

Post-Occupancy Evaluation of Design Quality in Higher Education: A Case Study of TETFUND Buildings in The Federal Polytechnic, Damaturu

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Abstract:

This study presents a comprehensive post-occupancy evaluation (POE) assessing design quality in higher education facilities, focusing on buildings funded by the Tertiary Education Trust Fund (TETFUND) at the Federal Polytechnic, Damaturu. The research evaluates the effectiveness of design features and spatial configurations in meeting diverse academic needs and enhancing the learning environment. Employing a multi-faceted methodology, incorporating qualitative and quantitative data collection methods such as structured interviews, surveys, and objective measurements, insights are gathered from students, faculty, and administrative staff. Evaluation criteria encompass functional and aesthetic aspects, including spatial efficiency, flexibility, accessibility, and user satisfaction. The findings revealed spatial layout and flexibility, lighting and acoustics, ergonomics and comfort, aesthetics and visual appeal, accessibility and inclusivity, collaboration spaces and environmental sustainability, and security and safety as the major design qualities in higher education buildings. These findings offer a nuanced understanding of the strengths and weaknesses of TETFUND-funded buildings, with implications for design choices in higher education. The study recommends enhancing inclusivity by consulting end-users during design phases and providing ample social interaction spaces, prioritizing user comfort and satisfaction through adequate lighting, ventilation, and ergonomic furnishings. Recommendations for design modifications or enhancements are provided to optimize educational spaces. This case study contributes insights to the broader discourse on design quality in higher education, informing future architectural decisions and policy considerations aimed at improving the learning experience, and emphasizes the importance of ongoing evaluation and refinement in creating optimal learning environments by focusing on the specific context of the Federal Polytechnic, Damaturu.

Keywords: *Architectural Design Quality, Federal Polytechnic Damaturu, Higher Education Environment, Post-Occupancy Evaluation (POE), TETFUND Buildings, User Satisfaction*

1.0 Background to the Study

The quality of educational buildings significantly influences learning environments, student satisfaction, and academic success (Dovey & Fisher, 2014; Hua et al., 2017). Post-occupancy evaluation (POE) assesses building performance during occupation, impacting user satisfaction and overall effectiveness (Tookaloo & Smith, 2015). POE, recognized in academic literature and professional institutes, improves building performance by addressing users' needs and enhancing the built environment (Hay et al., 2017). Scholarly discourse emphasizes the interplay between design and occupants, focusing on users' comfort, safety, efficiency, and satisfaction (Jones & Grigoriou, 2014; Watson et al., 2016; Preiser & Vischer, 2005; Preiser, 2002).

This study centres on the POE of design quality within Tertiary Education Trust Fund (TETFUND) intervention buildings at the Federal Polytechnic, Damaturu, Nigeria. TETFUND aims to upgrade tertiary education infrastructure, creating conducive learning environments. Despite literature emphasizing design quality's importance in education, there is a gap in POE specific to higher education buildings in Nigeria. Conducted as a case study at the Federal Polytechnic, Damaturu, this research aims to systematically evaluate TETFUND intervention buildings' design quality, providing insights and recommendations for future interventions in Nigerian higher education infrastructure. By acknowledging design quality's pivotal role and addressing the research gap, this study seeks to enhance educational building design in Nigeria.

1.1 Statement of Research Problem

The evolving higher education landscape underscores the critical role of physical spaces in shaping learning experiences. Tertiary Education Trust Fund (TETFUND) interventions, focusing on constructing and renovating educational buildings, are pivotal for enhancing higher education facilities in

Nigeria. The Federal Polytechnic, Damaturu, has benefited from TETFund projects, resulting in new constructions and refurbishments. Despite their importance, scholarly scrutiny on post-occupancy evaluation (POE) of design quality in higher education, particularly in the Federal Polytechnic Damaturu, Yobe –Nigeria remains scarce. This gap impedes evidence-based guidance for future infrastructure projects aiming at optimal learning environments. While TETFund interventions signify substantial investment in educational infrastructure, their effectiveness in improving the design quality of learning spaces warrants further exploration. This study aims to bridge this gap by conducting a thorough post-occupancy evaluation of design quality in TETFund intervention buildings at the Federal Polytechnic, Damaturu.

1.2 Aim of the Research

This study aims to carry out a thorough post-occupancy evaluation (POE) concerning the design quality of structures subject to TETFUND interventions within the Federal Polytechnic, Damaturu. The primary objective is to methodically assess the design attributes of these buildings and furnish evidence-based observations regarding their influence on the learning milieu, thereby enriching forthcoming educational infrastructure endeavours. Consequently, this research seeks to address the following questions:

1. What are the key indicators of design quality in higher education buildings within the context of TETFUND intervention projects?
2. To what extent have TETFUND intervention buildings in the Federal Polytechnic, Damaturu, achieved design quality standards, and how do these standards impact the overall learning environment?
3. What is the stakeholder's perception about the design quality of the intervention buildings?

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1.3 Research Objectives

1. To identify key indicators of Design Quality in higher education buildings.
2. To evaluate TETFUND Intervention Buildings in the Federal Polytechnic, Damaturu, considering architectural, ergonomic, and aesthetic aspects.
3. To collect and analyse feedback from various stakeholders, including students, faculty, and administrators, regarding their perceptions of the design quality of the intervention buildings.

2.0 LITERATURE REVIEW

2.1 Post-occupancy Evaluation of Architectural Design Quality

The symbiotic relationship between design and architecture is inherent to the architectural profession, with design governing product creation in the built environment (Senibi, 2018). Quality, defined as excellence, is crucial in architectural endeavours, alongside time and cost considerations (Tanushree, 2021). Architectural design quality encompasses stakeholders' essential building requirements beyond mere style (Senibi, 2018). Benchmarks are necessary to achieve consensus in design and evaluation (Kuan & Ahmad, 2016). Architectural design quality, fulfilling stakeholders' needs and expectations, is vital for construction excellence and value for money. The design stage is pivotal for optimizing facility value for end users (Nelson, 2006). Objective measurement of design quality throughout the project life cycle is essential to understand the building's performance during use. Post-occupancy evaluations are crucial for scrutinizing issues arising from the design and construction stages (Tanushree, 2021).

2.2 The Significance of Architectural Design Quality in Higher Education Environment

The design of physical learning environments in higher education institutions significantly influences student experiences, academic performance, and satisfaction (Dovey & Fisher, 2014; Hua et al., 2017). Educational infrastructure design is complex, involving spatial, psychological, physiological, and behavioural factors (Nair, 2005). Design considerations extend beyond aesthetics to include cognitive and emotional aspects that impact the learning experience (Becker, Fritz, & Wu, 2016). Consequently, understanding the multifaceted nature of design quality in higher education involves considerations such as spatial layout, lighting, acoustics, and ergonomics (Hua et al., 2017; Guzowski & Salmon, 2018).

The Design Quality Indicator (DQI) engages end users to gather requirements during the briefing stage, ensuring alignment between user demands and design supply (Amer, 2014). DQI has been successfully applied across various building types, including educational facilities, hotels, civic buildings, retail spaces, mixed-use buildings, sports and leisure facilities, and workplaces (Tanushree, 2022). Design Quality Indicator is based on Vitruvian Principles. The Roman architect Vitruvius in his treatise on architecture, *De Architectura*, emphasized that there were three principles of good architecture, they are as follows:

- 1) Firmatas (Durability) - It should be strong and remain in good condition.
- 2) Utilitas (Utility) - It should be useful and functional for the people using it.
- 3) Venustus (Beauty) - It should be beautiful and enhance people's spirit.

The modern mind rewrote them as, Functionality (Utilitas), Build quality (Firmitas), and Impact (Venustas)

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Figure 1: Components of design quality
(Source: Adapted from DQI.ORG)

With the growing focus on creating conducive and innovative learning environments, post-occupancy evaluation (POE) has emerged as a methodological approach to assess the effectiveness of design interventions in educational buildings (Preiser & Vischer, 2018). Tertiary Education Trust Fund (TETFUND) interventions aim to improve physical facilities in Nigerian tertiary institutions. However, scholarly attention on evaluating the outcomes of these interventions, particularly regarding design quality in higher education buildings, is limited. Understanding key indicators and attributes of design quality is crucial for optimizing learning spaces. This review examines existing literature to identify and define these indicators.

1) Spatial Layout and Flexibility

One fundamental aspect of design quality in higher education buildings is the spatial layout. Flexible and adaptable spaces have been identified as critical for accommodating diverse teaching methods and learning activities (Gosling & Gaffikin, 2019). A study by Becker, Fritz, and Wu (2016) highlights the importance of spatial flexibility in facilitating collaborative learning and accommodating evolving pedagogical approaches.

2) Lighting and Acoustics

Effective lighting and acoustics are integral to creating an environment conducive to learning. Guzowski and Salmon (2018) emphasize the significance of appropriate lighting conditions in promoting concentration and visual comfort. Additionally, the control of acoustics is crucial to minimizing distractions and ensuring clear

communication within educational spaces (Hua et al., 2017).

3) Ergonomic and Comfort

The ergonomic design of furniture and learning spaces contributes to the physical well-being of students and educators. Comfortable seating arrangements and ergonomic furniture enhance the overall experience, supporting prolonged engagement with academic activities (Preiser & Vischer, 2018).

4) Aesthetics and Visual Appeal

The aesthetic quality of higher education buildings contributes to the overall atmosphere and student satisfaction. Dovey and Fisher (2014) argue that aesthetically pleasing environments positively influence students' emotional experiences and contribute to a sense of identity and community within educational institutions.

5) Accessibility and Inclusivity

Design quality is closely tied to accessibility and inclusivity. Buildings that consider the diverse needs of students, including those with disabilities, contribute to a more inclusive and equitable learning environment (Gosling & Gaffikin, 2019).

6) Collaboration Spaces and Environmental Sustainability

Design quality extends beyond traditional classrooms to encompass community and collaboration spaces. These areas foster interaction, collaboration, and a sense of community among students and faculty (Guzowski & Salmon, 2018). The incorporation of environmentally sustainable design principles is gaining prominence in discussions about design quality. Sustainable features such as energy-efficient systems, green spaces, and eco-friendly materials contribute to the long-term viability of educational buildings (Becker et al., 2016).

7) Security and Safety

Ensuring the safety and security of occupants is a critical attribute of design quality. This includes considerations such as emergency exit routes, surveillance systems, and overall

building security measures (Preiser & Vischer, 2018).

Table 1: Functionality Aspect and Quality Indicators

Indicators	Descriptors
Use	Accommodates users' needs: classroom sizes and anthropometric dimension
Site selection	Easily accessible from the residential area, away from traffic, with good natural drainage
Parking	Provided with an adequate cycle, two-wheeler parking
The building layout	Easily understood by the user
Access	Good and safe access to everyone
Space	Right size for function
Lighting	The lighting is efficient and allows for different user requirements
Open spaces	Appropriate for the breeze, sunlight and outdoor activities
Pedestrian walkway	User friendly
Service	Providing essential service to the users
Natural lighting	Suitable position of the windows
Natural ventilation	Position of window and door
Universal aspect	The building is easily accessed by all users
Circulation	Adequate circulation areas between habitable spaces
Fire exits	The building is provided with adequate fire exits as per norm
Acoustic comfort	The building provides acoustic comfort to the users

(Source: Architectural Design Quality Assessment Framework for School Buildings Tanushree, 2021)

Table 2: Build Quality Aspect and Quality Indicators

Indicators	Descriptors
Engineering system	Mechanical, Electrical and Plumbing systems working properly
Security system	Safe environment for the students and personnel
Energy	The building is efficient in the use of energy
Green energy and sustainability	The building uses green energy
Landscape	The attractive landscape of the building
Finishing	Finishing the building is durable and suitable
Structure element	The structure is efficient
Road width	Suitable for pedestrian as well as vehicular
Stability	The building is stable from natural elements
Indoor air quality	Free from smoke, CO, etc
Hygienic condition	Proper drinking water
Building maintenance	The building is maintained

(Source: Architectural Design Quality Assessment Framework for School Buildings Tanushree, 2021)

In summary, the literature highlights a range of key indicators and attributes associated with design quality in higher education buildings. Spatial layout, lighting, ventilation, ergonomics, aesthetics, technological integration, accessibility, sustainability, community spaces, and safety are crucial factors that collectively contribute to the overall quality of the learning environment.

3.1 Research Methodology

3.2 Methodological Consideration in the Post-Occupancy Evaluation

Methodological approaches to post-occupancy evaluation exhibit variability, often encompassing a blend of qualitative and quantitative methodologies (Becker et al., 2016). Becker et al. emphasize the necessity of embracing diverse perspectives—ranging from students and faculty to administrators—to comprehensively grasp the overarching influence of design on the educational milieu.

3.2 Data Collection Methods

Accordingly, a mixed-method research paradigm was used to collect a comprehensive dataset. Quantitative data, sourced from survey responses, were complemented by qualitative insights obtained through interviews and observational methodologies. The quantitative segment of the study utilized a designed survey instrument, structured to encompass inquiries regarding overarching satisfaction levels, specific design attributes, comfort parameters, technological integration, and other pertinent factors. Drawing from an extensive review of the literature, a compilation of 41 indicators of design quality applicable to higher education infrastructure was synthesized. These indicators were subsequently categorized into three primary dimensions: Functionality, Build Quality, and Impact, to facilitate the evaluation of six (6) selected buildings serving as case studies. These buildings represent diverse intervention models spanning across various faculties within the institution;

1. SES Building – 2014 Special Intervention
2. Engineering Complex – 2014/2015/2016 Merged Annual Intervention
3. New Lecture Theatre – 2015/2016 Normal intervention
4. Twin-Theatre – 2019 High Impact Special Intervention
5. NSES2 Complex – 2019 Special Impact
6. Architecture Studio – 2022 Zonal Intervention
7. GNS Building – 2023 Annual Maintenance Intervention

Consequently, in-depth interviews were conducted on a stratified sampling of stakeholders; including students, faculty, administrators, and the directorate of physical planning and procurement to ensure representation from various user groups. Employing open-ended questions, interviews were tailored to elicit nuanced perspectives, experiences, and concerns about design quality. Moreover, on-site observations were systematically executed to evaluate aspects such as traffic patterns, utilization trends, and any pertinent issues related to the physical environment.

4.0 FINDINGS AND DISCUSSION

The findings offer a scholarly examination of the design quality within Tertiary Education Trust Fund (TETFUND) structures at the Federal Polytechnic, Damaturu. They provide insights into both the strengths and deficiencies inherent in these architectural constructs, thereby furnishing pertinent insights for prospective design deliberations and enhancements. Utilizing a five-point Likert scale, encompassing responses ranging from '1 = Not Significant' to '5 = Very Significant', feedback about various indicators was systematically gathered (see Table 3). An Average Index (AI) analysis was conducted to

ascertain the significance level of these indicators.

Table 3: Average Index value and interpretation

AI range value	Interpretation
4.50 – 5.00	Very significant
3.50 – 4.50	Significant
2.50 – 3.50	Moderately significant
1.50 – 2.50	Less significant



Figure 1: DQI Index for Functionality Aspect (Field Survey, 2024)

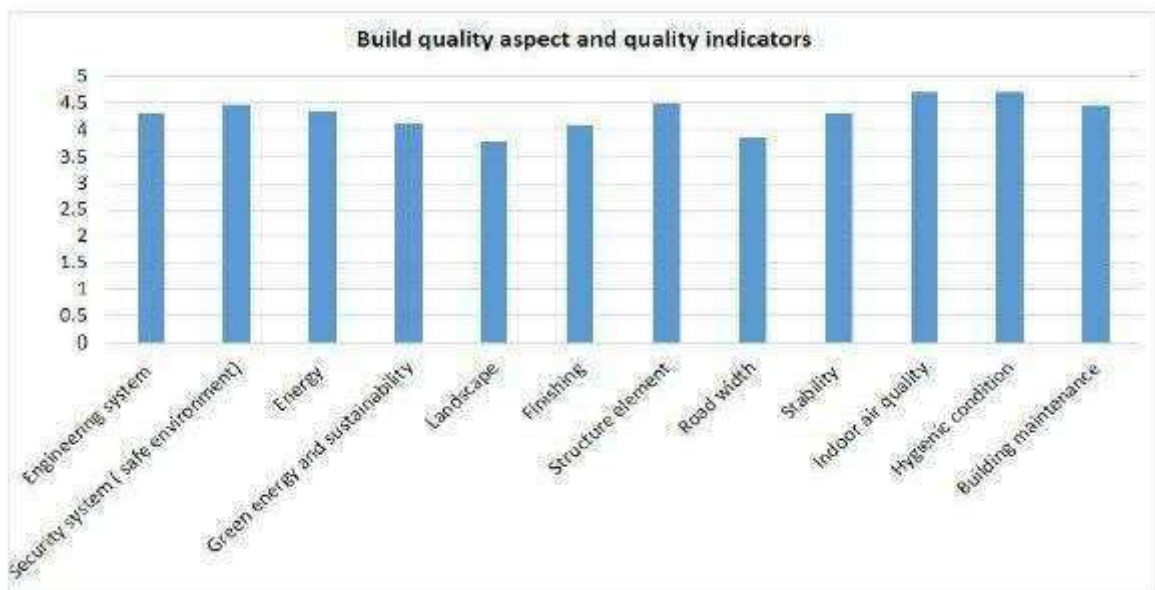


Figure 2: DQI Index for Build Quality Aspect (Field Survey, 2024)

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1. User Satisfaction and Comfort: Within the build quality assessment, stability and hygienic conditions garnered the highest rating of 4.7, closely trailed by structural integrity (4.5) and security provision (4.48), as depicted in Figure 5. Conversely, landscape features and road width received ratings of 3.8 and 3.86, respectively, rendering them comparatively less significant. Notwithstanding, a prevailing sentiment among respondents underscores contentment with the overarching

architectural layout of TETFUND edifices, attributing to the aesthetic enhancement of the campus environment conducive to scholastic pursuits. However, there exists a consensus regarding suboptimal comfort levels, with occupants decrying inadequacies such as deficient lighting, ventilation, functional spaces and ergonomic furnishings, particularly within spaces such as design studios as shown in plates 1, 3, 4, 5 & 6...as well as most of the offices and classrooms appear more of cubicles.



Plate 1: Architecture Design Studio procured through 2022 Zonal Intervention (Field Survey, 2024)



Plate 2: Engineering Drawing Studio procured through 2022 Zonal Intervention

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(Field Survey, 2024)

2. Orientation, Spatial Efficiency and Flexibility: The spatial design of TETFUND buildings was found to be efficient, providing well-organized and easily navigable spaces for various educational activities. However, there is a lack of adherence to the principles of proper building orientation for natural ventilation and lighting. This has negatively impacted

the lighting and thermal comfort as well as the flexibility in room arrangements and spaces for the adaptability of the buildings to different academic needs. This is obvious in the Architecture Design Studio, Engineering Drawing Studio, New School of Environmental complex, and the Twin-theatre as shown in plates 1, 2, 3, 4, and 5.



Plate 3: New School of Environmental Studies Complex – 2019 Special Impact exhibiting wrong orientation and lack of effective shading devices on the wall facades



Plate 4: Twin-Theatre – 2019 High Impact Special Intervention (Field Survey, 2024)

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Plate 5: Engineering Complex – 2014/2015/2016 Merged Annual Interventions
(Field Survey, 2024)

3. Accessibility and Inclusivity & Social Interaction Spaces: The design of TETFUND buildings promoted accessibility for all users, including individuals with disabilities, ensuring an inclusive educational environment. Way-finding is generally effective in guiding users through the facilities, minimizing confusion and enhancing accessibility. However, negative feedback was received from the students regarding the availability of social spaces in all the TETFUND buildings, contributing to a lack of increased social interaction among

students and faculty. Collaborative areas such as outdoor gardens, lounges and group study rooms, were identified as lacking in the overall design. This, according to the faculty members was a lack of design consultations with the end-users when the design decisions were taken especially in the interventions like High impact, Special impact, and Zonal intervention which they believe is awarded to the highly influential politicians for their political patronage without going through the normal project procurement.



Plate 6: GNS Building – 2023 Annual Maintenance Intervention (Field Survey, 2024)

4. Landscaping and Environmental Sustainability: It was also found that most of the TETFUND buildings have also failed to demonstrate commitment to the integration of attractive landscape of the building and its surrounding area as well as engendering environmental sustainability through features such as energy-efficient lighting, renewable energy sources, and waste reduction strategies. Only the School of Environmental Studies building and the New Lecture Theatre were procured

through either annual normal intervention or annual maintenance intervention models as shown in plates 7 & 8. These particular models allow the beneficiary institutions to have a say in the design decisions and also monitor the effectiveness to see to its construction standard. However, they acknowledged and appreciated the eco-friendly initiatives, contributing to a positive perception of the institution's commitment to sustainability.



Plate 7: School of Environmental Studies Building – 2014 Renovation Special Intervention with landscaping elements (Field Survey, 2024)



Plate 8: New Lecture Theatre – 2015/2016 Normal intervention with Landscaping Elements (Field Survey, 2024)

Conclusion

In conclusion, the study underscores the importance of design quality in higher education buildings and the need for systematic post-occupancy evaluation, especially in the context of TETFUND interventions. Therefore, meeting design quality standards in TETFUND intervention buildings at the Federal Polytechnic, Damaturu, is essential for creating a positive and effective learning environment. These standards not only influence the physical aspects of the buildings but also play a critical role in shaping the overall educational experience for students and faculty. This study has established the reflection of design quality in the TETFUND intervention buildings in one way or the other in the Federal Polytechnic Damaturu, and provided valuable insights for future educational infrastructure projects in Nigeria.

Recommendations

By implementing the following recommendations, future educational infrastructure projects can better meet the needs of users and contribute to a conducive learning environment;

1. Enhancing inclusivity by consulting end-users during design phases and

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providing ample social interaction spaces.

2. Prioritizing user comfort and satisfaction through proper building orientation for improved natural lighting, ventilation for enhanced thermal comfort, and ergonomic furnishings and spatial flexibility.
3. Integrating attractive landscaping and environmental sustainability initiatives to enhance the overall quality of educational infrastructure.
4. It is also recommended for design modifications or enhancements of these buildings to optimize educational spaces in the subsequent maintenance and renovation interventions, focusing on the environmental context of the Federal Polytechnic, Damaturu.

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