
“INTEGRATION OF BIOPHILIC DESIGN PRINCIPLES FOR SUSTAINABLE ENVIRONMENT PERFORMANCE AND DISABLED STUDENT ACCESSIBILITY IN SECONDARY SCHOOL, IMOTA, LAGOS”

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ABSTRACT

Secondary school environments play a critical role in shaping students learning experiences, wellbeing, and overall development. In Lagos, many schools face challenges related to accessibility, environmental performance, and the integration of natural elements, which can negatively affect students, particularly those with disabilities. This study explores how biophilic design principles can be applied to enhance both sustainability and accessibility in a secondary school in Imota. Findings indicate that accessibility is largely inadequate, with most areas being not or only partially accessible; environmental conditions such as ventilation and lighting are suboptimal, and green spaces are limited or insufficient. Despite these shortcomings, students and staff express strong support for incorporating natural elements, highlighting the potential benefits of integrating biophilic design. The study underscores the importance of an architectural approach that combines inclusive design strategies with nature-based interventions to create a more sustainable, accessible, and supportive learning environment for all users.

KEYWORDS: biophilic design, Inclusive education, Accessibility, Sustainable school environment, Student wellbeing.

INTRODUCTION

1.1 Background Of Study

The global shift towards healthier and more inclusive learning environments has intensified

interest in biophilic design as a framework for improving educational spaces through the integration of nature-based principles (AlSehaimi & Ayoub, 2025). Schools strongly influence student learning, wellbeing, and social inclusion, yet many in Lagos face challenges like poor circulation, inadequate lighting, and limited green spaces, which particularly affect disabled

Students (Ibitoye, Abiola, & Babamboni, 2023). Research across diverse climates has shown that exposure to natural elements in schools promotes comfort, wellbeing, and enhanced cognitive functioning among students of various age groups (Md Sakip et al., 2024). The use of water elements, greenery, natural light, and organic materials in educational buildings is increasingly recognized as a catalyst for reducing stress, improving concentration, and stimulating creativity, especially in environments that previously lacked sensory diversity (NEVZATI et al., 2021; Yasar, 2023). At the same time, educational systems worldwide are prioritizing accessibility as a central requirement for inclusive schooling, acknowledging that students with disabilities face profound learning barriers when school environments are poorly designed (Faizefu, 2025). Biophilic design, incorporating natural elements such as greenery, daylight, and natural materials, has been shown to improve environmental quality, cognitive performance, and emotional wellbeing (Oa, 2025). Studies conducted in mainstream school systems demonstrate that children with special educational needs require specific environmental adjustments such as low-stimulation learning zones, barrier-free circulation, and sensory-friendly cues—to participate meaningfully and comfortably in school routines (Morgenthaler et al., 2022). In Nigeria, particularly Lagos, infrastructural deterioration and inadequate planning standards have resulted in many secondary schools that fail to meet sustainability expectations or accessibility requirements (Ediae et al., 2025). Buildings are often constructed with limited consideration of thermal performance, energy efficiency, or natural comfort strategies, leading to classrooms that are overheated, poorly ventilated, and visually monotonous (Ogunleye et al., 2025). These deficiencies are compounded by the absence of well-structured outdoor landscapes, lack of greenery, and insufficient shaded spaces, all of which contribute to environmental stress and reduced student wellbeing (Gray & Downie, 2024). The adoption of sustainable materials and environmentally conscious construction approaches is still emerging in Nigeria, even though studies highlight the potential benefits of low-cost recyclable options such as recycled paper and upcycled timber for improving environmental performance in school projects (Ibitoye et al., 2021; Cognoli et al., 2024). Similarly, while national policies advocate equitable learning opportunities for all

students, implementation gaps continue to limit disabled learners' access to supportive learning environments, particularly in public secondary schools (Gabdo et al., 2025). The secondary school in Imota, Lagos, represents a local context where these overlapping challenges are evident, as the surrounding Ikorodu region experiences rapid urban expansion, environmental stress, and infrastructural pressures (Ediae et al., 2025). The lack of natural features within the school environment, poor indoor environmental quality, and limited mobility support for disabled learners contribute to reduced comfort and hinder both academic and social participation (Ogunleye et al., 2025). Scholars emphasize that integrating biophilic principles can serve dual functions—enhancing sustainability while simultaneously supporting the sensory and emotional needs of special needs learners—making it a suitable approach for addressing the deficiencies observed in schools such as those in Imota (Ghaziani & Fisher, 2025). However, local examples demonstrating these combined benefits remain scarce, reinforcing the need for research that bridges biophilic design, sustainability, and accessibility within the Nigerian secondary school context (Nursyamsu et al., 2025). Despite its benefits, Nigerian secondary schools rarely combine biophilic principles with accessibility considerations, highlighting the need for strategies that create sustainable, inclusive learning environments in Imota, Lagos (Ogunyemi et al., 2022).

1.2 Problem Statement

Educational facilities in Lagos continue to struggle with poor environmental performance, inadequate natural integration, and limited accessibility for disabled learners, resulting in uncomfortable, disjointed learning experiences that negatively affect academic performance and wellbeing (Ediae et al., 2025). Many secondary schools in the Imota axis lack biophilic features such as greenery, natural lighting, and ventilation systems that could significantly improve indoor comfort and reduce reliance on artificial energy sources (Ogunleye et al., 2025). Disabled students often encounter obstacles such as narrow pathways, inaccessible classroom entrances, and absence of sensory-friendly learning areas, all of which restrict independent mobility and deepen inequality in learning outcomes (Faizefu, 2025). These environmental deficiencies persist despite evidence showing that biophilic and sustainable design strategies can create healthier, more inclusive educational settings that support diverse learners, including those with special needs (Ghaziani & Fisher, 2025). The specific problem is the absence of a holistic design framework that integrates biophilic principles with sustainable environmental performance and accessibility requirements in secondary schools in Lagos, particularly in underserved communities like Imota (Gray & Downie, 2024).

1.3 Research Gap

Existing studies on biophilic design in educational environments largely focus on universities, libraries, or general learning settings, offering limited insight into secondary schools in developing contexts such as Lagos (AlSehaimi & Ayoub, 2025; Md Sakip et al., 2024). Research on disability accessibility in Nigerian schools tends to emphasize compliance assessment rather than exploring how accessibility can be integrated with sustainability and nature-based design strategies (Ediae et al., 2025). Similarly, literature on sustainable school architecture highlights advancements in materials, energy systems, and nature-based design but rarely connects these approaches to the needs of disabled learners in basic education (Adeyinka et al., 2024; Nursyamsu et al., 2025). As a result, there is minimal local research examining how biophilic principles can enhance environmental performance while simultaneously improving accessibility for disabled students in Lagos secondary schools. This creates a clear gap requiring an investigation into the potential for biophilic, sustainable, and accessible design integration in Imota secondary school environments (Ghaziani & Fisher, 2025).

1.4 Aim

This research aim to investigate how biophilic design principles can be integrated to enhance sustainable environmental performance and improve accessibility for disabled students in a selected secondary school in Imota, Lagos.

1.5 Objectives

1. To examine the existing environmental performance and accessibility conditions of the selected secondary school in Imota.
2. To identify biophilic design principles suitable for improving sustainability and supporting disabled student accessibility.
3. To propose an integrated architectural framework that combines biophilic elements with inclusive design strategies for enhanced learning environments.

2.0 Literature Review

Biophilic design promotes wellbeing by reconnecting people with natural systems, and studies in educational buildings consistently show improvements in comfort, cognitive performance, and emotional stability when natural elements are integrated into learning spaces (Md Sakip et al., 2024). Research in Saudi Arabian universities demonstrates that

natural lighting, plants, and organic forms significantly enhance students' spatial experience and promote healthier learning atmospheres (AlSehaimi & Ayoub, 2025). Similarly, the presence of water features and visual access to nature positively influences stress reduction and improves the overall wellbeing of building users in educational settings (NEVZATI et al., 2021). Environmental quality, including lighting, ventilation, and access to nature, is critical for student learning and comfort (Ogunyemi et al., 2022). Biophilic design enhances attention, creativity, and mental restoration through features like plants, natural light, and water elements (Oa, 2025). However, many Nigerian schools lack accessibility for disabled students, with barriers such as steps, narrow corridors, and inaccessible toilets limiting participation (Ibitoye, Abiola, & Babamboni, 2023). Integrating biophilic and inclusive design can create learning spaces that are both sustainable and equitable, yet few studies have addressed this combination in secondary schools, revealing a clear research gap in Imota, Lagos (Oa, 2025).

Creative disciplines also benefit from biophilic spaces, as environments infused with natural materials and sensory variety stimulate imagination and nurture design thinking (Yasar, 2023). Accessibility literature emphasizes that inclusive educational environments require physical, sensory, and psychological adaptations tailored to the needs of disabled learners (Faizefu, 2025). Children with disabilities thrive in school environments where adjustments such as clear spatial orientation, low-noise areas, tactile guides, and barrier-free circulation are intentionally designed (Morgenthaler et al., 2022). International studies stress the importance of universal design principles in enhancing mobility, independence, and participation in secondary school settings (Raza & Hussain, 2025). Accessibility also extends to learning resources, where libraries and digital platforms must support diverse user capabilities to achieve full inclusivity (Clark Hunt et al., 2025; Nnatu et al., 2024). Research in African contexts shows that inclusive practices in schools require not only physical modifications but also systemic, community-based learning approaches that promote wellbeing and equitable access (Müllegger & Chapman, 2024; Zorde & Lapidot-Lefler, 2025). Sustainability studies highlight the role of renewable energy systems, recycled materials, and nature-based architectural solutions in enhancing environmental performance in schools (Adeyinka et al., 2024). Studies in Peru and Nigeria show that low-cost materials such as cardboard and recycled paper can contribute to environmentally responsible school construction when properly engineered for durability and functionality (Ikemiyashiro Higa & Taki, 2024; Ibitoye et al., 2021). Nature-based school models in Southeast Asia demonstrate

that integrating vegetation, natural ventilation, and open-air learning supports both environmental quality and student wellbeing (Nursyamsu et al., 2025). Research also supports the idea that environmental sustainability education is strengthened when school environments themselves embody ecological principles, encouraging students to internalize sustainable behavior (Pimenta et al., 2025; Albar et al., 2024). While these bodies of knowledge demonstrate the importance of biophilia, sustainability, and accessibility individually, very few studies integrate these three themes within the context of secondary schools in rapidly urbanizing African regions such as Lagos (Ghaziani & Fisher, 2025). This underscores the need for research that bridges these domains in ways that enhance both environmental performance and inclusive learning outcomes.

2.1 Case Study

2.1.1 Government Secondary School, Imota, Lagos and Zumuratul Islamiyyah Senior High School, Imota, Lagos

A public secondary school in Ikorodu North LCDA illustrates the environmental and accessibility challenges commonly found in Lagos schools. The campus includes congested classrooms, poor ventilation, minimal tree cover, and almost no intentional green infrastructure. Artificial lighting is relied on for much of the school day, and circulation is hindered by uneven walkways and stair-only access points. These conditions not only reduce comfort but also heighten stress and distraction among students, aligning with observations from national studies on youth wellbeing in educational environments (Ogunleye et al., 2025). For students with disabilities, the absence of ramps, tactile markers, adequate signage, or assistive facilities severely restricts participation. A second case study, a private secondary school within Imota, demonstrates a slightly better integration of natural elements due to its peri-urban setting. Trees, informal outdoor learning spots, and courtyards exist, but they are not strategically planned or connected to the school's environmental performance goals. Accessibility features remain limited, with incomplete ramps and no structured design interventions for students with mobility, visual, or cognitive disabilities. Despite an openness to improvement, the school lacks a cohesive framework that connects biophilic strategies with sustainable performance and inclusive design. These two cases reveal systemic gaps that motivate the need for research targeting the integration of biophilic principles with accessibility-focused planning in Lagos secondary schools.

2.2 Study Area

The study area is Imota, a rapidly developing district within Ikorodu Local Government Area of Lagos State. Imota is characterized by a mix of peri-urban residential communities, expanding educational facilities, and ecological features such as wetlands and vegetated landscapes. The growing population and ongoing infrastructural development in the area are creating increasing pressure on school environments, making it an ideal context for investigating the integration of biophilic design strategies that can improve environmental performance while supporting accessibility for disabled learners.

2.3 Study population and size

The population for this study comprises students, teachers, and administrative staff in selected secondary schools in Imota. Specifically, the study focus on students across different grades, ensuring representation of both able-bodied and disabled students, as well as teachers and school administrators who can provide insights into facility use and design limitations. To determine the appropriate sample size, Cochran's formula was applied, yielding a total of **196 respondents**. This sample ensures reliable data collection.

2.4 Data Collection Methods

Data is collected using a mixed-methods approach. Primary data is obtained through structured questionnaires for students and staff, in-depth interviews with school administrators, and observational checklists to assess physical infrastructure, green spaces, natural lighting, and accessibility features. Secondary data includes prior research on accessibility in Lagos schools, and literature on biophilic design and sustainable educational. This approach ensures a comprehensive understanding of both subjective perceptions and objective environmental conditions.

2.5 Data analysis

Collected data is analyzed using descriptive and inferential statistical techniques. Descriptive analysis includes percentages, frequencies, and mean scores to summarize demographic data, perceptions of accessibility, and biophilic features. Inferential analysis, such as Chi-square tests and correlation analysis, is applied to explore relationships between biophilic design elements, accessibility measures, and student wellbeing. Observational data will be presented through comparative tables.

3.0 FINDINGS AND DISCUSSION

3.1 Descriptive Statistics of Responses

3.1.0 Demographic Information

1. Gender distribution: The 196 respondents include 53.1% male and 46.9% female, showing a nearly balanced gender distribution. This balance ensures that perceptions of accessibility, environmental quality, and biophilic needs are not dominated by one gender group.

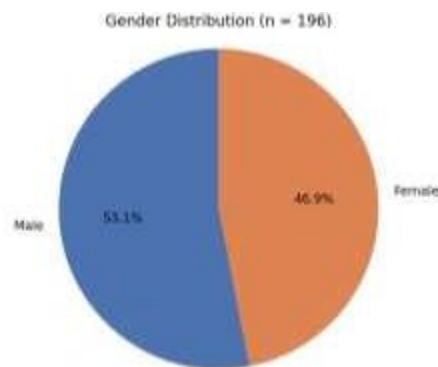


Figure 1: pie chart showing gender distribution Source: Authors Analysis from Microsoft Excel.

Roles distribution: Most respondents are students (65.8%), followed by teachers (25.5%) and administrative staff (8.7%). This mix captures multiple user perspectives, with students as primary space users and staff providing professional and operational insights.

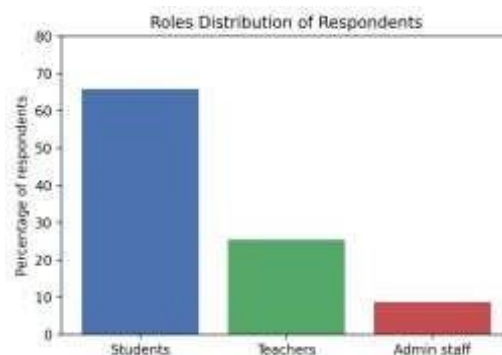


Figure 2: bar chart showing roles distribution Source: Authors Analysis from Microsoft Excel

2. Years in school distribution: About 34.2% have been in the school for over 5 years, while 23.5% are newcomers with less than one year of experience. Respondents with 1–3 years (19.9%) and 3–5 years (22.4%) create a well-rounded sample where most users (76.5%)

have long-term familiarity with the environment.

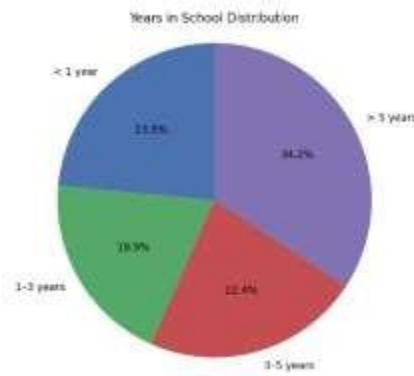


Figure 3: pie chart showing years in school distribution Source: Authors Analysis from Microsoft Excel.

Existing environmental performance and accessibility (Objective 1)

1. perceived accessibility of the school: The accessibility of the school is largely viewed as inadequate. A significant 49.5% rate the school as “Not accessible,” while 41.8% say it is “Partially accessible,” meaning that a total of over 90% of respondents perceive major accessibility shortcomings. Only 8.7% consider it “Fully accessible.” This clearly indicates that the school does not meet inclusive accessibility standards and requires major improvements.

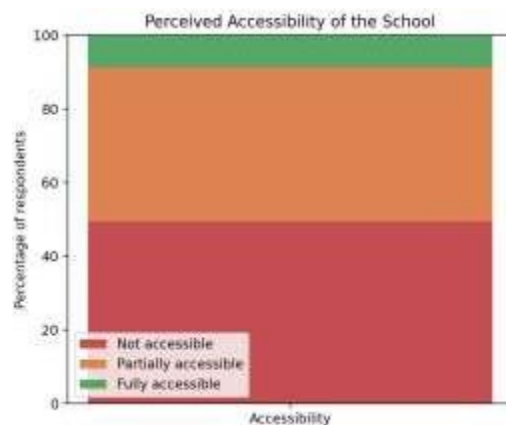


Figure 4: stacked bar chart showing perceived accessibility of the school Source: Authors Analysis from Microsoft Excel.

2. Ventilation and lighting quality: Ventilation and lighting show mixed performance. The majority of respondents cluster around moderate satisfaction, with 36.7% rating conditions as “Average.” Positive responses total about 43% (with 24.5% “Good” and 18.4% “Excellent”), but a notable 20% report dissatisfaction (12.2% “Poor” and 8.2% “Very Poor”). This suggests

that while many find conditions acceptable, the environmental quality is inconsistent and still affects a considerable portion of users.

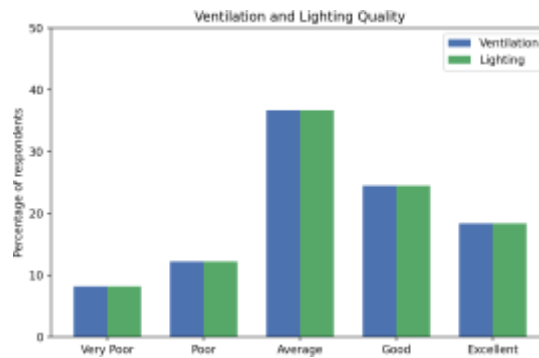


Figure 5: clustered bar chart showing ventilation and lighting quality Source: Authors Analysis from Microsoft Excel.

3. Availability of green spaces in the school: Green space availability is widely perceived as insufficient. A majority (52.0%) report “Some, but not enough” green areas, while 29.1% say there are “No, very limited” green spaces. Only 18.9% feel the school has “Adequate” greenery. Altogether, about 81% believe natural elements are lacking. This highlights the need for stronger biophilic integration such as trees, gardens, and outdoor learning areas.

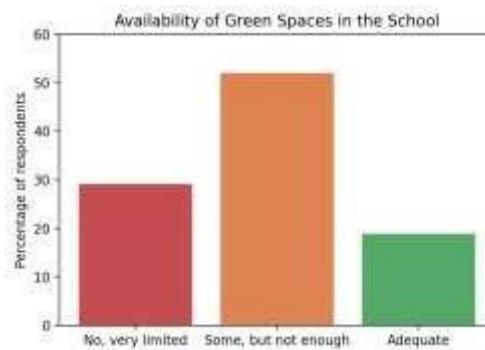


Figure 6: bar chart showing availability of green spaces in the school Source: Authors Analysis from Microsoft Excel.

4. Perceived impact of environmental factors on wellbeing/learning: Environmental factors like heat, noise, and air quality impact daily school experiences for most respondents. The most common response is “Sometimes” at 36.7%, followed by “Often” at 23.0%. When combined,

59.7% experience environmental disturbances at least sometimes or often. Only 10.7% report “Never” and 7.7% report “Always.” This shows that environmental performance is a regular concern for the majority.

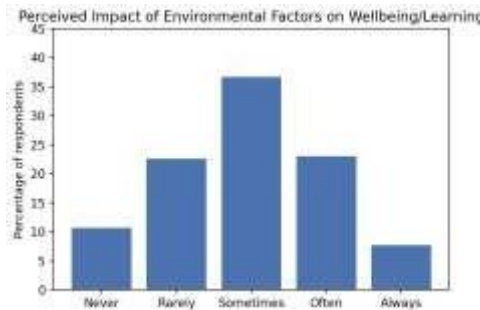


Figure 7: bar chart showing perceived impact of environmental factors on wellbeing/learning

Source: Authors Analysis from Microsoft Excel

3.1.1 Identifying biophilic design principles (Objective 2)

1. Importance of natural elements in the school environment

Most respondents value natural elements highly. **41.3%** rate them as “Important,” and 21.4% as “Very Important,” giving a combined 62.7% who strongly support nature in learning environments. 21.9% are neutral, while smaller portions consider natural elements unimportant (**9.2%** “Unimportant” and 6.1% “Very Unimportant”). This indicates strong user alignment with biophilic design principles.

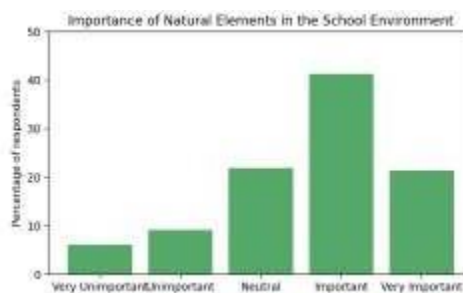


Figure 8: Bar chart showing importance of natural elements in the school environment

Source: Authors Analysis from Microsoft Excel.

3.1.2 Towards an integrated biophilic–inclusive framework (Objective 3)

Accessibility is severely lacking, with 91.3% of respondents reporting the school is not or only partially accessible. Environmental performance also falls short, as 20.4% rate

ventilation and lighting as poor, and 59.7% say environmental factors disrupt learning. Biophilic elements are insufficient, with 81.1% noting limited green spaces. Yet, 62.7% consider natural elements important, indicating strong support for nature-based improvements.

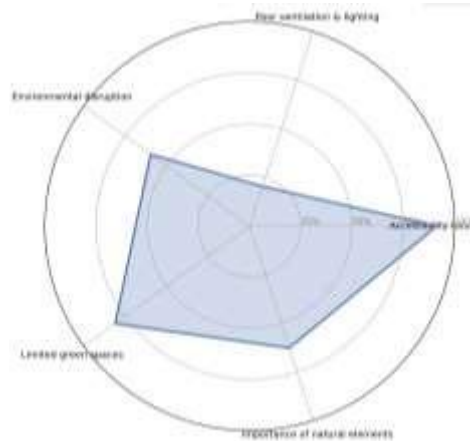


Figure 9: combined radar chart showing biophilic-inclusive framework Source: Authors Analysis from Microsoft Excel.

3.2 Inferential Statistics

3.2.0 Chi-square Tests analysis

1. Tenure in School and Perceived Green Space Adequacy: Chi-square test examined whether length of experience in the school influences perceptions of green space sufficiency. Respondents with over five years of tenure were more likely to report “Some, but not enough” or “No, very limited” green spaces (88%) compared to newer students (<1 year), who reported 72% in these categories. This indicates that longer-term users are more aware of biophilic deficiencies, possibly due to cumulative exposure to the environment.

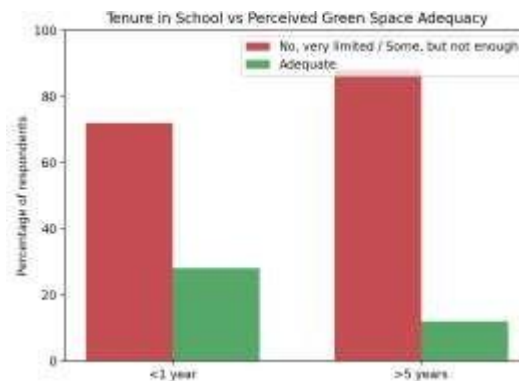


Figure 10: clustered bar chart showing tenure in school vs perceived green space adequacy Source: Authors Analysis from Microsoft Excel.

3.2.1 Correlation Analyses

1. Ventilation and Lighting vs Environmental Impact on Learning: A Spearman correlation was performed to explore the relationship between classroom ventilation/lighting ratings and reported impact on learning or wellbeing. The analysis revealed a moderate negative correlation ($r = -0.42$), meaning that as ventilation and lighting improve, the frequency of environmental disruptions decreases.

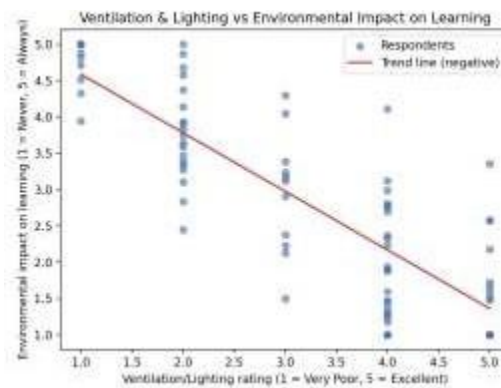


Figure 11: scatter plot showing ventilation and lighting vs environmental impact on learning.

Source: Authors Analysis from Microsoft Excel

2. Importance of Natural Elements vs Perceived Green Space Availability The second correlation analysis examined whether respondents who value natural elements highly also perceive the school as lacking sufficient greenery. A positive correlation ($r = 0.51$) was observed, indicating that those who consider natural elements “Important” or “Very Important” are more likely to report insufficient green spaces.

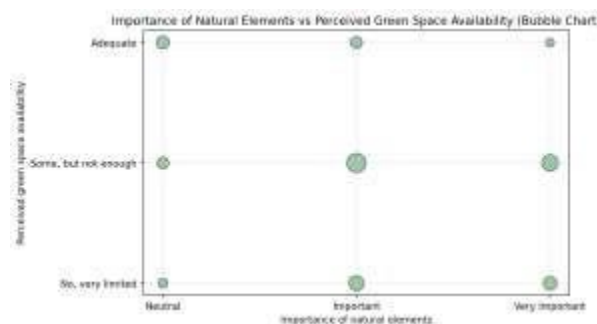


Figure 12: bubble chart showing importance of natural elements vs perceived green space availability

Source: Authors Analysis from Microsoft Excel

3.3 Analysis of Observational Findings

Table 1: Comparative Table of School Environmental Performance and Accessibility.

Observed Feature	Compliance / Adequacy	Comments / Notes
Ramps and circulation paths	Partially accessible (only main entrances)	Some ramps too steep; hallways narrow
Classrooms ventilation & lighting	Average	Natural light present in front classrooms; rear rooms darker
Toilets and sanitary facilities	Not accessible	No wheelchair-accessible stalls
Green spaces / courtyards	Limited	Small garden in front; no shaded outdoor learning areas
Signage and wayfinding	Poor	Lack of tactile or visual indicators for disabled users
Indoor plants / natural elements	Some	Sparse indoor plants, no integrated greenery

3.4 Summary of Findings

The study revealed that accessibility in the selected secondary school in Imota is critically insufficient, with 91.3% of respondents reporting the school as either not accessible or only partially accessible. Observational data confirmed these perceptions, showing that ramps and circulation paths are only partially compliant, toilets are not wheelchair-accessible, and signage or wayfinding is inadequate. Environmental performance also presents challenges; 20.4% of respondents rated ventilation and lighting as Poor or Very Poor, while 59.7% reported that environmental factors disrupt learning Sometimes or Often. This indicates that the school's indoor environment affects the wellbeing and concentration of a significant portion of students and staff. Biophilic elements were found to be lacking, with 81.1% of respondents indicating limited or insufficient green spaces, and observational data confirming sparse indoor plants and small, underutilized gardens. Despite these deficiencies, there is strong support for nature-based improvements, as 62.7% of respondents consider natural elements Important or Very Important. Chi-square analyses highlighted differences in perceptions across user roles and tenure, revealing that students and long-term users are more sensitive to accessibility and green space deficits. Correlation analyses further showed that better environmental quality is associated with reduced learning disruptions and that users who value natural elements perceive the current green infrastructure as inadequate. Collectively, these findings provide a clear evidence base for developing an integrated biophilic-inclusive architectural framework to improve accessibility, environmental

performance, and the incorporation of natural elements in the school environment.

4.0 Conclusion and Recommendations

4.1 CONCLUSION

The research demonstrates that the existing secondary school environment in Imota falls significantly short of inclusive, sustainable standards. Accessibility barriers, such as inadequate ramps, narrow circulation paths, and inaccessible toilets, limit mobility and inclusion for disabled students. Environmental quality issues, including suboptimal ventilation and lighting, affect learning and wellbeing for a majority of respondents, while biophilic features are minimal and underdeveloped. Observational data and inferential analyses reinforce these patterns, showing that long-term users and students perceive the deficits most acutely. At the same time, there is strong interest in integrating natural elements, suggesting that biophilic design could enhance both cognitive and emotional wellbeing. Overall, the study emphasizes the urgent need for an integrated architectural approach that combines inclusive design principles with biophilic strategies to create sustainable, accessible, and supportive learning environments. Implementing such a framework can improve student engagement, comfort, and health, while fostering a more harmonious relationship between the school environment and its users.

4.2 RECOMMENDATIONS

Based on the findings, it is recommended that the school prioritize accessibility improvements by installing ramps, widening circulation paths, and providing wheelchair-accessible toilets, alongside clear and inclusive signage to guide all users effectively. Environmental quality should be enhanced through improved ventilation, natural lighting, shading, and passive design strategies to reduce disruptions to learning and wellbeing. The integration of biophilic elements is crucial, including the expansion of green spaces, creation of courtyards, addition of indoor plants, and development of outdoor learning areas that support cognitive and emotional health. Furthermore, an inclusive planning approach should be adopted, engaging students, teachers, and administrative staff in ongoing evaluations to ensure that implemented interventions meet real user needs. Regular monitoring and assessment of environmental and accessibility improvements are recommended to track effectiveness, inform adjustments, and sustain a supportive learning environment over time.

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