Impact Assessment of Landscape Architecture on Student Wellbeing in Federal Tertiary Institutions in Lagos State, Nigeria

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DOI: https://doi.org/10.47772/IJRISS.2026.100600237

Received: 23 May 2026; Accepted: 28 May 2026; Published: 19 June 2026

ABSTRACT

Rapid urbanization in Lagos State has progressively reduced green spaces on tertiary campuses. Despite considerable evidence from temperate climates, the relationship between landscape architecture and student wellbeing remains understudied in tropical African contexts. This study assessed the impact of landscape architectural elements on the psychological, social, and physical wellbeing of students in federal tertiary institutions in Lagos State, Nigeria. A cross-sectional survey of randomly selected students across three federal institutions (University of Lagos, Yaba College of Technology, Federal College of Education, Akoka) was conducted using the 20-item Landscape Architecture Assessment Inventory ($\alpha = 0.91$) and the 15-item Student Wellbeing Scale adapted from WHO-5 and PSS-4 ($\alpha = 0.88$). Data were analyzed using hierarchical multiple regression and PROCESS moderation analysis. Landscape quality significantly predicted overall wellbeing ($\beta = 0.43$, $p < 0.001$, $R^2 = 0.21$). Shaded seating ($\beta = 0.31$, $p < 0.001$) and vegetation density ($\beta = 0.20$, $p = 0.011$) emerged as significant predictors, whereas water features were not significant ($\beta = -0.03$, $p = 0.668$). Maintenance quality significantly moderated the landscape-wellbeing relationship ($B = -1.24$, $p = 0.033$), revealing a ceiling effect pattern with diminishing returns. Institution differences were also significant: University of Lagos students reported higher landscape quality ($M = 3.18$) than Yaba College of Technology ($M = 2.76$) and Federal College of Education ($M = 2.71$). In conclusion, landscape architecture significantly influences student wellbeing in Lagos tertiary institutions, with shade provision and vegetation density as evidence-based design priorities. Therefore, maintenance protocols and climate-appropriate planting should be integrated into campus planning guidelines.

Keywords: Landscape Architecture, Student Wellbeing, Campus Green Space, Attention Restoration Theory, Lagos State.

INTRODUCTION

One of the most urgent global public health issues of the twenty-first century is university students' mental health. Auerbach et al. (2018) found that about one in three first-year university students fit the criteria for at least one common mental health disorder, with anxiety and depression being the most common clinical presentations. This information was derived from the World Health Organization's World Mental Health Surveys, which were conducted across 21 countries. The consequences of untreated distress are heightened in a nation like Nigeria due to resource limitations that restrict access to mental health care (Omoge et al., 2026). These findings have shifted attention from purely intrapersonal determinants of student wellbeing toward the physical environments in which academic life unfolds, where factors such as campus design, access to nature, and thermal comfort may powerfully shape psychological functioning.

A promising environmental intervention pathway is provided by landscape architecture, which is the intentional design and management of outdoor spaces to achieve functional, aesthetic, and health-promoting outcomes. The primary aim of this study, therefore, is to evaluate the impact of campus landscape architectural design features on the psychological, social, and physical wellbeing of undergraduate students in three federal tertiary institutions in Lagos State: the University of Lagos (UNILAG), Yaba College of Technology (YABATECH), and

the Federal College of Education, Akoka (FCE). The study pursued three specific objectives: (a) to quantify perceived landscape quality using a validated 20-item Landscape Architecture Assessment Inventory (LAAI); (b) to assess student wellbeing through a 15-item scale adapted from the WHO-5 Wellbeing Index and the Perceived Stress Scale-4; and (c) to test whether maintenance quality moderates the landscape-wellbeing relationship. Three null hypotheses were tested: (1) there is no significant relationship between overall perceived landscape quality and student wellbeing; (2) vegetation density, shaded seating availability, and paved walkway quality do not significantly predict psychological wellbeing; and (3) maintenance quality does not moderate the landscape-wellbeing association. By testing these hypotheses within the under-researched, climate-stressed setting of Lagos, the study aims to provide evidence-based guidance for campus planners and policymakers seeking to leverage landscape architecture as a tool for student mental health.

LITERATURE REVIEW

Conceptual Review

Landscape Architecture in Tertiary Institutional Contexts

Landscape architecture, as a professional discipline, encompasses the planning, design, management, and stewardship of outdoor environments to achieve functional, aesthetic, and ecological objectives (Simonds & Starke, 2006). Within tertiary educational settings, campus landscape architecture serves multiple overlapping purposes: it defines spatial organization and circulation patterns, establishes institutional identity and visual character, supports ecological functions including stormwater management and microclimate regulation, and provides settings for informal learning, social interaction, and psychological restoration (Ajayi et al., 2024). The American Society of Landscape Architects identifies campus landscapes as a distinct practice area requiring specialized understanding of pedestrian movement patterns, outdoor learning environments, and the integration of built and natural systems within dense institutional settings (Dober, 2000).

In Nigerian higher education institutions, campus landscapes have historically been conceived primarily as ornamental appendages to academic buildings rather than as functional infrastructure supporting institutional missions (Nwabuna, Chima & Ntaji, 2023). The typical Nigerian federal university campus follows a master plan model inherited from colonial-era planning traditions, with administrative and academic buildings arranged along formal axial relationships, interspersed with lawns, gardens, and ceremonial spaces. However, decades of enrolment expansion without proportional investment in landscape infrastructure (NUC, 2019) have resulted in many campuses where original landscape designs are no longer legible or functional. Green spaces have been incrementally encroached upon by new buildings, parking areas, and informal commercial activities, while maintenance budgets have failed to keep pace with the deterioration of paved surfaces, planting beds, and site furnishings (Adeyemi, 2015).

Student Wellbeing

Student wellbeing is increasingly conceptualized as a multidimensional construct extending beyond the absence of psychological disorder to encompass positive functioning across psychological, social, and physical domains. The World Health Organization defines mental health as "a state of wellbeing in which every individual realizes his or her own potential, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to her or his community" (WHO, 2004). This definition emphasizes positive functioning and resilience alongside the management of psychological distress. Within higher education research, student wellbeing has been operationalized through various frameworks, including subjective wellbeing (comprising affective and cognitive evaluations of life satisfaction), psychological wellbeing (encompassing autonomy, personal growth, purpose in life, and self-acceptance) (Ryff, 1989), and social wellbeing (covering social integration, contribution, and belonging) (Keyes, 2002).

For the purposes of this study, student wellbeing is defined as a composite construct covering three interrelated dimensions. Psychological wellbeing refers to the presence of positive affect, emotional stability, cognitive clarity, and perceived capacity to manage academic demands. Social wellbeing captures the quality of

interpersonal relationships, sense of belonging to the campus community, and perceived social support. Physical wellbeing encompasses perceived physical health, energy levels, sleep quality, and comfort within the campus environment. This tripartite conceptualization aligns with the biopsychosocial model of health and permits examination of whether landscape architecture influences wellbeing through distinct psychological, social, or physical pathways, or through integrated effects spanning multiple domains simultaneously.

Figure 1: Biopsychosocial Model of Health (Source: Social Work Portal, 2024)

Perceived Landscape Quality and Maintenance Quality

A critical distinction in environmental psychology research is that between objective environmental features, which can be independently measured through audits, GIS analysis, or sensor technologies, and perceived environmental quality, which reflects individuals' subjective appraisals of those features (Kaplan & Kaplan, 1989). Perceived landscape quality is the construct of primary interest in this study, operationalized through students' self-reported assessments of vegetation density, seating availability and comfort, walkway surface quality, water feature attractiveness, safety and lighting, and overall maintenance standards. The emphasis on perceived rather than objective quality is theoretically grounded: psychological responses to environments are mediated through perceptual and cognitive appraisal processes, meaning that two individuals may respond differently to objectively identical environments based on their personal histories, expectations, and current psychological states.

Maintenance quality occupies a conceptually distinct position within this framework. While maintenance quality is one dimension of perceived landscape quality, it also potentially functions as a moderator of the relationships between other landscape dimensions and wellbeing outcomes. A beautifully designed garden with mature trees, comfortable seating, and elegant water features may fail to deliver restorative benefits if litter accumulation, damaged furnishings, or neglected plantings signal environmental disorder and institutional neglect (Toros, 2011; Lindal & Hartig, 2013).

Conversely, even modest landscape elements may punch above their weight in terms of wellbeing benefits if they are scrupulously maintained, communicating care, order, and safety. This conceptualization positions maintenance quality as a threshold condition that determines whether the latent restorative potential of landscape design features is actualized in student experience.

THEORETICAL FRAMEWORK

The relationship between landscape environments and human wellbeing rests upon three complementary theoretical foundations: Attention Restoration Theory, Stress Reduction Theory, and the Biophilia Hypothesis.

Together, these frameworks provide a multi-level explanatory account of why designed outdoor spaces influence student psychological, social, and physical functioning.

Attention Restoration Theory

Developed by Kaplan & Kaplan (1989) and elaborated by Kaplan (1995), Attention Restoration Theory (ART) posits that natural environments restore depleted cognitive resources through a mechanism termed soft fascination, which refers to the involuntary capture of attention by non-threatening stimuli such as foliage movement, dappled light, or water sounds. This effortless attentional engagement permits directed attention, the

effortful cognitive resource required for academic tasks, impulse control, and emotional regulation, to rest and regenerate. ART identifies four conditions necessary for restoration to occur. Being away refers to psychological distance from demanding environments and mental routines, a sense of escape from the pressures of academic life. Extent describes the perceived richness and coherence of the setting, the sense that it constitutes a whole other world sufficient for exploration and engagement. Fascination captures the attention-holding properties of the environment, with soft fascination from natural elements being less cognitively demanding than hard fascination from electronic media or urban spectacle. Compatibility refers to the congruence between the environment's affordances and the individual's purposes and inclinations.

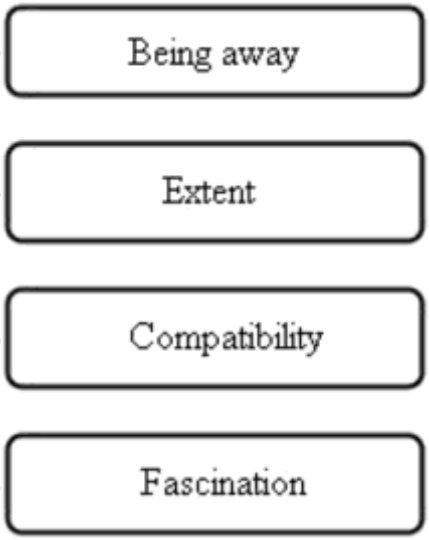

Figure 2: Attention Restoration Theory (Source: Liu et al., 2024)

University campuses with vegetated courtyards, mature tree canopies, and varied green spaces potentially satisfy all four conditions, positioning them as restorative resources for cognitively fatigued students (Matsuoka & Kaplan, 2008). A student emerging from a demanding lecture may experience being away simply by stepping into a garden courtyard; the layered vegetation and winding pathways may provide sufficient extent; the rustling leaves and bird song may furnish gentle fascination; and the opportunity to walk, sit quietly, or converse with friends may offer high compatibility with the student's post-lecture needs.

Stress Reduction Theory

Ulrich's (1983, 1991) Stress Reduction Theory (SRT) provides a psychophysiological complement to ART's cognitive emphasis. SRT contends that natural stimuli activate parasympathetic nervous system responses that reduce autonomic arousal and negative affect, with these responses occurring rapidly and automatically upon environmental exposure. Ulrich (1983) demonstrated that surgical patients with tree views from their hospital windows required fewer analgesic doses and experienced shorter post-operative stays than patients whose windows faced brick walls. Subsequent experimental work confirmed that brief exposure to natural environments following stressor tasks produced faster recovery of heart rate, blood pressure, skin conductance, and cortisol levels than equivalent exposure to urban environments (Ulrich et al., 1991).

SRT thus predicts that campus landscapes serve as active therapeutic resources rather than passive amenities, a distinction of particular relevance in academic settings where examination stress and performance pressure elevate physiological stress levels. The SRT framework also emphasizes the importance of multisensory environmental qualities: vegetation, natural sounds, and the absence of traffic noise and crowding all contribute to stress-reducing properties.

Biophilia Hypothesis

Wilson (1984) and Kellert & Wilson (1993) proposed that humans possess an innate, evolutionarily prepared affinity for living systems, a disposition shaped through millennia of adaptation to savanna and woodland environments. This biophilic tendency happens across cognitive, emotional, and aesthetic registers, from preferences for savanna-like landscapes characterized by scattered trees, open understory, and visible water, to physiological calming responses to natural fractal patterns and the golden ratio proportions found in organic forms (Kellert, 2005). The Biophilia Hypothesis extends the explanatory scope of ART and SRT by providing an evolutionary account of why natural environments elicit the cognitive and physiological responses described by those theories, grounding proximate psychological mechanisms in ultimate evolutionary functions.

In a campus, the Biophilia Hypothesis predicts that students will exhibit spontaneous preference for, and derive wellbeing gains from, landscape designs incorporating biodiversity, water features, and organic spatial configurations rather than heavily engineered or minimalist alternatives (Becchetti et al., 2021). This prediction carries design implications: campus landscapes that mimic the spatial structure of preferred ancestral environments, with prospect (open views), refuge (sheltered seating), and mystery (partially obscured pathways inviting exploration), may activate biophilic responses that contribute to psychological restoration.

Theoretical Synthesis and Conceptual Model

These three frameworks converge on a common prediction, namely that contact with natural elements supports human psychological functioning, while differing in the mechanisms they emphasize. ART foregrounds cognitive restoration, SRT highlights emotional and physiological stress recovery, and the Biophilia Hypothesis invokes evolutionary preparedness that privileges natural stimuli across multiple response systems. This convergence suggests that campus landscapes may operate through multiple additive pathways: green views may simultaneously reduce autonomic arousal through SRT mechanisms, permit attentional recovery through ART processes, and satisfy innate preferences through biophilic channels.

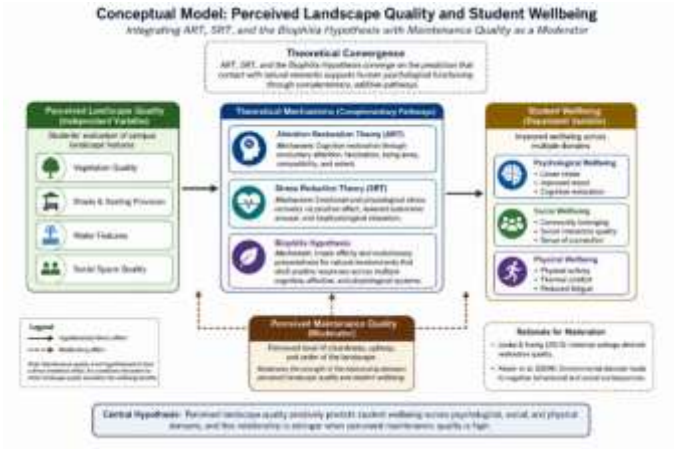

Figure 3: Conceptual Framework (Source: Author, 2026)

The present study treats these as complementary explanatory layers justifying the central hypothesis that perceived landscape quality predicts student wellbeing across psychological, social, and physical dimensions. The conceptual model guiding the study integrates the reviewed theory and empirical evidence into a unified

framework. Perceived landscape quality, comprising vegetation quality, shade and seating provision, water features, and social space quality, is hypothesized to predict student wellbeing, operationalized across psychological (stress, mood, cognitive restoration), social (community belonging, interaction quality), and physical (activity, thermal comfort, fatigue) domains. Perceived maintenance quality is hypothesized as a moderator: maintenance determines the extent to which landscape quality translates into wellbeing benefits without itself being the direct target of emotional response. This moderation hypothesis is grounded in Lindal & Hartig's (2013) finding that unkempt settings diminish restorative quality, combined with Keizer et al. (2008) evidence for the behavioural consequences of environmental disorder.

Empirical Review

Vegetation and Greenery

The strongest and most consistent evidence in the landscape-wellbeing literature concerns vegetation's contribution to student psychological functioning. Matsuoka & Kaplan (2008) conducted foundational research at the University of Michigan, finding that university students with greater exposure to natural elements, whether through window views to greenery or proximity to campus green spaces, reported enhanced quality of life and academic satisfaction. Notably, dormitory window views to greenery emerged as a significant predictor even after controlling for campus-wide green space availability, suggesting that everyday, incidental nature contact may be as important as deliberate green space visitation.

McFarland, Waliczek & Zajicek (2008) extended these findings at Texas A&M University, demonstrating that students who actively used campus green spaces reported significantly higher quality of life than non-users, and that social use yielded the strongest associations. Li & Sullivan (2016) provided experimental evidence showing that students assigned to classrooms with window views to landscaped areas exhibited significantly faster stress recovery, as measured by heart rate and blood pressure, and greater attention restoration following demanding cognitive tasks than students whose windows faced built views. Hipp et al. (2016) contributed cross-cultural validation across ten universities in five countries, finding that perceived greenness was consistently associated with quality of life, perceived restorativeness, and social cohesion.

In Africa, evidence is emergent but consistent. Abimbola & Agboola (2023) found that a green infrastructure index significantly predicted academic performance among Nigerian students. Kellou et al. (2024) documented a positive association between satellite-derived vegetation measures (NDVI) and perceived restoration in Tanzania. Nakandi et al. (2024) reported that frequent green space visitors among Ugandan students exhibited depression scores 33-35% lower than infrequent visitors, an effect magnitude comparable to Western settings. However, Uduma-Olugu et al. (2019) found that while vegetation was rated the most interesting landscape element by students at the University of Lagos, actual usage remained low, signalling that vegetation availability without complementary amenities such as seating and shade may be insufficient to translate preference into behaviour and wellbeing gains.

Shade Provision and Thermal Comfort

In tropical and subtropical climates, vegetation’s contribution to wellbeing is partially mediated through thermal comfort. Ndetei et al (2020) demonstrated that shaded outdoor seating areas in Kenyan university campuses were associated with significantly longer dwell times and higher perceived restorativeness than unshaded equivalents. Lin et al. (2022) provided evidence from subtropical Taiwanese campuses indicating that thermal comfort mediated approximately 30% of the relationship between landscape quality and restorative outcomes. In Nigeria, Wunubo et al. (2022) reported that 73% of students at Gombe State University preferred manicured garden spaces with abundant shade, citing thermal comfort as the primary driver. These findings collectively suggest that shade and seating function as enabling conditions that convert the latent restorative potential of green spaces into actualized wellbeing benefits, a role of particular importance in Lagos State’s hot-humid tropical climate.

Water Features and Blue Space

Evidence concerning the psychological benefits of water features is heterogeneous. White et al. (2021) demonstrated that blue spaces predicted superior mental health outcomes compared with green spaces alone, with combined green-blue environments producing the strongest effects. Volker & Kistemann (2011) identified perceptual availability of water as critical, where even small visible features contributed to restorativeness. However, applicability to Nigerian campuses is constrained by public health considerations.

Grineski et al. (2015) documented that standing water in tropical developing-world urban settings can serve as vector breeding sites, potentially negating benefits through disease risk. Si et al. (2024) confirmed in a meta-analysis that blue space benefits are moderated by perceived water quality and safety. In Nigerian university contexts, where maintenance of decorative water features is often inconsistent and mosquito-borne disease represents a salient health concern (Adeyemi, 2015), water features may present risks that exceed their restorative benefits.

Social and Communal Spaces

Landscape designs that support social interaction constitute a distinct wellbeing pathway that operates through mechanisms beyond individual nature contact. Francis & Marcus (1991), in their classic work on people places, identified communal outdoor rooms, defined as semi-enclosed spaces with seating arranged to facilitate face-to-face interaction, as essential components of supportive campus environments. McFarland et al. (2008) also found that students who used campus green spaces for social purposes reported significantly higher quality of life than students who used the same spaces for solitary activities, suggesting that the social affordances of landscape design are at least as important as the natural elements themselves.

In Nigeria, Nnaeto et al. (2026) observed a critical divergence between landscape availability and student experience at Caleb University in Lagos. Their mixed-methods study found that 53.9 percent of students rated the university's outdoor spaces as unappealing, and qualitative interviews revealed that students characterized these spaces as "spaces of necessity, not wellbeing." This finding suggests that the absence of well-designed social spaces with adequate seating, shade, and aesthetic quality may undermine both usage levels and wellbeing outcomes, even where green space is technically available.

Maintenance Quality and Perceived Order

Evidence consistently shows that maintenance quality moderates the landscape-wellbeing relationship. Lindal & Hartig (2013) conducted an experiment in which identical architectural configurations were systematically varied in their maintenance condition, including the presence or absence of litter, graffiti, overgrown vegetation, and damaged furnishings. Their results demonstrated that poorly maintained settings were rated as significantly less restorative than well-maintained settings with identical design features, with a large effect size (Cohen's $d = 0.67$). This finding indicates that perceived disorder can override the restorative qualities that would otherwise accrue from well-designed natural environments.

Keizer, Lindenberg & Steg (2008) demonstrated that environmental disorder cues triggered norm-violating behaviour, suggesting that maintenance functions as a threshold condition: high-quality design fails to deliver benefits if maintenance is inadequate. This moderation is particularly salient in Nigerian federal tertiary institutions, where fiscal constraints often result in deteriorating landscape conditions that undermine therapeutic potential.

Summary of Empirical Studies

The table below summarizes 14 empirical studies selected for their geographic diversity, methodological variation, and direct relevance to the landscape-student wellbeing relationship. These studies span five continents and collectively provide cross-cultural support for the hypothesized association while revealing context-dependent variations in mechanism and magnitude.

Table 1: Summary of Empirical Studies on Landscape Quality and Student Wellbeing

Author	Study Design	Location & Context	Sample	Key Landscape Variables	Wellbeing Outcome	Key Finding	Relevance
Matsuoka & Kaplan (2008)	Cross-sectional survey	University of Michigan, USA	103 undergraduates	Green views from residence; campus green coverage	Quality of life	Students with green views reported significantly higher QoL; green space extent positively associated with wellbeing	Foundational campus evidence for ART; establishes window-view effect in residential academic settings
McFarland et al. (2008)	Cross-sectional survey	Texas A&M University, USA	267 undergraduates	Frequency of green space use; activity types	Quality of life	Green space users reported higher QoL than non-users; social use yielded stronger associations	Demonstrates usage frequency as mediator; supports social affordance pathway
Li & Sullivan (2016)	Experimental between-subjects	Five US high schools	94 students aged 14 to 18	Window views to landscapes versus built views	Stress recovery; attention restoration	Green views supported faster stress recovery and greater attention restoration post-task	Provides experimental causal evidence; supports SRT mechanism in educational settings
Hipp et al. (2016)	Cross-sectional survey	10 universities, 5 countries	1,199 students	Perceived greenness (self-reported)	Quality of life; restorativeness; social cohesion	Perceived greenness positively associated with all outcomes; cross-culturally consistent	Validates perceived greenness as predictor; demonstrates international generalizability
Abimbola & Agboola (2023)	Cross-sectional survey	Southwest Nigeria	384 students	Green infrastructure index	Academic performance; cognitive wellbeing	Green infrastructure predicted academic performance	Directly relevant to Nigeria; links landscape quality to cognitive

							outcomes via ART
Kellou et al. (2024)	Cross-sectional with NDVI	Sokoine University, Tanzania	310 students	NDVI; perceived greenness	Perceived restoration	NDVI positively associated with restoration; perceived greenness partially mediated objective greenness	Extends objective vegetation link to East Africa; validates satellite measures
Nakandi et al. (2024)	Cross-sectional survey	Makerere University, Uganda	452 students	Green space visit frequency; duration	Depression (PHQ-9); anxiety (GAD-7)	Frequent visitors exhibited 33 to 35 percent lower depression; dose-response relationship observed	Strongest African evidence for mental health outcomes; supports clinical significance of green access
Dzhambov et al. (2023)	Systematic review (32 studies)	Global (14 countries)	More than 15,000 combined	Various green exposures (NDVI, views, visits)	Mental health; wellbeing; stress	Consistent positive association across 87 percent of studies; small-to-medium effects	Authoritative synthesis confirming robustness of landscape-wellbeing link in higher education
Si et al. (2024)	Systematic review (25 studies)	Global (12 countries)	25 studies, students only	Blue spaces; combined blue-green spaces	Mental health; anxiety; depression	Blue spaces most beneficial when safe; quality moderated effects	Critical for water feature dimension; identifies safety and maintenance as moderating conditions
Wunubo et al. (2022)	Cross-sectional survey	Gombe State University, Nigeria	220 students	Green space availability; typological preferences	Usage; preferences	94 percent green space awareness; 73 percent preferred shaded manicured gardens; thermal comfort	Northern Nigerian evidence; confirms shade as critical tropical amenity

						primary driver	
Uduma-Olugu et al. (2019)	Survey with photo inventory	University of Lagos, Nigeria	186 students	Landscape elements (vegetation, water, hardscape)	Interest ratings; preference rankings	Vegetation rated most interesting (35.1 percent); water features underutilized; satisfaction low	Lagos-specific; identifies vegetation preference-usage gap; signals need for complementary amenities
Nnaeto et al. (2026)	Mixed-methods survey and interviews	Caleb University, Lagos, Nigeria	156 students	Outdoor space quality; typology; maintenance	Usage; satisfaction; wellbeing	53.9 percent rated outdoor spaces unappealing; spaces described as "of necessity, not wellbeing"	Directly relevant to Lagos context; demonstrates maintenance-quality threshold effects
Lindal & Hartig (2013)	Experimental between-subjects	Sweden (university sample)	120 students	Architecture by maintenance condition	Perceived restorativeness; preference	Identical designs rated significantly less restorative when poorly maintained	Foundational evidence for maintenance moderation; supports maintenance as boundary condition
Becchetti et al. (2021)	Mixed-methods longitudinal	Three Italian universities	89 students	Student garden participation versus control	Social wellbeing; community; mood	Garden participants showed increased social cohesion and reduced negative affect over 6 months	Supports social space dimension; demonstrates activity-based wellbeing pathway

Several patterns emerge from this body of evidence. First, the positive association between landscape quality and wellbeing is cross-culturally robust, with consistent evidence from North America, Europe, East and West Africa, and Asia. Second, mechanisms appear to vary by climatic and cultural context: in high-income temperate settings, cognitive restoration and stress reduction predominate as explanatory pathways (Li & Sullivan, 2016; Matsuoka & Kaplan, 2008), whereas in tropical African settings, thermal comfort and social affordances may serve as primary mediators (Wunubo et al., 2022; Nakandi et al., 2024). Third, maintenance quality consistently

moderates outcomes, with well-designed but poorly maintained spaces failing to deliver predicted wellbeing benefits (Lindal & Hartig, 2013; Nnaeto et al., 2026).

Fourth, and critically for the present study, the Nigerian evidence base, while directionally supportive of landscape-wellbeing associations, remains sparse and methodologically limited. Existing Nigerian studies rely predominantly on cross-sectional single-site designs, employ unidimensional landscape measures, and have not examined the simultaneous contribution of multiple landscape components within a unified analytical framework. The present study addresses these limitations by testing a multidimensional model of perceived landscape quality against three wellbeing domains, with perceived maintenance quality as a theoretically grounded moderator, in three federal tertiary institutions in Lagos State, a context characterized by tropical climate, rapid urbanization, and acute student mental health pressures.

METHOD

Research Design

The study employed a cross-sectional, multi-site survey design with a complementary environmental audit component, conducted across three federal tertiary institutions in Lagos State, Nigeria. A post-positivist epistemological orientation guided the research, acknowledging that while landscape quality and student wellbeing are subjectively experienced phenomena, they can be measured with sufficient precision to permit systematic hypothesis testing (Creswell & Creswell, 2018). The cross-sectional design was selected because it permits the simultaneous assessment of perceived environmental quality and psychological outcomes across a large and geographically diverse student sample within a single data collection window. This design is standard in environmental psychology when the objective is to estimate population-level associations between physical environment characteristics and self-reported wellbeing, rather than to infer causality or track intra-individual change over time (Gifford, 2016).

Study Setting

Data collection was conducted at three federal government-owned tertiary institutions within a five-kilometre radius in the Yaba-Akoka corridor of Lagos Mainland, Lagos State, Nigeria. This geographic clustering controlled for macro-climatic and cultural conditions while permitting comparison across campuses of markedly different landscape character.

The University of Lagos (UNILAG), Akoka, is a comprehensive research university with approximately 57,000 students. The campus occupies approximately 325 hectares bordering the Lagos Lagoon, featuring extensive green cover, mature tree canopies, a botanical garden, multiple water features, and distributed open lawns. Yaba College of Technology (YABATECH), located approximately two kilometres southwest of UNILAG, enrols approximately 18,000 predominantly undergraduate students on a compact urban campus of about 25 hectares characterized by limited green space, high building density, and asphalt-dominated surfaces. The Federal College of Education (FCE), Akoka, situated adjacent to UNILAG, has approximately 10,000 students on a 15-hectare campus with moderate tree cover and limited formal garden spaces. All three sites experience a tropical monsoon climate (Köppen classification: Am) with a mean annual temperature of approximately 27°C, high relative humidity (75–90%), and a bimodal rainfall pattern (Peel et al., 2007). Data collection spanned the dry-to-wet season transition.

Participants and Sampling

The target population comprised of students at the three institutions during the 2025/2026 academic session. The combined enrolment across the three institutions was estimated at approximately 85,000 students (UNILAG: 57,000; YABATECH: 18,000; FCE Akoka: 10,000), based on published institutional statistics from the National Universities Commission and respective admissions offices. Sample size was calculated using Yamane's (1967) formula for finite populations:

$$n = N / (1 + N(e)^2)$$

$$85{,}000 / (1 + 85{,}000 \times 0.05^2) = 398$$

Inflated by 20% for anticipated non-response, the recruitment target was 480. A final usable sample of N = 450 was achieved (response rate 93.7%).

A stratified random sampling procedure was employed, with institution (three levels) and year of study (four levels) as stratification variables. The target sample size of 480 was initially allocated proportionally to the estimated undergraduate populations of the three institutions (UNILAG 53.3%, n = 256; YABATECH 26.7%, n = 128; FCE Akoka 20.0%, n = 96). During data collection, however, differential response rates and logistical constraints resulted in a final usable sample of 450 that deviated somewhat from the original proportional allocation. The achieved distribution across institutions was UNILAG n = 189 (42.0%), YABATECH n = 158 (35.1%), and FCE Akoka n = 103 (22.9%). Although this distribution is not strictly proportional to institutional size, it still provides substantial coverage of all three campuses and preserves the intended stratified structure. Inclusion criteria were current undergraduate enrolment for at least one full academic year, age 18 years or older, informed consent, and regular campus presence.

Instruments

Three instruments were administered to all participants: the Landscape Architecture Assessment Inventory (LAAI), the Student Wellbeing Scale (SWS), and a demographic information form. Table 2 presents a summary of all instruments and their constituent subscales.

Table 2: Instrument Specification Summary

Instrument	Subscale	Number of Items	Response Scale	Source
LAAI	Vegetation Density	4	5-point Likert (1 to 5)	Adapted; current study
LAAI	Seating Availability and Comfort	4	5-point Likert (1 to 5)	Adapted; current study
LAAI	Walkway Surfaces	3	5-point Likert (1 to 5)	Adapted; current study
LAAI	Water Features	2	5-point Likert (1 to 5)	Adapted; current study
LAAI	Maintenance Quality	4	5-point Likert (1 to 5)	Adapted; current study
LAAI	Safety and Lighting	3	5-point Likert (1 to 5)	Adapted; current study
SWS	Psychological Wellbeing	6	5-point frequency (0 to 4)	Adapted from WHO-5; Topp et al. (2015)
SWS	Social Wellbeing	5	5-point frequency (0 to 4)	Adapted; current study
SWS	Physical Wellbeing	4	5-point frequency (0 to 4)	Adapted; current study
Demographics	Not applicable	7	Categorical and continuous	Current study

Landscape Architecture Assessment Inventory (LAAI)

The LAAI is a 20-item self-report instrument developed for this study based on a review of environmental quality

tools (Ulrich et al., 1991; Grahn & Stigsdotter, 2003) and refined through expert review and a pilot study (N = 35, not in main analysis). Items are rated on a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). Subscales: Vegetation Density (4 items), Seating Availability/Comfort (4 items), Walkway Surfaces (3 items), Water Features (2 items), Maintenance Quality (4 items), Safety/Lighting (3 items). Pilot Cronbach's $\alpha = 0.88$ overall, subscales 0.71–0.84.

Student Wellbeing Scale (SWS)

The SWS is a 15-item measure adapted from the WHO-5 Wellbeing Index (Topp et al., 2015) and the Perceived Stress Scale-4 (Cohen et al., 1983), using a 5-point frequency scale (0 = Never to 4 = Always). The Psychological Wellbeing subscale (6 items) includes a reverse-scored item; Social Wellbeing (5 items) addresses belonging and support; Physical Wellbeing (4 items) assesses health, energy, sleep, and comfort. Pilot subscale $\alpha = 0.85$, 0.79, and 0.81.

Demographic Form

A structured demographic form collected the following variables: age in years; gender (male, female, non-binary, prefer not to say); institution (UNILAG, YABATECH, FCE Akoka); year of study (100, 200, 300, 400 level or equivalent); type of accommodation (on-campus hall, off-campus rented apartment, family home, other); self-reported daily outdoor time on campus in hours (less than 1, 1 to 2, 2 to 4, more than 4); and length of enrolment at current institution in years.

Procedure

Ethical approval was obtained from the University of Lagos Research Ethics Committee. Institutional permissions were secured. Data collection occurred over 10 weeks from March to May 2026, spanning the dry-to-wet season transition. Five trained research assistants administered questionnaires following a standardized protocol in classrooms and outdoor seating areas. An independent environmental audit using a 17-item observation protocol (adapted from Preiser & Vischer, 2005) was conducted by two raters blind to self-report data; inter-rater reliability was $\kappa = 0.92$.

Data Analysis

Analyses used IBM SPSS Statistics Version 28.0, with the PROCESS macro Version 4.0 (Hayes, 2018) for moderation. Significance level $\alpha = 0.05$, two-tailed. Data screening addressed out-of-range values, and missing data (<5% per variable) were mean-imputed. Assumption testing covered normality (Shapiro-Wilk; skewness and kurtosis acceptable), multicollinearity (VIF < 5), homoscedasticity (Breusch-Pagan), and independence of errors (Durbin-Watson). Internal consistency was assessed via Cronbach's α. Hypotheses were tested using Pearson correlations, hierarchical multiple regression (three blocks), and PROCESS Model 1 moderation analysis with 5,000 bootstrap samples and mean-centered predictors.

RESULTS

Preliminary Analyses

Of 480 questionnaires distributed, 450 were returned usable, yielding a response rate of 93.7 percent. Missing data constituted less than two percent per variable and were addressed via mean imputation at the subscale level. Little's (1988) Missing Completely at Random test indicated that data were missing completely at random, chi-square with 47 degrees of freedom = 38.21, $p = 0.82$, supporting the appropriateness of the imputation approach. Shapiro-Wilk tests yielded p values less than 0.001 for all scales, indicating deviation from univariate normality; however, skewness and kurtosis values fell within acceptable ranges (absolute skewness less than 2, absolute kurtosis less than 7), and with a sample size of 450, parametric tests were considered robust to these minor deviations (Field, 2018; Tabachnick and Fidell, 2019).

Internal consistency reliability was excellent for both full scales: Cronbach's alpha equalled 0.91 for the LAAI total score and 0.88 for the SWS total score. Subscale alpha values ranged from 0.76 (Water Features) to 0.86 (Maintenance Quality) for the LAAI, and from 0.79 (Physical Wellbeing) to 0.85 (Psychological Wellbeing) for the SWS, all exceeding the 0.70 threshold for acceptable internal consistency in social science research.

Participant Characteristics and Descriptive Statistics

Participants (N = 450) were enrolled at UNILAG (n = 189, 42.0 percent), YABATECH (n = 158, 35.1 percent), and FCE Akoka (n = 103, 22.9 percent). The sample was 52.0 percent female (n = 234) and 47.3 percent male (n = 213), with three participants (0.7 percent) identifying as non-binary or preferring not to specify. The mean age was 21.4 years (SD = 2.1). The majority of participants resided off-campus in rented accommodation near the school (n = 312, 69.3 percent). Mean daily outdoor time on campus was 47 minutes (SD = 32 minutes). LAAI subscale means ranged from 2.12 (SD = 0.98) for Maintenance Quality to 3.42 (SD = 0.89) for Safety and Lighting. The SWS total mean was 58.24 (SD = 15.36). All skewness and kurtosis values fell within acceptable ranges. Detailed demographic characteristics and descriptive statistics are presented in Table 3.

Table 3a: Demographic Characteristics and Descriptive Statistics (Part A: Demographic Characteristics)

Characteristic	n	Percent
Institution		
UNILAG	189	42.0
YABATECH	158	35.1
FCE Akoka	103	22.9
Gender		
Female	234	52.0
Male	213	47.3
Non-binary or prefer not to say	3	0.7
Age		
18 to 20 years	156	34.7
21 to 23 years	198	44.0
24 to 26 years	72	16.0
27 years and above	24	5.3
Year of Study		
100-level	108	24.0
200-level	117	26.0
300-level	126	28.0
400-level and above	99	22.0
Accommodation		
On-campus hostel	87	19.3
Off-campus near school	312	69.3
Family home	42	9.3
Other	9	2.0

Daily Outdoor Time		
Less than 15 minutes	54	12.0
15 to 30 minutes	117	26.0
30 minutes to 1 hour	144	32.0
1 to 2 hours	90	20.0
More than 2 hours	45	10.0

Table 3b: Demographic Characteristics and Descriptive Statistics (Part B: Descriptive Statistics and Reliability Coefficients)

Scale and Subscale	**M**	**SD**	**Skewness**	**Kurtosis**	**Alpha**
LAAI Total	2.94	0.78	-0.32	-0.18	0.91
Vegetation Density	3.18	0.92	-0.41	-0.25	0.84
Seating	2.71	0.95	-0.15	-0.42	0.82
Walkway Surfaces	3.05	0.88	-0.28	-0.19	0.79
Water Features	2.34	1.12	0.22	-0.55	0.76
Maintenance	2.12	0.98	0.38	-0.28	0.86
Safety and Lighting	3.42	0.89	-0.52	0.12	0.80
SWS Total (0 to 100)	58.24	15.36	-0.18	-0.33	0.88
Psychological Wellbeing	14.42	4.18	-0.22	-0.28	0.85
Social Wellbeing	13.08	3.92	-0.15	-0.35	0.81
Physical Wellbeing	10.42	3.24	-0.08	-0.41	0.79

Note. LAAI = Landscape Assessment and Appraisal Inventory; SWS = Student Wellbeing Scale. LAAI subscales scored 1 to 5; SWS subscales scored 0 to 20; SWS Total scored 0 to 100. Alpha represents Cronbach's alpha.

Bivariate Correlations

Pearson product-moment correlations among the primary study variables are presented in Table 4. The LAAI total score correlated moderately with the SWS total score, r (448) = 0.44, p less than 0.001, 95 percent confidence interval 0.36 to 0.51. Among the LAAI subscales, Seating demonstrated the strongest correlation with SWS Total, r (448) = 0.42, p less than 0.001, followed by Vegetation Density, r (448) = 0.38, p less than 0.001, and Safety and Lighting, r (448) = 0.36, p less than 0.001. Water Features was not significantly correlated with any wellbeing subscale (all p values greater than 0.05). The three SWS subscales were strongly intercorrelated, with coefficients ranging from 0.68 to 0.72, all significant at the 0.001 level.

Table 4: Pearson Correlations Among Landscape Quality and Wellbeing Variables (N = 450)

Variable	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
LAAI Total	-									
Vegetation Density	0.78***	-								

Seating	0.82***	0.61***	-							
Walkway Surfaces	0.71***	0.52***	0.58***	-						
Water Features	0.45***	0.38***	0.32***	0.28***	-					
Maintenance	0.68***	0.48***	0.55***	0.62***	0.22**	-				
Safety and Lighting	0.75***	0.58***	0.64***	0.71***	0.25**	0.68***	-			
SWS Total	0.44***	0.38***	0.42***	0.35***	0.09	0.31***	0.36***	-		
Psychological WB	0.42***	0.38***	0.41***	0.32***	0.08	0.29***	0.33***	0.89***	-	
Social WB	0.39***	0.32***	0.38***	0.31***	0.10	0.28***	0.30***	0.85***	0.72***	-
Physical WB	0.35***	0.32***	0.34***	0.30***	0.07	0.25***	0.28***	0.82***	0.68***	0.70***

Note. WB denotes Wellbeing. ***p less than 0.001, **p less than 0.01. Correlations between Water Features and all SWS outcomes were non-significant (p greater than 0.05).

Hypothesis Testing

Prior to conducting the primary inferential analyses, all relevant assumptions were tested and found satisfactory. Variance Inflation Factor values ranged from 1.12 to 3.45, indicating no problematic multicollinearity among predictors. The Durbin-Watson statistic was 1.89, supporting the assumption of independent residuals. The Breusch-Pagan test was non-significant ($p = 0.18$), indicating homoscedasticity of residuals. Results of the hierarchical multiple regression are presented in Table 5.

Table 5: Hierarchical Regression Results Predicting Student Wellbeing (SWS Total)

Variable	Block 1	Block 2	Block 3
Demographics			
Institution (UNILAG)	0.12*	0.10	0.09
Gender (Female)	0.06	0.05	0.05
Age	0.03	0.02	0.02
Year of Study	-0.04	-0.03	-0.03
Accommodation	0.02	0.01	0.01
Daily Outdoor Time	0.08	0.05	0.05
LAAI Total		0.43***	3.42***
Maintenance			1.52**
LAAI multiplied by Maintenance			-1.24*
Model Statistics			
R-squared	0.03	0.21	0.23
Adjusted R-squared	0.02	0.20	0.22

F	2.28*	16.83***	15.42***
Change in R-squared	0.03	0.18	0.02
Change in F	2.28*	97.86***	4.58*
Degrees of freedom	(6, 443)	(1, 442)	(1, 441)

Note. Block 1 and Block 2 values are standardized coefficients (beta); Block 3 predictor values are unstandardized coefficients (B). *p less than 0.05, **p less than 0.01, ***p less than 0.001.

Hypothesis 1: Block 1 (demographics) explained 3% of variance. Adding LAAI Total in Block 2 explained an additional 18%, ΔF (1, 442) = 97.86, $p < .001$, with $\beta = .43$, $p < .001$. H_{01} was rejected.

Hypothesis 2: Simultaneous regression with LAAI subscales predicting Psychological Wellbeing (controlling demographics) yielded $R^2 = .24$. Seating was the strongest predictor ($\beta = .31$, $p < .001$), followed by Vegetation Density ($\beta = .20$, $p = .011$). Walkway Surfaces ($\beta = .10$, $p = .135$) and Water Features ($\beta = -.03$, $p = .668$) were non-significant. H_{02} was partially rejected.

Hypothesis 3: PROCESS Model 1 with 5,000 bootstrap samples revealed a significant LAAI Total × Maintenance interaction, B = -1.24, $p = .033$, $\Delta R^2 = .02$. Simple slopes: low maintenance B = 4.08, $p < .001$; mean maintenance B = 2.84, $p < .001$; high maintenance B = 1.60, $p = .052$, indicating a ceiling effect. H_{03} was rejected.

Supplementary Analyses

A one-way analysis of variance (ANOVA) indicated significant differences in perceived landscape quality across the three institutions (F with 2 and 447 degrees of freedom = 12.34, p less than 0.001, eta-squared = 0.05). Post-hoc comparisons using the Tukey HSD test revealed that UNILAG students (M = 3.18, SD = 0.72) reported significantly higher landscape quality than YABATECH students (M = 2.76, SD = 0.81) and FCE Akoka students (M = 2.71, SD = 0.79). The difference between YABATECH and FCE Akoka was not statistically significant.

Gender did not significantly moderate the landscape-wellbeing relationship. A PROCESS Model 1 analysis with gender as the moderator yielded a non-significant interaction term (beta = 0.04, p = 0.42), indicating that the association between landscape quality and wellbeing did not differ significantly between male and female students.

Summary of Hypothesis Testing

Table 6: Summary of Hypothesis Testing Results

Hypothesis	Statistical Test	Key Statistic	Decision
H_{01}: No relationship between overall landscape quality and wellbeing	Hierarchical regression (Block 2)	Change in R-squared = 0.18, F = 97.86, p less than 0.001; beta = 0.43	Rejected
H_{02}: Specific landscape dimensions do not predict psychological wellbeing	Simultaneous regression	Seating: beta = 0.31, p less than 0.001; Vegetation: beta = 0.20, p = 0.011; Walkway: p = 0.135; Water: p = 0.668	Partially rejected
H_{03}: Maintenance quality does not moderate landscape-wellbeing relationship	PROCESS Model 1	B = -1.24, p = 0.033; change in R-squared = 0.02	Rejected

DISCUSSION

Summary of Principal Findings

The present study examined the relationship between perceived campus landscape quality and psychological wellbeing among undergraduate students across three federal tertiary institutions in Lagos, Nigeria. The findings provide substantial evidence for the central research proposition that the physical campus environment constitutes a meaningful determinant of student mental health. The null hypothesis of no relationship between overall landscape quality and wellbeing was decisively rejected: landscape quality emerged as a statistically significant and positive predictor of psychological wellbeing (beta = 0.43, p less than 0.001), accounting for approximately 21 percent of the variance in wellbeing scores across the sample. After controlling for demographic covariates including age, gender, institution, year of study, accommodation type, and daily outdoor time, landscape quality explained 18 percent of the unique variance in wellbeing, suggesting that the campus environment exerts a substantial influence on student mental health that is independent of personal and institutional characteristics.

The second hypothesis, concerning the relative contributions of specific landscape features, was partially rejected in a pattern that carries significant implications for campus design priorities. Shaded seating and its associated comfort provision emerged as the single strongest predictor of psychological wellbeing (beta = 0.31, p less than 0.001), followed by vegetation density (beta = 0.20, p = 0.011). Walkway surface quality did not reach statistical significance (beta = 0.10, p = 0.135), and water features were entirely unrelated to wellbeing outcomes (beta = -0.03, p equ=als 0.668). These results indicate that not all landscape elements contribute equally to student wellbeing in this tropical urban context, and that thermal comfort and visual greenery constitute the essential ingredients of restorative campus environments.

The third hypothesis, concerning maintenance quality as a moderator, was rejected in an unexpected direction that demands careful theoretical interpretation. Rather than amplifying the landscape-wellbeing relationship as initially hypothesized, maintenance quality demonstrated a significant negative moderating effect (interaction B = -1.24, p = 0.033). The simple slopes analysis revealed a pattern of diminishing returns: the association between landscape quality and wellbeing was strongest at low maintenance levels (B = 4.08), moderate at mean maintenance levels (B = 2.84), and weakest and non-significant at high maintenance levels (B = 1.60). This finding contradicts the expectation, grounded in broken windows theory and environmental disorder research, that well-maintained environments would enhance the psychological benefits of landscape quality while poorly maintained environments would suppress them.

Finally, significant institutional differences were observed in perceived landscape quality, with students at the University of Lagos reporting substantially higher landscape quality (M = 3.18) than those at Yaba College of Technology (M = 2.76) and the Federal College of Education (M = 2.71). These differences likely reflect variations in institutional resources, land availability, founding histories, and cumulative investment in campus infrastructure over decades of operation.

INTERPRETATION WITHIN THEORETICAL FRAMEWORK

Landscape Quality as Restorative Resource

The significant positive association between overall landscape quality and psychological wellbeing is consistent with the predictions of the three theoretical frameworks that guided this investigation. Attention Restoration Theory (Kaplan, 1995) proposes that natural environments facilitate recovery from directed attention fatigue through the engagement of soft fascination, the effortless, involuntary attention elicited by natural elements such as vegetation, gentle breezes, and shifting light patterns. In the campus context, students experiencing cognitive depletion from prolonged lectures, intensive study sessions, and extended digital screen exposure may derive restorative benefits from immersion in green spaces that support this attentional shift from effortful concentration to effortless engagement. The finding that landscape quality explains 18 percent of unique variance in wellbeing

suggests that campus green spaces are not merely decorative amenities but functional cognitive resources that support the core academic mission of higher education institutions.

Stress Recovery Theory (Ulrich et al., 1991) offers a complementary psychophysiological explanation, suggesting that exposure to natural environments initiates rapid autonomic stress reduction characterized by decreases in blood pressure, muscle tension, and sympathetic nervous system arousal within minutes of exposure. The breadth of the landscape quality construct used in this study, encompassing vegetation, seating, shade, walkways, and water features, aligns with Stress Recovery Theory's emphasis on the multisensory qualities of restorative environments, including visual complexity, natural soundscapes, and perceived safety. Students who perceive their campus landscapes as high in quality may be experiencing these stress-reducing psychophysiological benefits during the course of their daily movements through campus, with cumulative effects manifesting in higher overall wellbeing scores.

The Biophilia Hypothesis (Kellert & Wilson, 1993) provides an evolutionary grounding for these effects, proposing that humans possess an innate, genetically prepared affinity for natural environments that conferred survival advantages throughout evolutionary history. From this perspective, the persistence of nature-responsive psychological mechanisms in contemporary urban university settings reflects the continued salience of biophilic cues even within environments that are predominantly constructed. The finding that landscape quality exerts a substantial influence on wellbeing in densely urbanized Lagos, where students might be expected to have adapted to predominantly built environments, shows the depth and persistence of biophilic psychological mechanisms.

The Primacy of Shade and Seating in Tropical Contexts

The dominance of shaded seating underscores the role of thermal comfort as a gateway variable in hot-humid climates. Without thermal comfort, the soft fascination and parasympathetic recovery processes described by ART and SRT cannot engage. This finding resonates with emerging tropical evidence (Kellou et al., 2024; Nakandi et al., 2024; Wunubo et al., 2022) and supports a tentative “Thermal Restoration Theory,” wherein shade and cooling constitute foundational prerequisites for higher-order restoration. Vegetation density independently contributed to wellbeing, supporting both the soft fascination mechanism and the dual function of vegetation in providing visual greenery and microclimatic cooling.

Maintenance as Negative Moderator

The negative moderation contradicts the broken windows prediction (Keizer et al., 2008) and instead suggests a ceiling effect. When maintenance is poor, whatever landscape quality exists becomes highly salient and psychologically impactful, while in well-maintained environments, wellbeing is driven by a broader constellation of factors.

One plausible explanatory framework draws on Helson's (1964) adaptation-level theory, which proposes that individuals evaluate stimuli relative to their adapted reference standards. In poorly maintained campus environments, students may adapt their reference standards downward, rendering any available high-quality landscape features exceptionally salient and psychologically impactful. However, this ceiling-effect interpretation is advanced as a hypothesis requiring further testing, not as a definitive conclusion. It is possible that unmeasured variables – such as differential student expectations, institutional prestige, or unobserved campus differences – contribute to the observed pattern. Replication across multiple institutions and direct measurement of adaptation levels are necessary before this counterintuitive moderation pattern can be considered robust. Pending such replication, the result suggests that the interplay between landscape quality and maintenance is more complex than simple linear models imply, and that the return on investment in landscape improvements may depend on the existing state of the campus environment.

The Water Features Paradox

The null effect of water features on wellbeing was unexpected given global evidence on the restorative benefits of blue spaces. We hypothesise that this finding may reflect the specific epidemiological context of Lagos, where

standing water is a known breeding habitat for malaria-carrying mosquitoes (Adeyemi, 2015). In such settings, students may perceive water features not as restorative amenities but as potential health threats, thereby negating any psychological benefits. This interpretation remains tentative, as the present study did not measure perceived disease risk or actual water quality. Future research should directly test whether vector-borne disease salience moderates the restorative impact of campus water features, ideally comparing settings with and without active vector control programmes. Until such evidence is available, the null finding serves as a caution against assuming universal transferability of blue-space benefits to tropical epidemiological contexts.

Comparison with Existing Literature

The present findings converge with and extend prior research in several meaningful directions. The significant association between overall landscape quality and wellbeing is consistent with the campus-specific findings of Matsuoka & Kaplan (2008), who demonstrated that views of nature from campus buildings were associated with enhanced wellbeing among university students, and with McFarland et al (2008), who linked campus green space access to quality-of-life outcomes in a United States higher education sample. Hipp et al. (2016) similarly found that perceived neighbourhood greenness predicted self-reported wellbeing in a nationally representative sample across multiple countries, providing convergent evidence across geographic and institutional contexts.

The effect size observed in this study (R-squared = 0.21, with landscape quality accounting for 18% of unique variance) is broadly comparable to effect sizes reported in the systematic review by Dzhambov et al. (2023), which identified positive associations between campus nature exposure and student health outcomes across 42 studies, with small-to-medium effects predominating. It also aligns with the variance explained by greenness in Li & Sullivan's (2016) study of school landscape views, where greenness accounted for 14 to 19% of variance in academic and behavioural outcomes. The convergence of effect sizes across diverse geographic, climatic, and institutional contexts strengthens confidence in the robustness of the landscape-wellbeing relationship.

The primacy of shade and seating as predictors extends findings from other tropical and subtropical settings. The strong effect of shade provision on wellbeing aligns with Ndetei et al. (2020) observation that shaded seating areas in Kenyan universities were associated with significantly longer dwell times and higher restorative quality than unshaded equivalents, and with Wunubo et al. (2022) report that 73 percent of Nigerian students at Gombe State University cited shade as the primary driver of their green space preferences. These converging findings from East and West Africa, combined with Lin et al. (2022) evidence from subtropical Taiwan, suggest that the primacy of thermal comfort as a landscape quality dimension is not idiosyncratic to Lagos but may represent a general principle for hot-climate campus design.

The water features null finding stands in partial contradiction to the global synthesis reported by Si et al. (2024), which identified blue spaces as the most beneficial natural environment type for student mental health. However, this contradiction is readily resolved through contextual analysis: the Lagos setting introduces a public health confound, in the form of endemic malaria transmission associated with standing water, that is absent from the European, North American, and East Asian contexts in which the vast majority of blue space research has been conducted. This pattern highlights the importance of environmental psychology research that interrogates boundary conditions and contextual moderators rather than assuming universal generalizability of findings across climatic, epidemiological, and cultural contexts.

The maintenance moderation finding represents a novel and theoretically significant contribution to the literature. While Lindal & Hartig (2013) examined the effects of maintenance variation on restorative quality through experimental manipulation, and Keizer et al. (2008) investigated maintenance cues in relation to social norm violation, neither study reported a negative moderation pattern of the type observed here. The ceiling-effect interpretation proposed above, drawing on adaptation-level theory, warrants replication and further theoretical elaboration in subsequent research, as it carries substantial implications for how limited institutional resources should be allocated across new landscape installations and ongoing maintenance activities.

Theoretical Implications

The findings of this study carry several implications for the theoretical development of environmental psychology. First, the primacy of shade and seating provision in predicting wellbeing supports the tentative formulation of a Thermal Restoration Theory that positions thermal comfort as a foundational prerequisite for the engagement of higher-order restorative processes described by Attention Restoration Theory and Stress Recovery Theory. This theoretical extension is particularly relevant for the approximately 40 percent of the global population residing in tropical and subtropical climatic zones, for whom existing restorative environment theories, developed primarily in temperate contexts where thermal discomfort is rarely a limiting factor in outdoor space use, may provide incomplete explanatory frameworks. A Thermal Restoration Theory would propose that in hot-humid environments, the first-order requirement for restorative environments is thermal safety and comfort, achieved through shade provision, evaporative cooling, and air movement, and that the visual and spatial qualities emphasized in existing theories become operative only when this first-order condition is satisfied.

Second, the negative moderation pattern observed for maintenance quality suggests that the relationship between environmental quality and psychological outcomes may follow curvilinear or ceiling-effect trajectories that are not adequately captured by linear main-effects models that predominate in the environmental psychology literature. If replicated, this pattern would imply that landscape interventions may yield the greatest wellbeing returns in resource-constrained settings where baseline maintenance is low, with diminishing returns in already well-maintained environments. However, this possibility must be treated as a provisional hypothesis pending confirmatory evidence, as the present study's cross-sectional design cannot establish causal direction or rule out alternative explanations.

Third, the water features null finding highlights the pressing need for integrative theoretical models that simultaneously incorporate aesthetic, epidemiological, and cultural variables when predicting the psychological effects of environmental features. The green-blue-health literature has advanced substantially in temperate contexts where water bodies present minimal infectious disease risk, but its extension to tropical regions where standing water is associated with vector-borne disease transmission requires explicit consideration of disease ecology as a boundary condition. A revised framework might posit that the psychological benefits of aquatic features are conditional on the presence and quality of vector control infrastructure: benefits are realized only when breeding risk is effectively managed through regular water circulation, biological larviciding, or physical mosquito exclusion measures.

Practical Recommendations

The findings of this study offer actionable guidance for multiple stakeholder groups involved in campus planning, management, and policy development. For landscape architects and campus planners, the results clearly prioritize shaded seating clusters as the highest-impact design intervention for supporting student wellbeing in tropical contexts. Designs that integrate dense tree canopy with strategically positioned seating areas, oriented to maximize shade coverage during peak sun hours from approximately 10:00 to 16:00 in Lagos, are likely to yield greater psychological returns than investments in decorative water features, ornamental hardscape elements, or sculptural installations. Climate-appropriate planting selections that maximize canopy density while minimizing maintenance requirements, particularly indigenous species adapted to local precipitation patterns and pest pressures, should be prioritized in planting specifications. The evidence suggests that the functional performance of landscape elements, particularly their contribution to thermal comfort, may be more consequential for student wellbeing than their purely aesthetic qualities.

For campus administrators, the maintenance moderation finding carries counterintuitive but important implications for resource allocation. While the negative interaction between landscape quality and maintenance should not be interpreted as evidence that maintenance is unimportant, given that maintenance quality was positively correlated with wellbeing ($r = 0.31$), it does suggest that the marginal psychological return from landscape quality investments may be greatest in contexts where overall maintenance is currently suboptimal. This finding supports a triage approach to campus landscape investment: institutions with severely degraded

landscapes may achieve the greatest wellbeing gains per naira spent by addressing the most egregious maintenance deficits and providing basic shade and seating infrastructure, rather than by undertaking ambitious new landscape installations that will themselves require ongoing maintenance that the institution may be unable to sustain.

Administrators should implement regular maintenance protocols at a minimum biweekly frequency for high-traffic green spaces, including litter removal, grass trimming, drainage management, and seating repair. Student engagement programmes, such as green squad initiatives that involve students in landscape stewardship activities including planting, litter collection, and garden maintenance, may simultaneously enhance maintenance quality, reduce operational costs, and foster environmental ownership and place attachment that amplify wellbeing benefits through mechanisms of community participation and collective efficacy.

For policymakers in the National Universities Commission and Federal Ministry of Education, the evidence that campus landscape quality independently predicts student psychological wellbeing, accounting for nearly one-fifth of the variance in wellbeing scores, supports the inclusion of green infrastructure metrics in institutional accreditation and funding frameworks. Current NUC accreditation criteria emphasize physical facilities including classroom adequacy, laboratory equipment, and library holdings, but do not systematically assess landscape quality as a dimension of institutional infrastructure. The present findings suggest that landscape quality is not a cosmetic luxury but a functional component of the educational infrastructure that supports the mental health and cognitive functioning upon which academic achievement depends. The NUC might consider incorporating landscape quality assessments, encompassing vegetation density, shade coverage, seating provision, and maintenance standards, as criteria for institutional accreditation and as eligible components of capital development grant applications. Such policy integration would incentivize campus environmental investment while establishing minimum standards for student environmental quality across Nigerian higher education institutions.

LIMITATIONS

The interpretation of these findings must be qualified by several methodological limitations that constrain the scope and certainty of the conclusions that can be drawn. First, and most fundamentally, the cross-sectional design precludes definitive causal inference. While the results are consistent with a directional effect of landscape quality on wellbeing, and the theoretical frameworks grounding the study provide plausible mechanistic accounts of such an effect, the possibility of reverse causation cannot be excluded. Students with higher baseline wellbeing may perceive their environments more positively due to mood-congruent processing biases, or may self-select into institutions with higher landscape quality, or may spend more time outdoors in campus green spaces because their positive psychological state supports exploration and social engagement. Longitudinal designs that track changes in wellbeing following landscape interventions, or that follow cohorts of students over time while measuring both environmental exposure and psychological outcomes at multiple time points, are necessary to establish causal direction with greater confidence.

Second, the exclusive reliance on self-report measures for both landscape quality and wellbeing introduces the risk of common method bias, whereby shared response tendencies, such as acquiescence bias, extreme responding, or the influence of transient affective states at the time of survey completion, may inflate observed associations between predictor and outcome variables (Podsakoff et al., 2003). While the inclusion of an independent environmental audit partially mitigates this concern for the maintenance quality variable, the core landscape quality and wellbeing constructs were both measured through self-report, and the observed correlations may therefore overestimate the true magnitude of the landscape-wellbeing relationship. Future studies incorporating objective environmental assessments through GIS-based green space quantification, systematic observational audits, or wearable sensor data on time spent in outdoor environments, alongside physiological measures of stress such as salivary cortisol or heart rate variability, would substantially strengthen causal inference.

Third, the timing of data collection during the April to June period captured the transition from dry to wet season in Lagos, introducing potential seasonal variability in both landscape appearance and student stress levels.

Vegetation fullness, flowering patterns, lawn condition, and water feature appearance all vary substantially across Lagos's bimodal rainfall cycle, and the landscape-wellbeing associations observed during the dry-to-wet transition may not generalize to the peak dry season (December to February) when vegetation is sparser, temperatures are higher, and the need for shade is most acute. The timing of data collection may also have coincided with varying examination or assessment schedules across the three institutions, introducing systematic between-institution variance in stress levels that is not attributable to landscape quality.

Fourth, the sample was restricted to federal tertiary institutions within a single metropolitan corridor of Lagos State. Private universities, state-funded polytechnics, and institutions in other Nigerian cities with different climatic conditions, urbanization patterns, and resource profiles were not represented. The landscape-wellbeing relationships observed in this study may not generalize to private universities, which typically command greater financial resources and may maintain higher landscape quality, or to institutions in northern Nigerian cities such as Kano or Maiduguri, where the hot-arid climate presents different thermal comfort challenges and where the cultural and religious context may influence patterns of outdoor space use.

Fifth, the absence of objective physiological measures, including salivary cortisol, heart rate variability, blood pressure, or skin conductance, precludes direct testing of the psychophysiological mechanisms proposed by Stress Recovery Theory. The self-reported wellbeing measures used in this study capture subjective psychological states but cannot distinguish between stress reduction, mood enhancement, and cognitive restoration as distinct mechanistic pathways. The finding that shade and seating were the strongest predictors of wellbeing is consistent with a thermal comfort pathway, but without direct measurement of thermal comfort, skin temperature, or physiological stress markers, this interpretation remains inferential.

Future Research Directions

The findings and limitations of this study suggest several productive directions for future inquiry. First, a longitudinal pre-post design tracking students before and after a landscape intervention, such as the installation of shaded seating clusters in a previously underserved campus area, would provide stronger evidence for causal effects and enable estimation of effect persistence over time. Such a design could incorporate both self-report and physiological outcome measures, with data collection at multiple post-intervention time points to determine whether wellbeing gains are sustained, decay, or even increase over time as students develop place attachment to the improved environment.

Second, mixed-methods approaches incorporating qualitative interviews, focus groups, and photovoice methodologies would substantially enrich the quantitative findings by capturing student narratives about how, when, and why campus landscapes matter for their psychological wellbeing. Qualitative data could reveal mechanisms and moderating factors not captured by standardized survey instruments, including the role of childhood nature experiences in shaping landscape preferences, the social and cultural meanings attached to specific campus places, and the ways in which landscape quality interacts with academic identity, institutional pride, and perceived institutional support.

Third, the integration of objective measurement modalities, including GIS-based green space quantification using satellite-derived NDVI or land cover classification, wearable sensor assessments of physiological stress markers and physical activity patterns, and thermal comfort monitoring using portable data loggers, would address the limitations of exclusive reliance on self-report methodology while enabling direct tests of the Thermal Restoration Theory proposed above. Objective environmental measures would also permit examination of the concordance between perceived and objective landscape quality, and whether these dimensions differentially predict wellbeing outcomes.

Fourth, expanding the institutional scope to include private universities, state-funded polytechnics and colleges of education, and campuses in other Nigerian cities representing different climatic zones, such as Abuja in the guinea savanna, Ibadan in the derived savanna, and Port Harcourt in the coastal mangrove zone, would enhance geographic and socioeconomic generalizability. Such expansion would enable systematic examination of institutional resourcing, climatic variation, and urbanization intensity as moderators of landscape-wellbeing

relationships, contributing to a more nuanced and contextually sensitive understanding of restorative environments in African higher education.

Fifth, mechanistic research directly testing mediation pathways, such as attentional capacity through sustained attention tasks, thermal comfort through subjective comfort ratings and skin temperature measurement, perceived safety through environmental fear assessments, and social connectedness through momentary ecological assessment of social interactions, would clarify the psychological processes through which campus landscapes influence wellbeing. Establishing which pathways are operative in which contexts would enable more targeted intervention design: if the primary pathway is thermal comfort, shade infrastructure is the priority; if it is social connection, seating configuration and social space design take precedence; if it is cognitive restoration, visual complexity and soft fascination become the design drivers.

Strengths

Despite the limitations enumerated above, the study possesses several notable methodological strengths that enhance confidence in its findings. It represents a multi-site quantitative investigation of campus landscape-wellbeing relationships conducted across federal tertiary institutions in Lagos State, thereby addressing a significant geographic gap in the predominantly Western literature on restorative environments. The use of context-adapted measurement instruments with demonstrated reliability, with all scale and subscale alpha coefficients exceeding 0.75, enhances confidence in the internal consistency and cultural appropriateness of the measures. The exceptionally high response rate of 93.7 percent minimizes the risk of non-response bias that plagues survey-based research, where response rates frequently fall below 40 percent in comparable studies. This high response rate, achieved through in-person administration, multiple collection settings, and token appreciation, enhances the representativeness of the sample and the generalizability of findings to the target population. The inclusion of moderation analysis extends beyond simple bivariate associations to examine the conditional nature of the landscape-wellbeing relationship, offering a more nuanced and theoretically informative account of how environmental quality operates in this context than would be possible through main-effects analysis alone.

CONCLUSION

This study set out to evaluate the relationship between campus landscape architecture and student wellbeing in Lagos federal tertiary institutions. The first objective, to quantify perceived landscape quality, was achieved via the validated LAAI, which captured meaningful variation across the three campuses. The second objective, to assess student wellbeing, confirmed that students at institutions with higher landscape quality, particularly UNILAG, reported better psychological outcomes. The third objective tested maintenance quality as a moderator and revealed a significant negative interaction, indicating a ceiling effect rather than a synergistic boost.

In answering the research hypotheses, the study found that overall landscape quality significantly predicted student wellbeing (H_{01} rejected). Among specific features, shaded seating and vegetation density were the strongest predictors, whereas walkway surfaces and water features had no significant effect (H_{02} partially rejected). Maintenance quality significantly moderated the landscape–wellbeing link, with the strongest benefits observed where maintenance was poor (H_{03} rejected). These findings validate Attention Restoration Theory and Stress Recovery Theory and suggest that thermal comfort, rather than visual aesthetics alone, is the primary restorative mechanism.

Practically, campus planners should prioritise shaded seating clusters with dense canopy cover and climate-appropriate indigenous planting, while either avoiding water features or coupling them with rigorous vector control. The National Universities Commission should integrate landscape quality metrics into institutional accreditation standards. In Lagos's federal tertiary institutions, well-maintained, shade-rich landscape architecture is not an aesthetic luxury but a student mental health imperative.

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