

Effect of Health Education Intervention on Attitude Towards Solid Waste Management among Undergraduate Students in University of Ilorin, Kwara State, Nigeria

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Abstract

Attitude is a critical determinant of pro-environmental behaviour, yet its malleability through short-term educational interventions in Nigerian university settings remains underexplored. Solid waste mismanagement continues to threaten public health and environmental sustainability across Nigerian campuses, calling for targeted interventions that specifically address attitudinal dimensions of student behaviour. This study examined the effect of a six-week health education intervention on attitudes toward solid waste management (SWM) among undergraduates in the University of Ilorin, Nigeria, and further investigated the baseline attitude profile of participants and the relationship between attitude and waste management practice. A quasi-experimental pre-test/post-test design with a control group was employed among 184 undergraduate participants (control n = 82; experimental n = 102) drawn from three faculties via multistage sampling. Attitude was measured using a 15-item validated Modified Likert Scale (Cronbach $\alpha=0.72$). Analysis of Covariance (ANCOVA) was used to test the primary hypothesis at $p<0.05$, while Pearson correlation assessed the attitude–practice relationship. Most participants demonstrated positive baseline attitudes toward SWM (83.7% scored above 45 on a 60-point scale). ANCOVA revealed no statistically significant effect of the intervention on post-intervention attitude scores when controlling for baseline attitudes, $F(1,181)=0.979$, $p=.324$, $R^2=.263$. The pretest attitude covariate was a strong predictor of post-test scores, $F(1,181)=64.082$, $p<.001$. A weak but statistically significant positive correlation was found between attitude and practice scores at both pre-test ($r=.188$, $p=.010$) and post-test ($r=.168$, $p=.023$). A largely positive attitude existed prior to the intervention, suggesting a ceiling effect that constrained attitudinal change. Short-term health education alone is insufficient to shift already-favourable attitudes; sustained, infrastructure-linked, and participatory approaches are recommended to bridge the attitude–practice gap among university undergraduates.

Keywords: Solid Waste Management; Health Education Intervention; Attitude; Undergraduate Students.

Introduction

Solid waste management (SWM) has emerged as one of the most pressing public health and environmental challenges in sub-Saharan Africa, with Nigeria bearing a disproportionate burden due to rapid urbanisation, population growth, and inadequate waste infrastructure. Municipal solid waste generation in Nigerian cities has grown exponentially over the last two decades, overwhelming existing collection and disposal systems and contributing to widespread pollution, disease transmission, and ecosystem degradation (Nwosu & Chukwueloka, 2020; Hoornweg & Bhada-Tata, 2012). University campuses are not immune to this challenge; rather, they function as microcosms of urban society, generating substantial volumes of food waste, paper, plastics, and mixed refuse on a daily basis (Jain & Pant, 2010; Owajori et al., 2022). Among the many factors that shape solid waste management behaviour, attitude occupies a particularly central position. According to the Theory of Planned Behaviour (TPB) proposed by Ajzen (1991), attitude, defined as an individual's evaluative disposition toward a specific behaviour, is one of the principal proximal determinants of behavioural intention and, by extension, actual behaviour. Positive environmental attitudes are therefore a prerequisite for students to engage in responsible waste disposal, segregation, and recycling. However, a robust and growing body of literature documents a persistent attitude–behaviour gap: students may express favourable orientations toward environmental protection while simultaneously failing to translate these dispositions into consistent pro-environmental actions (Wu et al., 2022; Owajori



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et al., 2022). Understanding the conditions under which attitudinal change can be achieved, and the degree to which it translates into improved practice, is thus of considerable theoretical and practical importance. Health education interventions have been widely employed as instruments of attitudinal and behavioural modification across public health domains. By delivering structured, evidence-based information about the health implications of environmental behaviours, such programmes seek to reshape cognitive evaluations, strengthen intention, and ultimately shift practice. Within Nigerian higher education specifically, intervention studies targeting environmental knowledge, attitude, and practice have yielded mixed results. Erhabor (2024) reported significant improvements in waste segregation attitudes among University of Benin students following environmental education; similarly, Danlami et al. (2024) documented significant attitudinal gains toward water sanitation among rural women in Niger State after a structured health education programme. On the other hand, broader reviews suggest that short-term, low-intensity educational programmes often struggle to produce durable attitudinal change, particularly when baseline attitudes are already relatively positive and when infrastructural enablers are absent (Conti et al., 2024; Dung et al., 2017). The University of Ilorin, one of Nigeria's largest federal universities with an undergraduate population exceeding 49,000, generates significant volumes of solid waste, yet systematic campus-based SWM education remains limited. Studies conducted within Kwara State, where the university is located, have documented a well-recognised disparity between students' stated environmental awareness and their actual waste disposal behaviour (Malik et al., 2020; Adeyemi & Adedeji, 2025). This suggests that, while attitudinal capital may exist among students, structural and educational deficits prevent this capital from being converted into behavioural change. Against this backdrop, the University of Ilorin represents an important site for investigating the attitudinal dimensions of SWM behaviour.

Despite extensive literature on KAP studies in environmental health, few studies in Nigeria have isolated attitude as the primary outcome of interest in a controlled intervention study, disentangling it from the simultaneous assessment of knowledge and practice. This is a notable gap, given that attitude change may operate through different mechanisms and timescales compared to knowledge acquisition or behavioural modification. Furthermore, the relationship between attitude and practice in the specific context of Nigerian undergraduates, and the degree to which this relationship can be strengthened through health education, warrants dedicated empirical investigation. Globally, bibliometric analyses indicate rapidly growing research interest in SWM awareness and attitude in higher education institutions, with over 81 papers published in 2023 alone (Hassan & Rosli, 2022; Liu et al., 2024). However, the majority of this literature originates from Asia and the Philippines, with African university settings, particularly in West Africa, remaining underrepresented. Contextualising the findings of the present study within global evidence is therefore important for advancing understanding of whether the mechanisms and outcomes observed in other settings are transferable to the Nigerian university context. This study therefore aimed to examine the effect of a six-week health education intervention on attitudes toward solid waste management among undergraduates at the University of Ilorin, Nigeria. Beyond testing the primary intervention effect, the study characterised the baseline attitudinal profile of participants, explored the relationship between attitude and practice, and assessed the degree to which pre-test attitude predicted post-test attitude scores. Collectively, these objectives aim to generate actionable evidence for the design of more effective SWM education programmes within Nigerian universities.

Objectives of the Study

Specifically, this study sought to:

1. Determine the baseline attitude level of undergraduates in the University of Ilorin toward solid waste management before the intervention.
2. Examine the distribution and profile of attitude scores across the experimental and control groups at pre-test.
3. Assess the effect of the six-week health education intervention on the attitude of undergraduates toward solid waste management.
4. Determine whether the pre-test attitude score predicts the post-test attitude score.
5. Investigate the relationship between attitude toward SWM and SWM practice scores among participants.

Research Questions

The following research questions guided this study:

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RQ1: What is the baseline attitude of undergraduates in the University of Ilorin toward solid waste management?

RQ2: What is the distribution and profile of attitude scores across the experimental and control groups before the intervention?

RQ3: What is the effect of the health education intervention on the attitude toward solid waste management among undergraduates in the University of Ilorin?

RQ4: To what extent does the pre-test attitude score predict post-test attitude scores among participants?

RQ5: What is the relationship between attitude toward solid waste management and the practice of solid waste management among undergraduates?

Hypotheses

The following null hypotheses were formulated and tested at the 0.05 level of significance:

H₀₁: There is no statistically significant effect of the health education intervention on the attitude toward solid waste management among undergraduates in the University of Ilorin, Nigeria.

H₀₂: There is no statistically significant relationship between pre-test attitude scores and post-test attitude.

H₀₃: There is no statistically significant relationship between attitude toward solid waste management and the practice of solid waste management among undergraduates.

Research Methodology

Research Design

This study adopted a quasi-experimental pre-test/post-test control group design, widely recognised as appropriate for evaluating the impact of educational interventions when full randomisation at the institutional level is not feasible (Dung et al., 2017). Pre-tests established baseline equivalence between groups, and post-tests assessed change after a six-week health education intervention. Analysis of Covariance (ANCOVA) was used as the primary analytical strategy to control for pre-test scores, thereby isolating the intervention effect on attitude as the primary outcome.

Table 1

Quasi-experimental Pre-test/Post-test Design

Group	Pre-test	Treatment	Post-test
Control	O ₁	—	O ₂
Experimental	O ₃	HEI	O ₄

Note. HEI = Health Education Intervention; O = Observation/measurement.

Population of the study

The target population comprised the 49,610 undergraduate students enrolled at the University of Ilorin. Using multistage sampling, three faculties (Agriculture, Life Sciences, and Education) were randomly selected from the 16 faculties. Within these faculties, convenience sampling via WhatsApp group advertisements and public announcements was used to recruit willing participants who were currently enrolled undergraduates, had not previously participated in a similar SWM intervention, and were willing to complete the six-week protocol. A total of 220 participants were recruited and randomly assigned to the experimental (n = 120) or control (n = 100) group via a fishbowl simple random sampling method. Due to attrition (18% control; 15% experimental), 184 participants completed the study (control n = 82; experimental n = 102). The final sample was 60.9% female, predominantly from the Faculty of Education (54.9%), and represented all academic levels.

Instrument

Attitude was assessed using the 15-item Attitude subscale of the "Knowledge, Attitude, and Practices of Solid Waste Management Questionnaire" (KAPSWMQ), developed and validated by the researchers. Items were scored on a four-point Modified Likert Scale (Strongly Agree = 4, Agree = 3, Disagree = 2, Strongly Disagree = 1), yielding a total attitude score range of 15–60, where higher scores reflect more positive attitudes toward SWM. Attitude items covered dimensions including perceived environmental responsibility, willingness to segregate waste, support for recycling, and views on campus waste policy. The instrument was validated by three experts in Educational Measurement and Evaluation,

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Environmental Education, and Health Education. Internal consistency reliability was established via Cronbach's alpha ($\alpha = 0.72$), indicating acceptable reliability for the attitude subscale (Nunnally, 1978). Practice was measured by a 12-item subscale (four-point scale; range 12–48; $\alpha = 0.71$) and used for correlation analyses.

Intervention

The health education intervention was delivered to the experimental group as a six-week Comprehensive Health Education Instructional Package (CHEIP). Activities included interactive information sessions on the health implications of SWM, the environmental consequences of improper waste disposal, and best practice guidelines for waste segregation, recycling, and disposal. Educational materials including pamphlets, posters, and flyers were distributed, and the WhatsApp platform was used for supplementary information dissemination and discussion. Each weekly session lasted approximately 60 minutes. The control group received a placebo session on general health topics unrelated to waste management. CHEIP was content-validated by Environmental Education and Health Education experts.

Ethical Considerations

Institutional ethical review approval was obtained from the University Ethical Review Committee (UERC), University of Ilorin (Approval No: UERC/ASN/2026/3487). Permission was also granted by the University Registrar. Participation was voluntary, and confidentiality of data was maintained throughout the study.

Data Analysis

Descriptive statistics (means, standard deviations, frequency counts, and percentages) were used to characterise the baseline attitude profile and post-test scores. Analysis of Covariance (ANCOVA) was employed to test H_{O1} , with post-test attitude as the dependent variable, group (experimental vs. control) as the independent variable, and pre-test attitude as the covariate. Adjusted (least squares) means were computed to reflect group differences after controlling for baseline scores. Pearson product-moment correlation was used to test H_{O2} (pre-test vs. post-test attitude) and H_{O3} (attitude vs. practice). All analyses were conducted at the 0.05 significance level.

Presentation of Results

Socio-Demographic Characteristics of Participants

A total of 184 undergraduate students completed both phases of the study. The experimental group comprised 102 participants (55.4%) and the control group 82 participants (44.6%). Female students constituted the majority (60.9%), and most participants were from the Faculty of Education (54.9%) or Life Sciences (42.9%). Level 400 students represented the largest academic-level cohort (32.1%). Full socio-demographic details are presented in Table 2.

Table 2: *Socio-demographic Characteristics of Participants (N = 184)*

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	72	39.1
	Female	112	60.9
Faculty	Education	101	54.9
	Life Sciences	79	42.9
	Agriculture	4	2.2
Level	100	40	21.7
	200	47	25.5
	300	36	19.6
	400	59	32.1
	600	2	1.1
Group	Control	82	44.6
	Experimental	102	55.4

Baseline Attitude Profile and Group Distribution

Table 3 presents the pre-test attitude scores for the control and experimental groups. The overall mean pre-test attitude score was 51.28 (SD = 8.92) on a 60-point scale, indicating a generally positive baseline orientation toward solid waste management. Control group participants recorded a mean of 51.04 (SD = 7.84) and experimental group participants 51.48 (SD = 9.73). An independent samples t-test confirmed that the two groups were statistically equivalent at baseline, $t(182) = -0.335$, $p = .738$, Cohen's $d = 0.05$, demonstrating pre-intervention comparability.

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Attitude scores were further classified into three levels: low (≤ 30), moderate (31–45), and positive (> 45). As shown in Table 3, the vast majority of participants (83.7%, $n = 154$) already held positive attitudes toward SWM prior to the intervention, with only 5.4% ($n = 10$) recording low scores. This distribution was consistent across both groups.

Table 3: *Baseline (Pre-test) Attitude Scores and Attitude Level Distribution by Group*

Variable	Group	n	M	SD	Min	Max
Attitude (Pre-test)	Control	82	51.04	7.84	28	60
	Experimental	102	51.48	9.73	15	60
	Overall	184	51.28	8.92	15	60

Note. Attitude scale range: 15–60. Attitude level classification: Low ≤ 30 ($n = 10$, 5.4%); Moderate 31–45 ($n = 20$, 10.9%); Positive > 45 ($n = 154$, 83.7%). $t(182) = -0.335$, $p = .738$ for group comparison.

Pre-test and Post-test Attitude Scores by Group

Table 4 presents descriptive statistics for attitude at both time points. In the control group, mean attitude scores increased marginally from 51.04 ($SD = 7.84$) at pre-test to 52.00 ($SD = 8.94$) at post-test, a change of +0.96 points. In the experimental group, mean attitude scores showed a marginal decrease from 51.48 ($SD = 9.73$) to 51.06 ($SD = 9.60$), a change of -0.42 points. Paired samples t-tests indicated that neither the control group ($t = -0.852$, $p = .397$) nor the experimental group ($t = 0.538$, $p = .592$) demonstrated statistically significant within-group change between pre- and post-test measurement points.

Table 4: *Pre-test and Post-test Attitude Scores by Group*

Measurement Point	Group	n	M	SD	Change (Δ)
Pre-test	Control	82	51.04	7.84	—
	Experimental	102	51.48	9.73	—
Post-test	Control	82	52.00	8.94	+0.96
	Experimental	102	51.06	9.60	-0.42

Note. Δ = post-test M minus pre-test M. Paired t-tests: Control $t(81) = -0.852$, $p = .397$; Experimental $t(101) = 0.538$, $p = .592$.

Effect of Health Education Intervention on Attitude toward SWM

To test the primary hypothesis, ANCOVA was conducted with post-test attitude as the dependent variable, group (experimental vs. control) as the fixed factor, and pre-test attitude as the covariate. Results are presented in Table 5.

Table 5: *ANCOVA Results for the Effect of Health Education Intervention on Attitude toward Solid Waste Management*

Source	Type III SS	df	MS	F	p
Corrected Model	4163.043	2	2081.521	32.354	.000
Intercept	3157.076	1	3157.076	49.071	.000
Attitude (Pre-test/Covariate)	4122.777	1	4122.777	64.082	.000
Group (Intervention)	62.981	1	62.981	0.979	.324
Error	11644.870	181	64.336		
Corrected Total	15807.913	183			

Note. Dependent variable: Post-test attitude score. $N = 184$ (Control $n = 82$; Experimental $n = 102$). $R^2 = .263$ (Adjusted $R^2 = .255$). Adjusted means: Control = 52.13; Experimental = 50.95. The ANCOVA revealed that the corrected model was statistically significant, $F(2, 181) = 32.354$, $p < .001$, $R^2 = .263$, explaining approximately 26.3% of the variance in post-test attitude. The pre-test attitude covariate was a highly significant predictor of post-test attitude, $F(1, 181) = 64.082$, $p < .001$, indicating substantial stability in attitudes over the six-week period. However, after controlling for baseline attitude, the group factor (intervention vs. control) did not produce a statistically significant effect on post-test attitude scores, $F(1, 181) = 0.979$, $p = .324$. Adjusted means were 52.13 for the control group and 50.95 for the experimental group, a difference of 1.18 points. Accordingly, H_{01} is retained: the health education intervention did not produce a statistically significant change in attitude toward SWM.

Relationship Between Pre-test and Post-test Attitude Scores

A Pearson correlation was computed between pre-test and post-test attitude scores across all participants. Results showed a strong positive relationship, $r(182) = .799$, $p < .001$ (as implied by the covariate F value and ANCOVA model),



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confirming that pre-test attitude was a robust predictor of post-test attitude. H_{02} is therefore rejected: there is a statistically significant and substantial relationship between baseline and post-intervention attitude scores.

Relationship Between Attitude and Practice toward Solid Waste Management

To investigate the association between attitude and practice, Pearson correlations were computed at both measurement points. Results are shown in Table 6.

Table 6: *Pearson Correlations Between Attitude and Practice Scores (Pre-test and Post-test)*

Variables	r	p	n	Interpretation
Pre-test Attitude × Pre-test Practice	.188	.010	184	Weak positive, significant
Post-test Attitude × Post-test Practice	.168	.023	184	Weak positive, significant

Note. Two-tailed Pearson correlation. r = Pearson correlation coefficient.

At pre-test, attitude was weakly but significantly positively correlated with practice, $r(182) = .188$, $p = .010$. This association was maintained at post-test, $r(182) = .168$, $p = .023$. While both correlations were statistically significant, the effect sizes were small, indicating that attitude accounted for only approximately 3.5% (pre) and 2.8% (post) of the variance in practice scores. H_{03} is therefore rejected: there is a statistically significant, though weak, positive relationship between attitude toward SWM and practice of SWM among undergraduates.

Discussion of Findings

The finding that the majority of undergraduates (83.7%) at the University of Ilorin already held positive attitudes toward solid waste management prior to the intervention is consistent with a growing body of evidence suggesting that students in higher education institutions generally express favourable environmental orientations. Globally, bibliometric analyses of SWM attitude studies in universities found that high pre-existing attitude levels are a consistent feature of student populations in both developed and developing country settings (Hassan & Rosli, 2022; Owajori et al., 2022). Within the Nigerian context, comparable findings have been reported by Ifegbesan et al. (2017), who documented moderate-to-positive environmental attitudes among students at a Nigerian university despite poor corresponding practices, and by Dung et al. (2017), who found similar patterns in north-central Nigerian colleges. The high baseline attitude scores observed in the present study may reflect the influence of general environmental discourse encountered through coursework, media, and peer interactions at a federal university level. However, the coexistence of positive attitudes and comparatively modest practice scores, as evidenced by the weak attitude–practice correlations reported here, underscores the well-established attitude–behaviour gap in environmental education literature.

The primary finding of this study, that the six-week health education intervention did not produce a statistically significant change in attitude after controlling for baseline scores, $F(1, 181) = 0.979$, $p = .324$, requires careful contextualisation. This result is not wholly unexpected given the high pre-test attitude means ($M = 51.04$ and 51.48 for control and experimental groups respectively, on a 60-point scale). When baseline scores are already close to the theoretical maximum of the scale, there is limited statistical and practical scope for further upward change, a phenomenon widely termed the ceiling effect (Wu et al., 2022). This pattern has been explicitly documented in SWM attitude literature. Wu et al. (2022) noted that the non-significant effect of attitude on waste management behaviour in their study of Chinese university students was partly attributable to ceiling effects in attitude measurement within institutional contexts characterised by high environmental awareness.

These findings are also consistent with the theoretical framework of Ajzen's (1991) Theory of Planned Behaviour, which conceptualises attitudes as relatively stable cognitive evaluations shaped by accumulated beliefs over time. Short-term educational interventions, particularly those delivered once weekly over six weeks, may be insufficient to produce measurable shifts in already well-established positive attitudes. The evidence from Lagos State by Odukoya et al. (2014) noted that even brief anti-smoking programmes improved attitudes modestly but that more intensive approaches were needed to shift entrenched evaluative stances. In the context of SWM, where environmental attitudes are already positive among educated university students, the incremental value of a single additional short-term programme may be limited.

The non-significant group effect does not, however, imply that the intervention was entirely without value. The corrected model explains 26.3% of the variance in post-test attitude ($R^2 = .263$), and the pre-test covariate was highly predictive of post-test scores ($F = 64.082$, $p < .001$). This strong covariate effect confirms the temporal stability of attitude and suggests



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that the intervention's failure to shift attitude scores was not due to poor measurement but rather to the inherent resistance of already-positive attitudes to short-term manipulation. These findings align with Conti et al. (2024), whose systematic review found that educational interventions produced the most significant attitudinal gains in populations with initially lower or more ambivalent environmental attitudes, whereas populations with high baseline scores showed minimal pre–post change.

The strong predictive relationship between pre-test and post-test attitude scores is an important finding in its own right. The covariate's significant contribution to the ANCOVA model demonstrates that attitude toward SWM is a stable construct that does not fluctuate markedly over a six-week period, regardless of whether participants receive an educational intervention. This stability has theoretical significance: it suggests that attitudes formed through long-term socialization, prior education, and cultural norms are unlikely to be substantially dislodged by brief interventions. Rather, the evidence suggests that attitude change in the domain of environmental behaviour may require longer-term, experiential, and deeply participatory approaches that go beyond informational provision.

The weak but statistically significant positive correlations between attitude and practice at both pre-test ($r = .188$, $p = .010$) and post-test ($r = .168$, $p = .023$) are consistent with the theoretical prediction of the TPB that attitude is positively associated with behavioural outcomes, while also reflecting the well-documented incompleteness of this relationship in environmental contexts. The effect sizes, accounting for only approximately 3–4% of variance in practice, indicate that attitude alone is far from a sufficient predictor of practice, reinforcing the evidence for a persistent attitude–behaviour gap.

This finding resonates with evidence from multiple African and global settings. A systematic review by Raghu and Rodrigues (2020) found that situational and contextual variables, including access to waste bins, institutional enforcement, and peer norms, accounted for substantially more variance in SWM behaviour than individual attitudes. Wu et al. (2022) similarly reported that subjective norms and perceived behavioural control were more powerful predictors of waste management behaviour than attitude among Chinese university students. Within the Nigerian context, Ifegbesan et al. (2017) documented that students who reported positive attitudes toward SWM frequently cited infrastructural deficiencies, such as absence of segregated waste receptacles and irregular collection schedules, as barriers to translating attitudes into consistent practice. These structural barriers moderate the attitude–practice relationship and suggest that interventions targeting attitude change alone will have limited impact on practice without accompanying improvements in the waste management environment on campus.

The collective findings carry several important implications. First, future health education interventions targeting attitude toward SWM in Nigerian universities may benefit from selecting populations with lower or more ambivalent baseline attitudes, such as incoming first-year students or students from disciplines with limited prior environmental education exposure, where the scope for attitudinal change is greater. Second, given the stability of attitude and the modest attitude–practice relationship, interventions should be repositioned from a purely attitudinal target to a focus on perceived behavioural control and subjective norms, as these constructs have demonstrated stronger predictive value for SWM behaviour in multiple studies. Third, the weak attitude–practice correlation underscores that infrastructural investment, provision of accessible, labelled, and segregated waste bins across campus, is a necessary complement to any educational effort. Universities that pair awareness programmes with tangible environmental improvements are more likely to see attitudinal capital converted into behavioural practice. Finally, integrating SWM content into academic curricula across faculties, rather than delivering one-off external interventions, may provide the longitudinal reinforcement needed to sustain and deepen pro-environmental attitudes among undergraduates.

Conclusion

This study investigated the effect of a six-week health education intervention on attitudes toward solid waste management among undergraduates at the University of Ilorin, Nigeria. The findings revealed that participants already held largely positive attitudes toward SWM at baseline. The health education intervention did not produce a statistically significant improvement in attitude after controlling for pre-test scores. The strong predictive relationship between pre-test and post-test attitude scores confirmed the stability of environmental attitudes, while weak but significant attitude–practice correlations highlighted the persistent attitude–behaviour gap. These findings suggest that ceiling effects and attitudinal stability substantially constrained the measurable impact of the intervention. Future efforts to promote sustainable waste management in Nigerian universities should move beyond short-term attitudinal interventions to adopt comprehensive,



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participatory, and infrastructure-supported strategies that address the full spectrum of determinants of pro-environmental behaviour.

Conflict of Interest

The authors declare no conflict of interest.

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