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An Assessment of End User Satisfaction with Indoor Environmental Quality in Public Buildings in Akwa Ibom State

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ABSTRACT

End user satisfaction with indoor environmental quality (IEQ) was a crucial aspect of building performance evaluation (BPE) and post-occupancy evaluation (POE) in public buildings. This study assessed end-user satisfaction with IEQ in selected public buildings across different regions of Akwa Ibom State, Nigeria. The research utilized a survey design with a questionnaire employing a five-point Likert scale to gather feedback from public office employees. A total of 390 respondents from nine public offices participated in the survey. The Relative Satisfaction Index (RSI) was calculated to quantify satisfaction levels, revealing significant variations across regions. The overall RSI for the study was 0.45, indicating a moderate level of satisfaction with IEQ among end users in public office buildings. The findings indicated that Essien Udim had the highest satisfaction levels with IEQ, with a mean RSI of 0.61, while Abak exhibited the lowest satisfaction levels with a mean RSI of 0.35 among the surveyed regions. Uyo showed relatively high satisfaction with a mean RSI of 0.55, while regions like Eket, Ikot Ekpene, Uruan, Oron, Nsit Ibom, and Okobo demonstrated mixed perceptions of IEQ. Statistical analysis using the Kruskal-Wallis test confirmed significant differences in satisfaction levels among the regions ($H = 59.650$, $df = 8$, $p < 0.05$), rejecting the null hypothesis of equal satisfaction levels across public buildings. It was noted that architects play a critical role in optimizing IEQ through sustainable design practices, integration of biophilic elements, and post-occupancy evaluations. Policy implications of the study included the need for standardized IEQ parameters, regular monitoring using advanced tools, customized improvement plans tailored to regional needs, stakeholder engagement, and capacity-building programs for building managers.

Keywords: Indoor Environmental Quality (IEQ), End User Satisfaction, Public Buildings

Introduction

End user's satisfaction has been researched from several angles across a variety of fields, including social science, real estate, and building contexts. In the context of architecture, the word "end-user satisfaction" is not well defined. According to the Cambridge Dictionary (2023), satisfaction is a good feeling that occurs when requirements or aspirations are met or when there are no complaints to make. According to Frontczak *et al.*, (2019) analyzed 10 studies on end users' satisfaction and observed that end users' experience is strongly correlated with the location or building quality.

Building Design and Quality (BDQ) in particular is one of the most important factors affecting how satisfied end users are. This is so because end users' perceptions of their comfort and health are influenced by how well-designed and well-made a structure is. Due to these reasons, it is important to consider how users would feel about the spaces they use while working in the buildings, particularly public ones. Frontczak *et al.*, (2019) further showed that end users' discontent typically results from a number of building ambient conditions. Additionally, it could result from a variety of physical building factors, such as where they locate their offices, how the façade is oriented and if the space is cellular or open. A building serves as a place that caters to the needs and expectations of its occupants or users providing them with a comfortable environment that enhances their behavior and supports their activities within it. The definition of a building has evolved from being a structure made of materials and providing shelter to becoming an amalgamation of experiences with outcomes linked to the people residing in it. Consequently, the concept of assessing the performance of buildings has gained prominence in decades ensuring that they function well and highlighting any issues that need attention. Alongside the rise of Building Performance Evaluation (BPE) there is an increased focus, on user's satisfaction among researchers, designers and those funding business ventures. To assess the performance of a building we incorporate user satisfaction as a component of the Post Occupancy Evaluation (POE). This evaluation entails gauging user satisfaction levels alongside measurements to evaluate the building. Recognizing the significance of user satisfaction is crucial, the improvement, sustainability, benchmarking and evaluation of any product is likely to lead to an increased performance (Othman *et al*., 2003). According to Parker and Mathews (2021), satisfaction implies a measurement of how well items or services really performed compared to how well they were expected to function from the users' or customers' perspective during or after a consumption experience. In order to gauge end user's satisfaction, Maarleveld (2019), pointed out that BPE evaluates the architectural, functional, technical, and economic value of buildings. BPE also offers input on the factors that contribute to the environmental problems that affect buildings, which helps to plan and handle operations over the course of a building's life cycle (Meir, 2019). The principal segments of

approaches to BPE, which have been given in more explanatory form in Khair *et al*. (2022), are those approaches that emphasises on the (i) functional suitability of public buildings, that is space utilization, physical condition, safety and statutory demands; (ii) quality evaluation of public buildings; (iii) serviceability of public buildings with respect to users' needs and facilities on ground; (iv) environmental considerations in terms of Indoor Environmental Quality (IEQ), burglary control, lighting; (v) power consumption and quality of indoor air; (vi) end user satisfaction with the design and construction of and services in the public building; (vii) POE of functional, technical, and behavioural feature of buildings.

IEQ is defined as the general indicator of the quality of conditions inside a building and when IEQ is mentioned, the analysis of the BPE focus is placed on these Building Performance Indicators (BPIs) such as thermal comfort, indoor air quality, lighting, acoustic qualities, office furnishings, cleaning and maintenance in the workplace (Wilkinson *et al.,* 2011). Studies about the impact of IEQ have shown that factors of IEQ can produce a noticeable influence on the well-being of the end users which can affect the outcomes of employees and their organizations as well as reduce productivity in office environments, increases absenteeism, churn rates and expose them to higher risk of experiencing symptoms related to Sick Building Syndrome (SBS) such as irritation in the eyes, nose and throat allergies, headaches, respiratory problems, dry skin, difficulty concentrating, dizziness, fatigue and asthma (Albuainain *et al.*, 2021). This study is aimed at assessing the level of satisfaction of the end users with the IEQ of selected public buildings in Akwa Ibom State.

Concept of Post Occupancy Evaluation

Post-Occupancy Evaluation (POE) is a critical process in architecture and building management, focusing on assessing how well buildings meet user needs and expectations over time. It involves gathering feedback from occupants through surveys, interviews, and observations to understand their experiences and satisfaction levels with aspects like indoor environmental quality, functionality, accessibility, and aesthetics. POE plays a key role in identifying areas for improvement, helping designers and managers prioritize interventions to enhance user experiences and overall building performance.

Furthermore, POE contributes to evidence-based decision-making by providing data on building metrics such as energy efficiency, comfort levels, maintenance needs, and operational costs. This data-driven approach guides investments, renovations, and sustainability initiatives, ensuring resources are allocated effectively and decisions align with user preferences and industry standards. Overall, POE promotes continuous learning, innovation, and best practices in the built environment, driving improvements in building design, management, and user satisfaction.

Methods

This research utilized a survey design, employing a questionnaire to gather feedback from public office employees on their satisfaction with indoor environmental quality (IEQ). A five-point Likert scale was used to rate satisfaction levels. Based on sample size calculations, 356 questionnaires were needed, which was rounded up to 400 for distribution. The study assessed nine public offices, and satisfaction levels were quantified using the relative satisfaction index. The Kruskal-Wallis statistics was used to test the null hypothesis.

Findings and Discussions

The assessment of satisfaction levels of end users with IEQ in public office buildings aimed to evaluate occupants' perceptions and experiences regarding the quality of the indoor environment within these buildings. The method used for this assessment involved administering a questionnaire survey to gather feedback directly from occupants. The assessment employed a Relative Satisfaction Index, calculated based on the distribution of responses across the satisfaction scale (Very Dissatisfied to Very Satisfied). This index provided a quantitative measure of overall satisfaction with IEQ among end users in the public office buildings. The result of the assessment is presented on Table 5.21.

Table 1: Satisfaction level of end users with IEQ

Satisfaction Level	Essien	Uyo Udim	Eket	Ikot	Uruan Ekpene	Oron	Nsit	Okobo Ibom	Abak	Total

Very Dissatisfied	2	14	5	6	8	16	12	12	14	**89**
Dissatisfied	6	41	10	10	10	10	10	13	14	**124**
Neutral	14	43	12	17	10	4	10	5	6	**121**
Satisfied	8	26	3	0	2	7	0	2	0	**48**
Very Satisfied	2	6	0	0	0	0	0	0	0	**8**
No. of Respondents	32	130	30	33	30	37	32	32	34	**390**
Total Weighted Score	98	359	73	77	66	76	62	61	60	**932**
Mean weighted Score	3.06	2.76	2.43	2.33	2.20	2.05	1.93	1.91	1.76	**2.27**
Relative Satisfaction Index	0.61	0.55	0.49	0.47	0.44	0.41	0.39	0.38	0.35	**0.45**
Ranks		**1st**	**2nd**	**3rd**	**4th**	**5th**	**6th**	**7th**	**8th**	**9th**

Source: Researcher (2024).

The analysis of the satisfaction levels across different regions shows significant variations in the perceptions of the respondents. The regions under study include Essien Udim, Uyo, Eket, Ikot Ekpene, Uruan, Oron, Nsit Ibom, Okobo, and Abak. Starting with the overall satisfaction, the highest level of satisfaction was recorded in Essien Udim, with a mean weighted score of 3.06 and a Relative Satisfaction Index (RSI) of 0.61. This region ranked first among all areas surveyed, indicating that respondents here were generally more satisfied with the services or conditions being evaluated. In contrast, the region with the lowest satisfaction was Abak, with a mean weighted score of 1.76 and an RSI of 0.35, ranking ninth. This suggests that respondents in Abak were the least satisfied.

Uyo, the region with the highest number of respondents (130), had a mean weighted score of 2.76 and an RSI of 0.55, placing it second in terms of satisfaction. This indicates a relatively high level of satisfaction, though not as high as Essien Udim. In Eket, with a mean weighted score of 2.43 and an RSI of 0.49, the satisfaction level was moderate, ranking third. Ikot Ekpene, Uruan, Oron, Nsit Ibom, and Okobo showed declining satisfaction levels with mean weighted scores of 2.33, 2.20, 2.05, 1.93, and 1.91, respectively. These regions ranked fourth to eighth, demonstrating a trend where satisfaction diminishes progressively. Notably, Nsit Ibom and Okobo had identical dissatisfaction levels, reflecting close satisfaction indices (RSI of 0.39 and 0.38, respectively).

The total number of respondents across all regions was 390, with varying responses ranging from very dissatisfied to very satisfied. A significant proportion of respondents in Uyo, Eket, and Essien Udim reported neutral satisfaction, suggesting neither high dissatisfaction nor satisfaction. In contrast, the regions of Oron, Nsit Ibom, and Okobo showed a significant number of respondents reporting dissatisfaction. The relative satisfaction index and mean weighted scores provide a clear ranking of regions based on the respondents' satisfaction levels. Essien Udim stands out as the most satisfied region, while Abak ranks as the least satisfied.

Analyzing the satisfaction levels with the Indoor Environmental Quality (IEQ) of public buildings across different regions provides valuable insights into the varying perceptions and needs of the respondents. The overall satisfaction index, with a mean weighted score of 2.27 and a Relative Satisfaction Index (RSI) of 0.45, suggests that, on average, respondents are neither highly satisfied nor highly dissatisfied with the IEQ of public buildings. However, there are notable regional differences that need to be addressed. In Essien Udim, the highest satisfaction levels were recorded with an RSI of 0.61 and a mean weighted score of 3.06. This indicates that the IEQ of public buildings in Essien Udim is perceived positively by the majority of respondents, suggesting effective design and maintenance practices that contribute to a comfortable and healthy indoor environment. This could include factors such as adequate ventilation, appropriate lighting, comfortable temperature, and effective noise control, which are all critical components of IEQ.

Uyo, with an RSI of 0.55 and a mean weighted score of 2.76, also shows a relatively high level of satisfaction. The respondents in Uyo likely experience public buildings with good IEQ, contributing to their overall comfort and well-being. However, there is still room for improvement to reach the satisfaction levels seen in Essien Udim. Conversely, regions such as Abak, Okobo, and Nsit Ibom exhibit significant dissatisfaction with RSIs of 0.35, 0.38, and 0.39, respectively. These low satisfaction levels suggest that the IEQ of public buildings in these regions is inadequate, potentially due to issues like poor ventilation, insufficient natural light, uncomfortable temperatures, high noise levels, or inadequate cleanliness. Such conditions can negatively impact the health, comfort, and productivity of building occupants.

The neutral satisfaction levels observed in regions like Eket, Ikot Ekpene, Uruan, Oron, and Nsit Ibom, with RSIs ranging from 0.49 to 0.39, indicate a mixed perception of IEQ. Respondents in these regions might experience both positive and negative aspects of IEQ, leading to an overall neutral stance. This suggests a need for targeted improvements to enhance specific aspects of IEQ, such as air quality, thermal comfort, lighting, and acoustics.

Test of Hypothesis

The null hypothesis that there is no significant difference in the levels of satisfaction with IEQ of end users across public buildings was tested using the Krusall-Wallis test. The result is here presented:

Table 2: Kruskal-Wallis Test

	Satisfaction with IEQ
Kruskal-Wallis H	59.650
df	8
Asymp. Sig.	.000

Source: SPSS extract.

The Kruskal-Wallis test results for satisfaction with indoor environmental quality (IEQ) indicate significant differences among the groups compared. The test statistic (H) is 59.650 with 8 degrees of freedom, and the asymptotic significance (p-value) is 0.000. Since the p-value is well below the 0.05 threshold, we reject the null hypothesis that all groups have the same level of satisfaction with IEQ. This suggests that there are statistically significant differences in satisfaction levels with IEQ across the various groups analyzed.

Implications of the Study

The findings of this study carry significant implications for various stakeholders involved in public building design, management, and policy-making in Akwa Ibom State and beyond. Architectural and design considerations gain prominence as the study unveils varying levels of end user satisfaction with indoor environmental quality (IEQ) across different regions. These findings underscore the importance of prioritizing user-centric design principles in public buildings. Architects and designers can leverage this insight to focus on elements like natural lighting, ventilation, thermal comfort, and acoustic quality, which play pivotal roles in occupant satisfaction and well-being. Integrating sustainable design practices, including the use of green materials and energy-efficient systems, can further enhance IEQ while minimizing environmental impact.

Building management and maintenance strategies also stand to benefit from the study's findings. Effective building management practices are crucial for ensuring consistent and satisfactory IEQ. The study sheds light on areas of concern such as air quality, lighting, noise control, and cleanliness, providing guidance for building managers to address these issues. Regular monitoring, maintenance, and periodic evaluations based on end user feedback can lead to improved IEQ and overall occupant satisfaction in public buildings.

The implications extend to policy and regulation, advocating for the development and enforcement of standards and guidelines for IEQ in public buildings. Standardized parameters for measuring and assessing IEQ, coupled with regular audits and compliance checks, can help maintain high standards of indoor environmental quality across the state. Policies can also incentivize the adoption of sustainable practices and the use of technology for real-time monitoring and management of IEQ parameters.

User engagement emerges as a key aspect influenced by the study's findings. Engaging building occupants in the IEQ evaluation process can empower them to voice their concerns and preferences, fostering a more responsive and user-friendly built environment. Implementing user feedback mechanisms such as suggestion boxes, surveys, and focus groups can facilitate continuous insights and improve communication between users and building management teams, ultimately enhancing overall satisfaction and productivity.

Capacity building and training initiatives are also recommended to enhance IEQ management. Training programs aimed at building managers, maintenance staff, and other stakeholders can improve their knowledge and skills in maintaining optimal IEQ. These initiatives can focus on best practices for IEQ management, the use of advanced monitoring tools, and addressing common issues related to indoor environmental quality, contributing to long-term improvements in IEQ and user satisfaction in public buildings.

In summary, the implications of the study underscore the need for a holistic approach to IEQ management, encompassing design, maintenance, policy, user engagement, and capacity building. By addressing these implications, stakeholders can work towards creating healthier, more comfortable, and more sustainable indoor environments for building occupants in Akwa Ibom State and similar regions.

Conclusion

This study delved into assessing end-user satisfaction with indoor environmental quality (IEQ) in public buildings across various regions of Akwa Ibom State, Nigeria. The findings revealed significant variations in satisfaction levels, with Essien Udim exhibiting the highest satisfaction and Abak the lowest. Uyo showed relatively high satisfaction levels. The overall Relative Satisfaction Index (RSI) for the study was moderate at 0.45, suggesting room for improvement in IEQ across public buildings in the region.

However, this study had some limitations that should be considered. Firstly, the sample size, although sufficient for statistical analysis, may not fully represent the diverse population and conditions within Akwa Ibom State. Additionally, the survey relied on self-reported data, which could be subject to response bias. Future research could address these limitations by employing larger and more diverse samples, incorporating objective measurements of IEQ, and considering broader aspects of building performance and user experience. Despite these limitations, this study provides valuable insights into the current state of IEQ satisfaction in public buildings in Akwa Ibom State, laying the groundwork for further improvements in building design and management practices.

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