental instruction produced comparable gains in environmental awareness and responsibility among male and female secondary school students. These findings suggest that the inclusive nature of environmental remediation packages characterized by hands-on activities, collaborative tasks, and real-life environmental contexts provides equal learning opportunities for all learners regardless of gender. The results further align with Adeyemi (2023), who observed that instructional strategies emphasizing experiential learning and contextual relevance tend to neutralize traditional gender performance gaps commonly reported in conventional teaching approaches. Therefore, the result of this study implies that environmental remediation packages are gender-neutral in impact and effective in fostering environmental consciousness equitably among students. This reinforces the view that instructional quality and strategy selection are more critical determinants of learning outcomes than gender differences, especially in environmental education contexts

### **Conclusion**

The research concluded that environmental remediation packages has the capacity and potential to improve students' environmental consciousness and the method is suitable for both male and female students.

### **Recommendations**

Based on the findings of the study, it is recommended that:

1. Stakeholders should include environmental remediation packages as instructional technique or method in the Nigerian secondary school curriculum.
2. Environmental remediation packages/ activities should be practiced among all students irrespective of their gender

### **Acknowledgements**

The authors acknowledged the cooperation of the participants of the research, from the sampled schools' administrators to the sampled students and the research assistants throughout the duration of the research.

The researchers also acknowledge the Tertiary Education Trust Fund (TET Fund) for funding this Institution-Based Research (IBR) TETF/DR&D/CE/UNI/SOKOTO/IBR/2025/VOL.1.

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