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ASSESSMENT OF USERS PERCEPTION OF ENVIRONMENTAL PERFORMANCE OF UNIVERSITY LIBRARY BUILDINGS IN NIGERIA

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ABSTRACT

The Indoor environmental quality of any building can directly affect the wellbeing of the users of the building. The university libraries being a public space designed for learning purposes, must meet important specific indoor criteria such as lighting, acoustics and etc in order to enhance students' academic performance. The aim of this is to examine elements in the indoor environmental condition of university libraries that could enhance user's educational learning. The objective is to identify and address the potential issues and the challenges encountered by the library use's that could discourage them from using the library. A survey methodology and the use of questionnaire was adopted to collect data from library users in three (3) universities in the study location (n=484). The response rate recorded 84% having overall reliability test of 0.87. Findings indicate that the respondents agreed that the indoor environmental condition were satisfactory. However further findings suggests that as the environmental condition improves, the users were more inclined to the use of the library. The study concludes that there is need to improve the indoor environmental condition of the library. This would encourage more attention of the library users to harness the library for their educational learning and consequently boost their academic performance.

Keywords: *environmental performance, library buildings, users perception, Nigeria.*

INTRODUCTION

In recent times, there has been a growing recognition of the impact that indoor environmental quality can have on the productivity and well-being of building occupants (Steinemann et al., 2017). Numerous studies have demonstrated a significant correlation between the quality of the indoor environment and the effectiveness of users in different types of buildings (Sadrizadeh et al., 2022; Woo et al., 2021). The importance of creating comfortable, healthy indoor spaces where people can thrive mentally, physically, and intellectually has been highlighted by these studies. The majority of early research on indoor air quality-related health problems and symptoms in humans (Al-Horr et al., 2016) raised concerns about the indoor environmental conditions in university library facilities.

Because university libraries provide staff and students with a space for research, study, and learning, it is crucial to comprehend user well-being in these settings (Kutsyuruba et al., 2015). Ensuring that these library environments enhance the welfare of patrons is imperative. Indoor environmental quality is defined by Geng et al. (2019) as the combination of various elements such as air quality, thermal comfort, lighting, acoustics, and visual comfort. Research on the indoor environmental quality of university library facilities has mostly focused on evaluating these elements and how they impact users' well-being. The lack of comprehensive research specifically focused on the interior environment quality (IEQ) of university library buildings hinders the capacity of facility managers, architects, and university administrators to effectively address and enhance the interior environment within these spaces.

The limited research on the assessment of IEQ in university library buildings and the inadequate comprehension of the implications of IEQ on users' well-being present a dual problem dynamic that is crucial to the ability of university library buildings to support students' academic endeavors. This study's aim is to assess the users need and indoor environmental quality (IEQ) in university library facilities and look into how it affects user's wellbeing which is to assess the current indoor environment quality (IEQ) parameters in university library buildings. The objectives are (i) To determine the users' requirement in contemporary academic 21th century library buildings? (ii) To evaluate the indoor environmental quality (IEQ) in university library buildings affect users' well-being. (iii) To determine users perception of environmental performance of university library buildings

LITERATURE REVIEW

Numerous studies have evaluated how university library buildings are perceived for their environmental performance. According to one study, management and librarians place more emphasis on space planning and budgets than on energy, water, and recycling usage (Jankowska & Marcum 2010). According to a different study, students' study habits and academic achievement are highly influenced by elements including staff responsiveness, resources availability, cleanliness, and comfortable lighting (Pagalilauan *et al.*, 2023). Furthermore, a study carried out in South East Nigeria discovered that most university buildings' environmental concerns and functionality were inadequate, which left staff and students unhappy Okongwu, (2021). In addition, an energy audit carried out in a university library found ways to maximise electricity use and lower carbon dioxide emissions. Lastly, research conducted in nonprofit buildings, such as libraries, revealed that raising the indoor environment can raise occupant performance and satisfaction (Zhang, 2019).

Users' opinions of university library buildings are greatly influenced by their environmental performance. The indoor environmental quality (IEQ) of libraries has a significant impact on users' comfort and productivity (Zhang, 2019). A conducive atmosphere for users is largely dependent on variables like daylighting, acoustics, and temperature. Users' experiences may be adversely affected by unsatisfactory IEQ parameters, such as high indoor air temperature, relative humidity, CO2 levels, noise levels, and low light intensity (Amoatey *et al.*, 2023). However, users' learning experiences and satisfaction can be improved by a well-designed library space that offers physical comfort and flexibility (Peng *et al.*, 2022). In order to create an environment that fosters positive user perceptions and encourages library use, it is crucial to take into account thermal comfort, the acoustic environment, and user preferences when designing and renovating library spaces (Aflaki *et al.*, 2023)

Numerous factors affect how users perceive the environmental performance of university library buildings. These elements include the library's arrangement and structural design, the calibre of the acoustic setting, the availability of roomy and comfortable study areas, the existence of user distractions, and the library's capacity to meet a variety of study needs over the course of the semester. Consumers also take into account how environmentally friendly and sustainable the library's management techniques are. Users' opinions of the environmental performance are also influenced by how satisfied they are with the services provided by the library and how much of a disconnect there seems to be between expectations and reality. Furthermore, users' opinions of how well library facilities perform are influenced by their input and experiences with the built environment (Aflaki *et al.*, 2023)

The topic of evaluating the impact of indoor environmental quality (IEQ) on users' well-being in university library buildings has several significant implications. First, by evaluating the IEQ parameters in these buildings, this study will help create a more conducive and healthy learning environment, which will promote the well-being of students and other library users even more. Secondly, since the indoor environment is particularly important in supporting students' academic endeavours, policymakers and practitioners will find the implications of this study significant. The study will add to the body of knowledge and be useful to researchers, architects, facility managers, and administrators about how IEQ impacts users' well-being. It will yield valuable insights that can be applied to create evidence-based strategies and interventions that improve IEQ and benefit the academic community at large. Academic libraries are unique since their establishment is determined by the institution (Table 1).

Table 1: Historical Overview of Academic Libraries

Name of Library/institution	Year	City	Country
Trinity Hall	1590	Cambridge	United Kingdom
Queens College	Mid-17th Century	Cambridge	United Kingdom
University Library Leiden	1694	Leiden	Netherland
The Wren Library, Trinity College	1695	Cambridge	United Kingdom
Bibloteca, Joanina	1728	Coimbra	Portugal
Codrington Library	1751	Oxford	United Kingdom
The Radcliffe Camera	1751	Oxford	United Kingdom
Yale University Library	1766	New Haven	Yale, USA
Windsor, Nova Scotia	1789	Nova Scotia	Canada
Cambridge University Library	1842	Cambridge	United Kingdom
The Fisher Fine Arts Library	1891	Philadelphia	USA
The Beinecke Library	1963	New Haven	Yale, USA
Information, Communications and Media Center	2004	BTU Coutbus	Germany
Utrecht University Library	2004	Utrecht	Netherland
The Grimm Center, Humboldt University	2009	Berlin	Germany

Source: Campbell & Pryce (2013)

Kapoor et al., (2021) posited that natural light, suitable temperature and humidity levels, and low noise levels all support a healthier indoor environment, which lowers the risk of health issues and improves users' general well-being. Architectural concerns for university libraries encompass a range of design and planning factors with respect to evaluating indoor environmental quality (IEQ) and its impact on users' well-being (Kim, 2020). These elements are meant to create a cosy and healthful indoor environment for library buildings. Some major architectural issues with this framework are as follows:

- Space Planning: To improve the distribution and layout of various regions, effective space planning is essential in university libraries (Ezzell *et al.,* 2003). To suit various user needs, adequate space distribution for study areas, collaboration spaces, silent zones, and resource sections should be taken into account (Tyrväinen *et al.,* 2007).
- Natural Light and Views: For the benefit of users, university libraries must be designed with lots of windows and natural light (Balocco & Volante, 2019). According to Jamrozik et al. (2019), access to daylight and views of the outdoors have been connected to higher levels of happiness, productivity, and overall satisfaction. The positioning of windows, skylights, and atriums should be taken into account by architects in order to maximise natural light penetration and give people linkages to the surrounding environment.
- Indoor Air Quality: It is crucial to address indoor air quality if we want library patrons to be healthy. Pollutant management, proper air filtration, and ventilation systems are important factors to take into account (Pourkiaei & Romain, 2023). In order to limit the presence of allergens, pollutants, and volatile organic compounds (VOCs) in the indoor environment, architects should design HVAC systems that ensure enough fresh air exchange rates, regulate temperature and humidity levels, and control these factors (Nimlyat et al., 2023).
- Acoustics: In order to create a calm and productive study atmosphere, noise control in university libraries is essential. To lessen noise reverberation, architects could use sound-absorbing materials such acoustic ceiling panels and wall treatments (Kim et al., 2020). Further enhancing acoustic comfort and accommodating varied user preferences is possible by designing distinct zones for various noise levels, such as quiet study areas and collaborative spaces (Zamin et al., 2021).
- Ergonomics and Comfort: It is crucial to take user comfort and ergonomics into account when choosing furniture and seating layouts. Longer durations of study without discomfort or weariness are encouraged by the availability of ergonomic seats, adjustable desks, and pleasant seating options (Jabeen et al., 2023).

- Technology Integration: Integrating technology into architectural design is crucial in modern university libraries. Architects should consider infrastructure for power outlets, data connectivity, and wireless networks to support users' digital needs. The design should allow for the seamless integration of technology, such as power outlets within furniture, smart lighting controls, and charging stations, to enhance user convenience and promote the efficient use of digital resources (Fairchild, 2019).
- Sustainability and Energy Efficiency: Modern library architecture must incorporate sustainable design tenets and energy-saving techniques (Edwards et al., 2019). A sustainable and eco-friendly indoor environment is a result of design factors like the use of energy-efficient lighting systems, the incorporation of renewable energy sources, the optimization of insulation, and the utilisation of recycled and ecologically friendly materials. In addition to supporting the institution's dedication to environmental stewardship, sustainability activities can improve users' general well-being (Edwards et al., 2019).

Theoretical Review

There is a direct correlation between behavioural changes and prevalent theories regarding the indoor environmental quality of any type of building. As a result, the theories of energy behaviour in offices and behavioural shifts in university buildings have a direct bearing on this research. (Zamin and others, 2021) claim that there are higher-level justifications for evaluation that go beyond the specific project, in addition to permitting optimisation of the building that is being assessed. Through evaluation, one can help others learn from one's own experiences in both the construction and use and management phases. Theoretical development and testing of established theories, such as the relationship between the arrangement of the built environment and human behaviour and experience, or between design decisions and design quality, cost, and environmental impact, can benefit greatly from individual evaluations and comparisons with other buildings and planning processes.

Users' theory

In addition to permitting the building that is being evaluated to be optimised, there are additional higher-level justifications for evaluation that go beyond the specific project. Through evaluation, one can help others learn from one's own experiences in both the construction and use and management phases. The development of new theories and the testing of preexisting ones can benefit greatly from individual assessments, comparisons with other buildings and planning procedures, etc. University buildings are impacted by the relationships that exist between human behaviour and experience and the

way the built environment is arranged, as well as between design choices and factors like cost, quality, and environmental impact.

Theory of Behavioral Changes in University Buildings

Norm Activation Model (NAM) was developed based on works by Schwartz and Howard in 1977 and 1981; it was based on an interventional experiment conducted by Mahdavi *et al.* (2021) among university staff members in 15 public German universities. (Zhang and others, 2013). Elbanna (2006) posits that a decision-making process consisting of four stages should be followed when deciding which actions to take inside university facilities. They were separated into the attention stage, where the individual, feeling in control of their behaviour, becomes aware of their demands and the consequences of the specific behaviour. The next step, called motivation, is making decisions about a university building by linking moral and immoral factors to social standards. The last phase, the assessment stage, represents the process through which an individual decides whether to engage in a specific behaviour or not. Prior to rating a particular behaviour, it compiles and evaluates data from the preceding stages. This essentially indicates that an individual utilising one of these structures would be required to repeatedly go through the four stages and could be impacted by particular environmental factors or rewards (Mahdavi *et al.*, 2021).

The outcomes of a systematic literature review that aims to determine the influence of four indoor environmental factors—indoor air, thermal, acoustic, and lighting conditions—on the calibre of instruction at colleges and universities as well as on students' academic achievement are also included. The information gathered showed that indoor environmental quality (IEQ) can improve students' learning quality and short-term academic performance. It is suggested that since students perform best in these task-dependent situations, classrooms offering a variety of IEQ settings best support different learning tasks. The evidence is useful in showing how to evaluate the users' impact of the IEQ as well. To sum up, this information helps facility management and building systems engineering decision-makers improve IEQ, which in turn helps teachers and students perform to the best of their abilities (Brink *et al.*, 2020).

METHODS

Using a methodical evaluation of the elements influencing the overall indoor environmental quality (IEQ), the study assesses the indoor environment in university libraries. Information is gathered, quantified, and examined to ascertain how it affects the welfare of users. An observation checklist and a descriptive survey methodology were used in the study. Among the primary

sources of data used in this study were the field survey, checklists, photographs, drawings, questionnaires, and notes. Because of the nature of the study, data that could not be obtained in any other way were verified through a field survey. A list of the variables that were taken from the literature was also included. For this study, questionnaires were shared both physically and digitally amongst library users within four universities in Nigeria. These universities include the university of Abuja (150 questionnaires), Federal University of Technology Minna (300 questionnaires), Newgate college Minna (120 Questionnaires) and Ibrahim Badamasi University Lapai Niger State (20 questionnaires). Of the 590 questionnaires distributed, 484 were retrieved and analyzed appropriately amounting to 82% of the entire questionnaire distributed. The data retrieved is presented thus.

RESULTS AND DISCUSSION

Table 2 provides the respondent's demographic information. Findings reveals that of the 484 responses gotten, 61% of library users are male, with 39% female. The majority of library users are aged 18-22, with 41.6% being 100L students and 18.6% being 500L students. Academic staff make up 0.6% of library users, while non-academic staff make up 0.2%. The library users in universities are predominantly undergraduates, with a smaller percentage of graduates and postgraduates.

Table 2: Respondent Demographic Information

Variable	Frequency	Percentage
Gender		
Male	295	61.0%
Female	189	39.0%
Age		
18-22	298	61.4%
23-27	155	32.0%
28-32	23	4.70%
33-37	5	1.0%
38-42	3	0.6%
53-57	1	0.2%
Category of users		
100L	202	41.6%
200L	61	12.6%
300L	81	16.7%
400L	47	9.7%
500L	90	18.6%
Academic staff	3	0.6%
Non-Academic staff	1	0.2%

Educational qualification		
Undergraduate	407	83.9%
Graduate (HND,BSc, B.Tech)	30	6.2%
Post-graduate	34	7.0%
Others	14	2.9%

Perception of library users on the environmental condition of the library

Figure 1 shows the users perception of the condition of library environment. It was discovered that 74.4% of the respondents agree and strongly agree that lighting is adequate in the library.

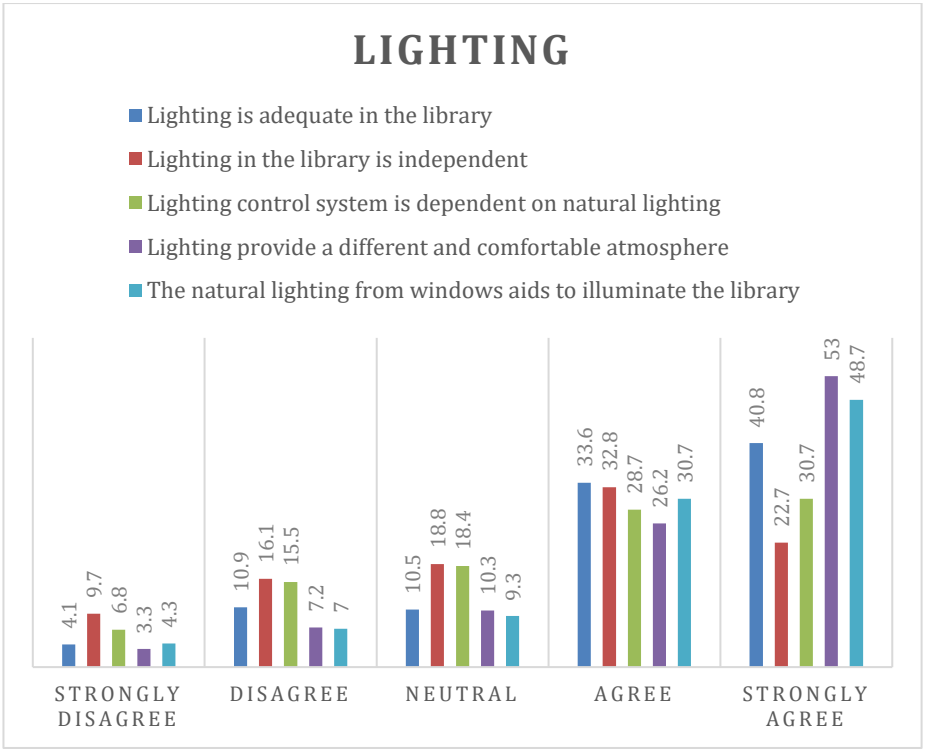

Figure 1: Perception of library users on lighting

Meanwhile 10.5% are neutral about it and 15% disagreed and strongly disagreed that lighting is adequate in the library with a mean value of 3.96 which implies that the respondents agreed that lighting is adequate in the library. Furthermore, there was a degree of neutrality to the independent lighting systems within university libraries as 55.5% of the respondents agree and strongly agree that lighting in the library is independent while 18.8% are neutral about it and 25.8% disagreed and strongly disagreed that lighting in the library is independent with a mean value of 3.43

Adequacy of the library design for library in the 21st century

Figure 2 shows the study assessed the adequacy of library design in the 21st century by assessing key components of library buildings. The majority of respondents agreed that windows are available, fans are available, air conditioning is neutral, ventilation is high quality, illumination is adequate, and accessibility to natural lighting is adequate.

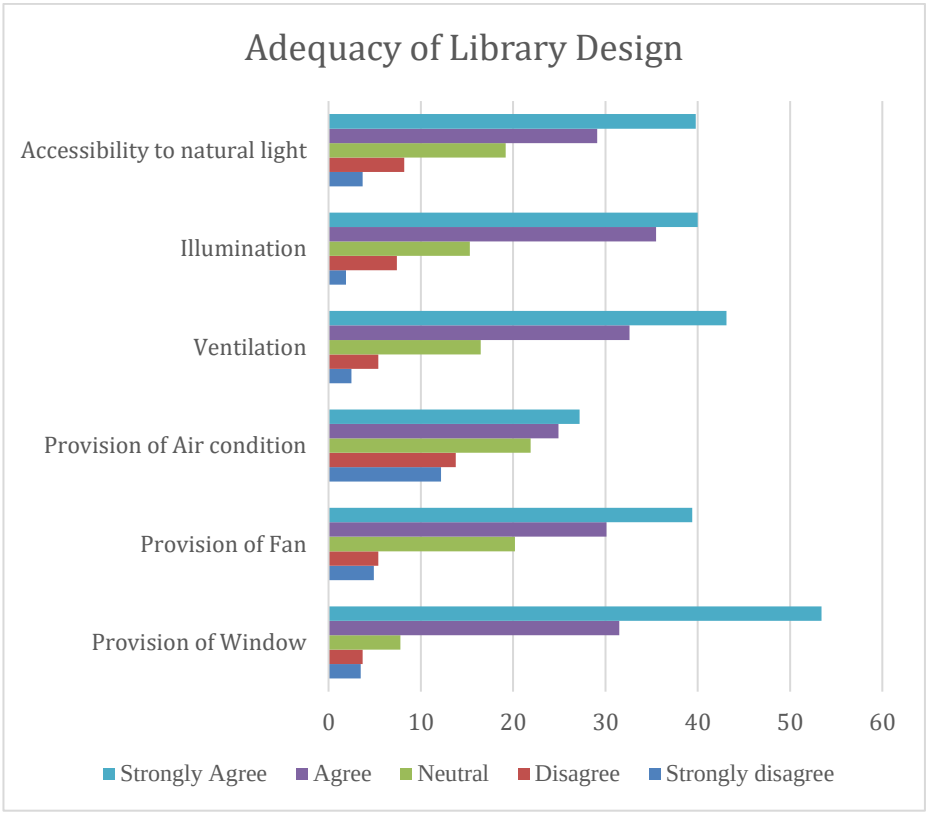

Figure 2: Adequacy of the library design for library in the 21st century

The mean value of window availability was 4.29, fan availability was 69.4%, air conditioning was 3.41, ventilation was 4.08, illumination was 4.04, and accessibility to natural lighting was 3.93. Overall, the respondents agreed that the library design is adequate for modern needs. Viewing the effect of environmental conditions on how frequent they use the library, the question how often do you use the library was asked with 13.8% of the respondents stating that they never use the library, 29.7% rarely use the library, 31.5% of the respondents sometimes uses the library while 12.2% always use the library and 12.8% often use the library. Table 3 shows a significant relationship between environmental condition on ergonomics and the use of the library with

a coefficient of 0.111 and a p-value of 0.001 which is less than 0.05 was also seen which implies that as the environmental condition on ergonomics increases, the use of library also increases.

Table 3: Effect of environmental conditions frequency of library usage

		How often do you use the library
Environmental on day lighting	Correlation Coefficient	.063
	Sig. (2-tailed)	.073
	N	485
Environmental on acoustic	Correlation Coefficient	-.012
	Sig. (2-tailed)	.741
	N	485
Environmental on ergonomics	Correlation Coefficient	.111**
	Sig. (2-tailed)	.001
	N	485

It is also observed that environmental condition on daylight and acoustics does not influence the use of library with a p-value of 0.073 and 0.741 respectively which is greater than 0.05. To this effect, the impact of available spaces and facilities on frequency of library usage was also assessed with findings revealing that library facilities and spaces do not influence the use of library with a p-value of 0.631 which is greater than 0.05 (Table 4).

Table 4: Effect of available spaces and facilities on frequency of library usage

		How often do you use the library
Library facilities spaces	Correlation Coefficient	.017
	Sig. (2-tailed)	.631
	N	485

This finding implies that as the library design get better it influences more people to visits the library. Table 5 shows the effect of library designs on how frequent the respondent uses the library was seen to have a significant impact on the use of library with coefficient of 0.071 and a p-value of 0.041 which is less than 0.05.

Table 5: Effect of library designs on frequency of library usage

		How often do you use the library
Library design	Correlation Coefficient	.071*
	Sig. (2-tailed)	.041
	N	485

CONCLUSION

The study reveals that lighting, noise levels, ergonomics, and ventilation play crucial roles in influencing the indoor environment in university library buildings. A well-designed environment enhances user wellbeing, comfort, and engagement during academic pursuits. Lighting is independent across various buildings, with windows being the primary source of natural light. Isolation keeps out noise, and ergonomics through furniture is well-designed and suitable for all users. High-quality ventilation is achieved through windows, fans, and air conditioning systems. Access to Wi-Fi, research consultation, online reference services, technology hubs, and skill development assistants are the most required spaces in libraries. A significant relationship exists between ergonomics and library usage, with better design influencing indoor air quality. Library design should incorporate air vents, windows, and air conditioning systems to improve indoor air quality. Natural lighting sources should be considered, with translucent facades offering shading. Internal plants and shrubs can purify the environment. Soundproofing elements should be used to control external noise during reading. Professionals should consider climate, air flow, illumination, greenery, and building orientation. Adjustable furniture can also be introduced within the library.

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