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Research Paper

Assessment of Biophlic Design Impacts on Students' Comfort in Ibadan Public Secondary Schools, Southwest, Nigeria

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ABSTRACT
In today's rapidly urbanizing world, learning spaces are crucial in determining how comfortable students are. This study assesses the impact of biophilic design on students' comfort in public secondary schools in Ibadan, Nigeria. By incorporating natural components into the architectural environment, including waterbodies, plants, and natural ventilation, biophilic design strengthens the bond between students and the natural world. Two urban local government areas, Ibadan North and Ibadan South West, known for having a high concentration of public schools, were chosen using a multistage sampling technique. Field observations and structured questionnaires were given only to JSS3 (junior secondary school) and SSS3 (senior secondary school) students to gather data. According to the findings, biophilic classrooms greatly improve students' mental health, lower stress levels, and sharpen their academic attention. Ibadan South West has the highest biophilic features, with air being the highest biophilic element (100%) and water bodies being the lowest (16.7%) across all the schools selected. The impact of biophilic design on student comfort was rated very high, with a mean weighted value of 4.24 in Ibadan South West and 4.16 in Ibadan North. This research highlights how important it is to include biophilic design techniques in the learning environment.

Keywords: *Biophilic Design, Students' Comfort, Public Secondary Schools, Environmental Psychology, Sustainable Development, Educational Architecture.*

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I. Introduction

The rapid development and urbanization of many cities in the world has distanced many people from nature and natural processes that used to be a central part of human activity (Viliunas and Grazuleviciute-Vileniske, 2022) and is characterized by discomfort for people. Over the course of human history, mankind has developed methods of adapting to nature. However, this process started to slow down after the industrial revolution, when the inhabitants of cities were isolated from the natural environment, and the prevailing design approach encouraged the modern urban environment to undergo massive alteration and degradation of natural systems. Thus, growing human disconnection from nature has led to increased energy use, the use of non-renewable resources, biodiversity loss, chemical pollution, climate change, and human alienation (Pitizen, 2019) and 90% of human time is spent within built environments. However, by 2030, 60% of the world will be urbanized, thereby further dissociating humans from nature (Kayihan, 2018). While this scenario is distressing for all people, it is particularly harmful to children in the urban centres in their developmental years and it is imperative to re-evaluate how to preserve the bond between urban residents and nature (Kayihan, 2018).

Hence, it becomes essential to evaluate the role of nature and its importance for society, including secondary schools. A new educational space design represents a powerful and required tool for stimulating creativity and increasing concentration, comfort, motivation, and assimilation of knowledge for future generations as a method that works with perspective ideas and readings doted by high positive human sensitivity. Thus, there has been more recent interest from theorists and architects in discovering approaches to reconnecting the constructed environment with natural components. One of the most current theories of re-communication and its use in architecture is called "biophilia" (Kayihan, 2018).

Biophilic design is a design concept that connects humans and the natural world within built environments and communities (Richardson and Butler, 2022). It is the practice of incorporating nature, natural materials, and concepts into human-made environments, creating a closer connection with nature and the surrounding environment. The word "biophilia" can be broken down into two ancient Greek words: "bio," which translates to nature, and "philia," which translates to love, pointing to the love of life or living systems (Kellert, 2018).

Existing research extensively documents the positive impacts of biophilic design on various settings, particularly its influence on comfort and well-being. For example, Terblanche and Khumalo (2024) discussed the effects of biophilic design in university study areas on students' productivity, emphasizing the positive impact on comfort; however, there is currently a significant gap on comprehensive information regarding the impacts of biophilic design on students' comfort generally and in the public secondary schools in Ibadan, the capital of Oyo State, Nigeria. In Ibadan's unique socio-cultural and climatic context, the specific impact of biophilic elements on students' comfort in public secondary schools remains largely unexplored. Therefore, there is a pressing need for localized research to determine if the impacts of biophilic elements in these schools lead to measurable improvements in academic achievements, concentration levels, and overall student well-being as well as comfort which is one of the preoccupations of this study. Ibadan is selected for the study because it is one of the fastest growing cities in Africa and is capable of showing the characteristics of the region in which it is located.

Conceptualization and Review of the Literature

In the modern era, urbanization has significantly impacted the comfort of city inhabitants, prompting scholars like Kayihan (2018) and Pitizen (2019) to explore its psychological effects and the need to reconnect with nature. Biophilic design has emerged in response, integrating natural elements into built environments to enhance occupant well-being. Rooted in the concept of biophilia the innate human affinity for nature biophilic design improves comfort through elements such as natural lighting, greenery, and ventilation (Kellert, 2018; Ryan and Browning, 2020). Empirical studies support its benefits: Yin et al. (2018) found that natural light and vegetation improve students' concentration and mood, while Determan et al. (2019) reported positive impacts on comfort and mental health in educational settings. Despite its proven advantages, the application of biophilic design in Nigerian public secondary schools remains limited. In rapidly urbanizing cities like Ibadan, where natural elements are often overlooked in school design, its integration presents a valuable opportunity. Owoseni, Ibem, and Opoko (2021) emphasized the role of green spaces, natural light, and ventilation in creating supportive learning environments. Beyond aesthetics, biophilic design also offers functional benefits. Obasi (2019) noted its potential to reduce energy consumption through natural light and airflow, while Ibara (2018) highlighted its calming effects through greenery and water features

However, the absence of comprehensive studies on biophilic design in Nigerian secondary schools creates a significant research gap. Addressing this gap is essential for understanding how biophilic design can be effectively implemented to enhance students' comfort and well-being. By contextualizing insight from Ibadan's unique socio-cultural and climatic environment, this study aims to explore the transformative potential of biophilic design in public secondary schools, providing a foundation for its integration in future educational projects.

II. Materials and Methods

Study Area

The study was conducted in Ibadan, the capital of Oyo State in southwestern Nigeria. With a population of 3.5 to 4 million, it is the third-largest city in the country (Adedeji, 2016) and is predominantly inhabited by the Yoruba people. Ibadan has a tropical wet and dry climate, with rains from March to October and dry seasons from November to February. Temperatures range from 22°C during the rainy season to 35°C in hotter months, with Harmattan winds in December and January (Wahab and Ola, 2018). Located about 120 kilometers northeast of Lagos, the city lies among hills and valleys, traversed by rivers such as the Ogunpa. Its urban landscape features a mix of colonial, traditional, and modern architecture, alongside green spaces. Ibadan remains an important economic center, with agriculture, trade, and services driving its growth.

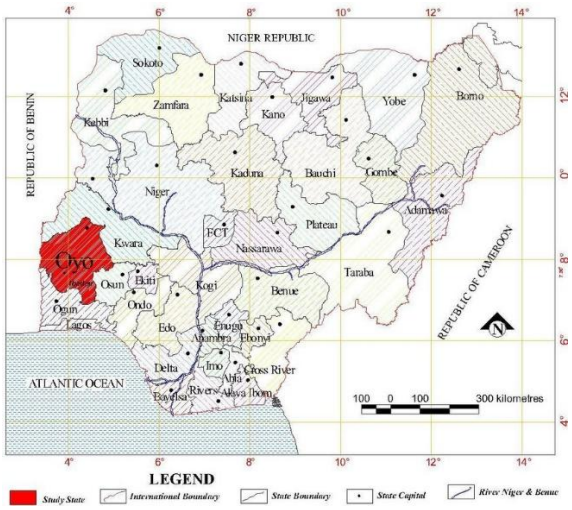

Figure 1: Oyo State within the Context of Nigeria
Source: Ministry of Lands and Survey, Ibadan, Oyo State (2018)

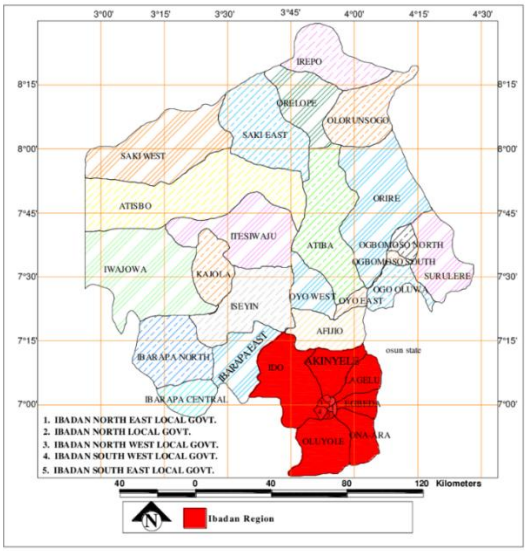

Figure 2: Ibadan Region within the Context of Oyo State
Source: Ministry of Lands and Survey, Ibadan, Oyo State (2018)

All students in the public secondary schools in Ibadan constituted the sample frame for the study (see Table 1). Multistage sampling technique was adopted and both primary and secondary data were utilized. According to Okanlawon (2018) and Oladimeji (2023), the technique of multistage sampling involves the division of the population of a study into groups and sub-groups, while the selection of the sample is based on their location characteristics and not necessarily on their social characteristics.

Thus, the first stage was the purposive selection of Ibadan because it is a traditional city, and one of the fastest growing cities in Nigeria which is capable of exhibiting the characteristics of the region in which it is domiciled. However, the second stage was the identification of all the local government areas in Ibadan and field survey carried out shows them to be eleven (11) (see Table 1). The local government areas are Ibadan North; Ibadan North East; Ibadan South East; Ibadan South West; Ibadan North West; Akinyele; Egbeda; Lagelu; Oluyole; Ona Ara and Ido.

However, the third stage was the identification of the public secondary schools in each local government and these are shown in 1. In the fourth stage, schools used for the study were selected and purposive sampling technique was used to select all the public secondary schools with biophilic features (Table 2). Similarly, stage five was the selection of the sample size and only students in Junior Secondary School (JSS) 3 and Senior Secondary School (SSS) 3 were purposively used for the study. The two groups were selected because they are in the exam year and read a lot and hence, they are in the best position to know the impacts of biophilic design on students' comfort. A total number of 4089 students were found in the exam class according to the field survey carried out.

Table 1: Public Secondary Schools in Ibadan

S/N	Local Government Area	Schools
1	Ibadan North (42)	Abadina College U.I Ibadan, Abadina Grammar School Ibadan, Anglican Commercial Grammar School Total Garden, Anglican Commercial Grammar School Orita Mefa Ibadan , IMG Grammar School Yemetu Aladorin Ibadan, Basorun/Ojoo High School, Chesire High School Ijokodo, Community High School Agbowo Bodija, Community Grammar School Mokola, Humani Alaga High School Sango, Community Secondary School Sango, Ijokodo High School Ijokodo, Ikolaba Grammar School Ikolaba, Community Secondary School Ikolaba, IMG Grammar School Oje Igosun, Ikolaba High School Ikolaba, Immanuel College High School Orita U.I, Immanuel Grammar School Orita U.I, Community High School Samonda, Islamic High School Bashorun, Methodist Grammar School Bodija, Methodist Grammar School Bodija (Junior), Methodist Secondary School New Bodija, Mount Olivet Grammar School Bodija, Nawar-Ul-Deen High School Nalende, Oba Akinbiyi High School 1 Mokola Cultural Centre, Oba Akinbiyi High School I Mokola - Oremeji, Oba Akinyele Memorial High School Basorun, Polytechnic High School Polytechnic Campus, St. Gabriel Secondary Commercial Grammar School Sabo Ibadan, St. Gabriel Commercial Grammar Junior School Sabo Ibadan, St. Brigid's Secondary School Mokola, St. Louis Grammar School Mokola, St. Louis Grammar School Mokola (Junior), St. Patrick Grammar School Orita Basorun, United Secondary School Ijokodo, Community Grammar School Ijokodo, Bishop Onabanjo High School Bodija, Ebenezer Grammar School Nalende, Islamic Day Secondary School Basorun.
2	Ibadan North East (34)	IMG Grammar School Gbelekale, Ayekale Community Grammar School Agugu, Army Barracks Grammar School Iwo Road, Community Grammar School Iwo Road, Christ The King Secondary School Oluoro, Fazil-Omar-Ahmadiyya (F.O.A.) Grammar School Ajibola Are, Holy Trinity Grammar School Off Old Ife Road, Islamic Mission Grammar School Agugu, Basorun High School Basorun, Basorun High School Basorun (Junior), Lagelu Grammar School Agugu, Agugu High School Agugu, Hisibu Lahi-Algalib (HLA) Secondary School Agodi Gate, IMG High School (Along Renascent High School Road), Loyola College Old Ife Road Ibadan, Loyola Junior College Old Ife Road Ibadan, IMG Grammar School Agodi, Mufu Lanihun Comprehensive High School Express Road, Mufu Lanihun Comprehensive High School Express Road (Junior), Okebadan High School Oluyoro, Olubadan High School Aperin, Olubadan High School Aperin (Junior), Olubadan Grammar School Orita Aperin, Ode Aje/Ajibola High School, Queens of Apostles Secondary Commercial Grammar School Oluyoro, St. Claires Girls High School, Oluyoro Girls Secondary School, Ratibi College Oluyoro Oke-Offa, Renascent High School Agugu, Renascent High School Agugu (Junior), St. John's Secondary School Ode-Aje, United High School Agugu, United High School Agugu (Junior), Community Secondary School Agugu.
3	Ibadan South East (37)	Adekile Goodwill Grammar School Aperin, Adekile Goodwill Grammar School Aperin (Junior), Adelagun Memo Grammar School Odinjo, Adelagun Memo Grammar School Odinjo (Junior), Christ Church High School Orita-Aperin, Anglican Grammar School Molete, Aperin Boys High School, Aperin Oniyere Community Grammar School, IMG Grammar School (Mixed), Eleta High School, Eleta High School (Junior), Eyinni High School, Eyinni High School (Junior), Community Grammar School Eyinni Area, Ibadan CAC Grammar School, Ibadan CAC High School, Ibadan City Academy I, Ibadan City Junior Academy, Ibadan Grammar School, Ibadan Grammar School (Junior), Community Grammar School Kudeti, Nuru Islamiyya Grammar School, Methodist Grammar School Elekuro, Methodist Grammar School Elekuro (Junior), Olubi Memorial Grammar School, St. Anne's School Ibadan, St. Anne's School Ibadan (Junior), St. Anne's Girls High School Molete, St. David's Grammar School Kudeti, Ori-Aje Community Secondary School Kudeti, St. Luke's College Molete, St. Luke's Grammar School, St. Luke's Grammar School (Junior), Wesley College Of Science, Yejide Girls Grammar School, Yejide Girls Grammar School (Junior), Government Secondary School Orita Aperin, Government Secondary School I Orita Aperin (Junior I), Government Secondary School II Orita Aperin (Junior II).
4	Ibadan South West (38)	Adifase High School Apata, IMG High School Apata, African Church Grammar School Apata, African Church Grammar School Apata , Apata Community Grammar School Apata, Apata Grammar School Logudu, Ansar-U-Deen (AUD) High School Oke Ado, Ansar-Deen Secondary School Oke-Ado, Baptist Grammar School Idi-Isin, Baptist Secondary School Oke-Ado, Baptist Secondary Grammar School Oke-Ado, Basorun Ogunmola High School Ring Road, Celestial Church High School Oke-Ado, Community Grammar School Elewura, Government College Apata, Ibadan, Government College School Ibadan, IMG Grammar School Sharp Corner, Odo Ona Girls Grammar School, Oke Ado High School Oke-Ado, Oke Bola Comprehensive High School, Oluyole Estate Grammar School Ring Road, Oluyole Extension High School, Oluyole High School Ring Road, Our Lady Of Apostles Odo-Ona, Our Lady Of Apostles School Odo-Ona, Ibadan Boys High School, People Girls Grammar School, Queen's School Ibadan, Queen's School Ibadan ,St. Teresa's College Oke Ado, St. Teresa's College Oke Ado (Junior), Urban Day Grammar School Ring Road, Oladipo Alayande School of Science, Community Grammar School Gbekuba, Community Grammar School Ring Road.
5	Ibadan North West (13)	Anwar-Ul-Islam Grammar School, Elevele High School Polo Ground, Army Day Grammar School Letmuck Barrack, Eleyele, Urban Day High School Jericho, Oba Abass Alesinloye Grammar School Eleyele, Eleyele Secondary School, Community High School Adamasingba, Sacred Heart Secondary School Ode Olo, Onireke Girls High School, Jericho High School, Ansar-Ud-Deen High School Sango-Eleyele Road, Army Barracks Grammar School Letmuck Barracks Eleyele, Community Secondary School Olopomewa.
6	Akinyele (35)	Ajibode Grammar School, Community High School, Anglican Grammar School, Atapa Community High School, Laleye Community High School, Aponmode/Moniya High School, Aponmode/Moniya Community Secondary School, Community High School, Community Grammar School, Army Day Secondary School, Community Grammar School, Community High School, Ijaye High School, Ikereku Community Grammar School, Iroko Community Grammar School, Community Secondary School, Community Secondary School, Community High School, Ojoo High School, Community High School, Orogun Grammar School, Community Grammar School, Community High School, Community High School, School of Science, Community Grammar School, Sasa Community Secondary School (Junior), Community Grammar School, Community

		High School, Samuel Adegbite Memorial Grammar School, Community High School, Iware United Community High School, Community High School, Community Grammar School.
7	Egbeda (30)	Bishop Phillip Academy, Bishop Phillips Academy (Junior), Bishop Phillips High School, Community High School Alakia/Isebo, Community High School Alakia Isebo (Junior), Ilupeju Community Grammar School, Alogbo, Community Commercial High School Ayede, Community High School Egbeda, Community High School Kasunmu, Community High School Kumapayi, Community Secondary School Kumapayi, Community High School Ogungbade, Community High Secondary School Ogungbade In. 2, Community Grammar School Olodo, Community Grammar School Olodo (Junior), Community High School Osegere, Community High School Owobaale, Idito High School Erunmu, Community Grammar School Erunmu, Urban Day Grammar School Old Ife Road, Urban Day Grammar School Old Ife Road (Junior), Community Grammar School Old Ife Road, Community High School Alarere, Community Secondary School Adegbayi, Community Secondary School Olde, Community High School Ajagba Wakajaiye, Community High School Alalubosa, Community Grammar School Olodo Akinlumo, Christ Anglican Secondary School Akinfenwa, Community High School Olukeye/Asejire.
8	Lagelu (26)	Anglican Grammar School Oyedeji, Anglican Grammar School Kutayi, Community Grammar School Apatere, Community Grammar School Abudoro, Community Grammar School Adetunji/Owode, Community Grammar School Alapata/Onireke, Community Grammar School Ajara, Community Grammar School Alegongo, Community Grammar School Olosunde, Community Grammar School Ogunjana, Community Grammar School Ofa-Adedokun, Community Grammar School Lagun, Community Grammar School Ejioku, Community Grammar School Lalupon, Estate High School Akobo, Estate High School Akobo (Junior), Igbo Elerin Grammar School, Isabatudeen Girls Grammar School Basorun, Isabatudeen Girls High School, Monatan High School Wofun, Monatan High School Wofun (Junior), Monatan Secondary School, Ifesowapo Community High School Kute, N.O. Idowu Comprehensive High School, T.L. Oyesina Model High School Monatan, T.L. Oyesina Model High School Monatan (Junior).
9	Oluyole (27)	Abe Technical Secondary School, Alaho Community Grammar School Alaho, Bare Community Grammar School, Community Grammar School Aba Alfa, Olunde Community Secondary School, Community Secondary School Pegba, Community Secondary School Onipe, Christ High School Oleyo, Ifesowapo Comprehensive Secondary School Onigambari, Methodist High School Express, Molete High School, Moslem High School, Moslem Junior High School Oke-Ogbere, Moslem Secondary School Odinjo, Moslem Junior Grammar School Odinjo, Olojuoro Grammar School, Olomi Community Secondary School, Prospect High School Abanla, Community Grammar School Agbamu, Community Secondary School Ataga, Community Secondary School Ayegun, Ifelodun Secondary School, Liberty Commercial Academy, Oyalami Community Secondary School, Community High School Olomi-Olunde, Community High School Olomi-Olunde (Junior), Community High School Odokun Akorde Via Arapaja Village.
10	Ona Ara (33)	Aja Secondary Grammar School, Anglican Grammar School Ojebode, Community Grammar School Akanran, Community Secondary School Araromi Aperin, Community Secondary School Badeku, Community Secondary School Gbedun, Elekuro High School Ogbere, Elekuro High School Ogbere (Junior), Abonde Community Grammar School Ibadan, Abonde Community Junior Grammar School, Community High School Sawia Ibadan, Community High School Sawia (Junior), Methodist Secondary School Gangansi, Ogbere Community High School Idi Osan, Ogbere High School Idi-Osan (Junior), Airport Community High School, Community Grammar School Airport, Olorunda/Ogunsola Community Grammar School, Zumrat Hujaj Community Grammar School Olorunsogo, Zumrat Hujaj Community Junior Grammar School Olorunsogo, Zumrat Hujaj Community Secondary School, Zumrat Hujaj Community Junior Secondary School, Oke Ogbere Community High School, Oke Ogbere Community Junior High School Olorunsogo, Community Grammar School Amuloko, Itesiweaju Community High School, Itesiwaju Commercial Junior High School, Community Grammar School Gbedeogun, Bioku Alaadun Community High School, Bioku Alaadun Commercial Junior High School, Community Secondary School Alaadun Area, Community Secondary School Alaadun (Junior), Jago-Kupalo Community High School Jago.
11	Ido (21)	Akufo High School Akufo, Apete Ayegun Community Grammar School, Awotan/Araromi Community High School Awotan, Community High School Arola, Community Secondary School Awotan Orisun, St. Michael African Church Grammar School Owode, St. Michael African Church Grammar School Owode (Junior), Community High School Batake Idi-Iva, Community High School Elenu Sonso, Community High School Elesin Funfun, Community High School Bakatari, Leo Community High School Oloko/Elere, Community High School Ologuneru, Community High School Ologuneru (Junior), Owode Estate Community High School Bode Igbo, Community High School Kusenla/Erinwusi, Community High School Ogundele Alaho, Community High School Ido, United Christ Secondary School Omi Adio, St. John's Secondary School Omi Onigbagbo, Iwajowa Community High School

Source: Author's Compilation (2024)

Using Solving formula at 95% confidence level and a 0.05 margin of error, a sample size of 364 students was selected for questionnaire administration.

Table 2: Secondary Schools with Biophilic Design

Urban LGAs	Selected Schools	Populations		Total	Sample Size (8.9%)
		Jss3	Sss3		
Ibadan North	Abadina College U.I Ibadan,	157	214	371	34
	IMG Grammar School Yemetu Aladorin	243	348	591	53
	Ikolaba Grammar School Ikolaba,	143	178	321	29
	Immanuel College High School Orita U.I,	289	378	667	59
	Methodist Grammar School Bodija	182	247	429	38
Ibadan South-West	Government College, Apata,Ibadan.	198	176	374	32
	Oke Bola Comprehensive High School	156	170	326	29
	Ibadan Boys High School	145	160	305	27
	Our Lady Of Apostles	167	148	315	28
	St. Teresa's College Oke Ado	185	205	390	35
Total	**10**	**1,865**	**2,224**	**4,089**	**364**

Source: **Author's Compilation (2024)**

Results and Discussion

(i) Socioeconomic Characteristics of Respondents

Only gender and age of students were measured in the study because they are considered pertinent to the study. Thus The data in Tables 3 and 4 present the gender and age of respondents. Female respondents account for 46.2%, while male was 53.8%. For age distribution, 48.9% fall between 10 and 15 years, 48.1% between 16 and 20 years, and 3.0% between 21 and 25 years. There was no response from any respondent above 25 years. This shows a notable gender disparity, with some schools having a higher proportion of female students. In terms of age, the majority fall within the 10 and 15 years group, with a smaller percentage between 16 and 20 years. The absence of respondents above 25 confirms the study's focus on the secondary school population.

Table 3: Gender Distribution of Respondents

S/N	Variable (Gender)	Frequency (N)	Percentage (%)
	Male	196	53.8
	Female	168	46.2
	Total	**364**	**100.0**

Source: Author's Field Survey (2024)

Table 4: Age Distribution of Respondents

S/N	Age(Years)	Frequency (N)	Percentage (%)
	10 - 15 years	178	48.9
	16 - 20 years	180	49.5
	21 - 25 years	11	3.0
	Above 25 years	0	0.0
	Total	**364**	**100.0**

Source: Author's Field Survey (2024)

(ii) Available Biophilic Elements in the Public Secondary Schools in Ibadan

Table 5 presents respondents' perceptions of biophilic elements in selected schools across Ibadan North and Ibadan South-West. Plants were the most common feature, reported by 75.1% in Ibadan North and 89.4% in Ibadan South-West. Natural light was also widely available, with 82.0% and 92.7% respectively, indicating well-lit environments. Open spaces and outdoor gardens were more prevalent in Ibadan South-West (56.3% and 59.6%) compared to Ibadan North (35.2% and 37.6%). Animal presence was noted by 39.9% in Ibadan North and 44.4% in Ibadan South-West. Less common elements included rocks (20.7% in Ibadan North; 49.7% in Ibadan South-West), hills (10.3% and 22.3%), and water bodies (7.0% and 9.7%). Air was universally acknowledged (100% in both areas). Overall, Ibadan South West schools reported greater availability and diversity of biophilic features, suggesting a more enriching natural environment that can enhance students' comfort, environmental connection, and mental wellbeing. While plant life and natural light are abundant, the limited presence of water bodies and varied terrain may restrict exposure to diverse natural settings, which could affect environmental learning opportunities.

Table 5: Biophilic Elements in the Study Area

S/N	Natural Features	Study Area				Total (Frequency)	
		Ibadan North		Ibadan South-West			
		N	%	N	%	N	%
i.	Plants	160	75.1	135	89.4	295	81.0
ii.	Outdoor Garden	80	37.6	90	59.6	170	46.7
iii.	Natural Light	175	82.2	140	92.7	315	86.5
iv.	Water Bodies	15	7.0	12	7.9	27	7.4
v.	Open Space	75	35.2	85	56.3	160	44.0
vi.	Rock	44	20.7	75	49.7	119	32.7
vii.	Animals	85	39.9	67	44.4	152	41.8
viii.	Hill	22	10.3	35	23.2	57	15.7
ix.	Air	213	100.0	151	100.0	364	100.0
x.	Others	0	0	0	0	0	0.0

Source: Author's Field Survey (2024)

(iii) Accessibility to Biophilic Elements by Students

Analysis shows that 28.8% of respondents reported "Not accessible" while 71.2% identified accessibility showing that the majority of the students' access to biophilic elements during school hour. The data shows a marginal difference in accessibility experiences, revealing that, while a significant portion finds green spaces accessible, there is still a considerable number of individuals who perceive these areas as restricted during school hours. Thus, it is recommended that there should be improvement in the accessibility of the biophilic elements

(iv) Impacts of Biophilic Elements on Students' Comfort in the Selected Public Secondary Schools IBESC (Impact of Biophilic Element on Students Comfort) Index

The study highlights how biophilic elements improve students' comfort in their learning environments. Using a Likert scale from "Very High" to "Not High at All," the analysis provides a clear view of students' perceptions. Mood improvement had the highest impact, with scores of 4.26 in Ibadan North and 4.41 in Ibadan South West. This suggests that natural elements, such as greenery and proper ventilation, help students feel more at ease and engaged in their learning spaces.

Visual delight, which measures the aesthetic appeal of nature, also received high ratings of 4.34 and 4.30. This emphasizes the importance of adding visually pleasing natural elements to schools. A well designed environment enhances the overall ambiance and makes learning spaces more enjoyable. The study also found that biophilic elements promote relaxation, with scores of 4.17 and 4.28. Exposure to nature in schools has a calming effect, reducing restlessness and improving focus. Stress reduction was slightly lower, with scores of 4.06 and 4.17. This suggests that while nature helps ease stress, its effectiveness may depend on factors like exposure time and how it is integrated into daily activities.

Cognitive restoration, which refers to improved mental clarity and focus, had the lowest impact scores at 3.95 and 4.02. This indicates that while nature offers some mental refreshment, its effects on cognitive function are not as strong as its influence on mood and relaxation.

Thus, the study confirms the positive impact of biophilic design in schools. The mean IBESC values of 4.24 and 4.16 reflect students' recognition of nature's benefits in their learning environments. By incorporating more natural elements, schools can create spaces that support students' comfort and well-being, which help in enhancing learning experiences.

Table 4.4: Perceived Impacts of Biophilic Elements on Students' Comfort

Variables	Ibadan North									Ibadan SouthWest								
	VH 5	H 4	I 3	NH 2	NHAA 1	NR (F)	SWV	IBESC	Rank	VH 5	H 4	I 3	NH 2	NHAA 1	NR (F)	SWV	IBESC	Rank
Relaxation	90	55	22	08	07	182	759	4.17	**3**	95	60	15	7	5	182	779	4.28	**3**
Visual Delight	98	58	18	05	03	182	789	4.34	**1**	100	55	14	7	6	182	782	4.30	**2**
Mood Improvement	95	56	20	06	05	182	776	4.26	**2**	110	50	12	6	4	182	802	4.41	**1**
Cognitive Restoration	80	51	26	12	13	182	719	3.95	**5**	82	55	22	13	10	182	732	4.02	**5**
Stress Reduction	85	53	24	10	10	182	739	4.06	**4**	90	57	18	9	8	182	758	4.17	**4**
Sum (Σ)								**20.78**									**21.18**	
	Mean = 20.78/5 = 4.16									**Mean = 21.18/5 = 4.24**								

III. Conclusion

This study assesses the transformative potential of biophilic design in improving student comfort. Findings demonstrate that incorporating biophilic elements such as natural light, ventilation, and greenery plays a crucial role in the learning environment. Schools that integrate these features report higher levels of relaxation, mood improvement, and cognitive function among students.

IV. Recommendation

Schools should integrate more biophilic elements, such as green spaces, water features, and natural ventilation, to enhance student comfort. Additionally, government authorities and educational stakeholders should enforce biophilic design standards in both the construction of new schools and the renovation of existing ones to create healthier learning environments. Furthermore, future research should examine the long term cognitive and health benefits of biophilic environments across different climate zones, providing deeper insights into their impact on students' comfort.

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