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BUILDING PERFORMANCE ASSESSMENT VIA POST OCCUPANCY EVALUATION (POE): A CASE STUDY OF SCHOOL OF ENVIRONMENTAL STUDIES, NUHU BAMALLI POLYTECHNIC, ZARIA.

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Abstract

Buildings are important components of educational institutions and their conditions and performance have been acknowledged to play vital roles in the productivity of the teachers and the students who use them. As a consequence, evaluation of building facilities after its construction phase has become necessary as it gives insights on the performance of such buildings and what necessary measures could be taken to restore or retain it in good condition. This paper seeks to use the post-occupancy evaluation (POE) approach to appraise the condition and performance of the School of Environmental Studies building of Nuhu Bamalli Polytechnic, Zaria, Nigeria. Data were collected based on walkthrough/observation survey and questionnaires, in which users of the building facilities were asked to report on their assessment and experience of the facility. Seventy five web-based questionnaire responses were used for the analysis to get mean score of occupants opinions. Personal interviews were also used to gather reasonable information from administrators of physical planning and procurement in the institution. Findings from the study pointed to areas of deficiency in the level of noise, quality and cleanliness of washrooms/toilets and adequacy of storage spaces. It also showed that the deficiency in some of these facilities prompted users activities which directly or indirectly affected their comfort and performance level within their work spaces. The

study recommends that higher education institutions in Nigeria can improve their buildings performance by using users' feedback to formulate maintenance policy and improve on future infrastructural development from the design stage. It also recommends that post occupancy evaluation should be incoporated in the building procurement processes.

Introduction

A study by El-khawas (2003), acknowledged that the major roles of higher educational institutions are knowledge transmission and promotion of learning capacity and the spaces provided by the buildings in these institutions serve as the enabling tools. In these regard olatunji (2013) asserted that to achieve effective functioning and productivity , educational facilities and their environment must be given the highest premium. Hence, Costanza et al (2007), in their study showed how greatly the overall comfort of spaces within a building can influence human behaviour and productivity. Vischer (2008) study also noted that physically and psychologically the human behaviour is greatly influenced by indoor environmental quality indicators such as thermal, visual, acoustic, indoor air quality (IAQ), office layout, and so on.. In the same study, it showed that human productivity goes high when they are satisfied with their work environment, meaning that, any form of deficiency in the building system in respect to the indoor environment condition and facility management could lead to negative effects on human health. This signifies that the workspace of individuals is pivotal to the performance and the success of the organizational goals. In this regard, it is important for a regular and critical assessment of the level of comfort and satisfaction of users of building space in order to understand their behaviour and level of productivity.

Heitor (2005) study acknowledged that the success of a building is determined by how it has accomplished its design purpose. The study stated that the success of educational buildings is measured by how effective it serves its function, that is, how users who are predominantly students and teachers are utilizing the spaces and how the design has promoted the educational process. Thus, the ability of the building to successfully accomplish the purpose for which it is designed measures its success.

Post Occupancy Evaluation (P.O.E),has emerged as a tool for measuring this success after the construction phase. Baird (2001), described Post Occupancy Evaluation (POE) as —techniques or procedures of evaluating the performance of

existing buildings and facilitiesǁ. POE as a tool looks at the condition of existing building facilities and how well they satisfy their users' needs and identifies ways to improve the building fitness to its design purpose.

Despite the prevalence of research in the context of building performance, post-occupancy evaluation (POE) as a systematic method of gathering data of existing buildings is still lagging behind in practice for buildings in higher education institutions especially in Nigeria. As asserted by Ahmadi et al (2016), most educational facilities do not conduct a post occupancy evaluation (POE) due to absence of it in the contract agreement between the institution and the consultant or often at times the client chooses to bypass the POE. In a similar regard, Riley (2010) stated that post occupancy evaluation (POE) studies over the years have been concentrated on commercial and residential buildings whilst performance of higher educational buildings have received lesser attention. Iiter et al (2018) study which critically examined POE tools asserted that over a 40 year time frame of developing POE tools in which 45 (forty five) has been established, only 1 (one) has been developed for university buildings and four (4) for other level of schools.

Prensky (2009) and Krada et al (2014) in their studies highlighted the dynamism of higher education buildings and facilities, which is as a result of the great influence of information and communication technologies in the creation and dissemination of knowledge and so makes building performance evaluation very paramount.

Additionally, Brown (2009) acknowledged socio-cultural and contextual factors relating to a building's design and operation may play an equally important role in shaping occupant's comfort as the quality and characteristics of a space itself. As posited by Indriyati (2016), behavior or human behavior affects space design and vice versa. Consequently, Aliyu et al (2016) observed that current studies on POE are mostly focused on technical performance of buildings and the evaluation methods are limited in their ability to capture significant socio-cultural determinants of user experience in buildings. This leaves a knowledge gap in certain performance categories of building evaluation.

Also, as observed by the researcher, there are insufficient details about building performance in Nuhu Bamalli Polytechnic, even with the growing rate of construction within the institution. Hence, this study is an attempt to carry out a POE study that will capture significant functional, technical and behavioral determinants of user experience in the selected building of Nuhu Bamalli Polytechnic, Zaria.

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Research Aim

The aim of this research is to assess the performance of School of Environmental Studies building in Nuhu Bamalli Polytechnic, Zaria by considering the functional, technical and behavioral performance indicators so as to come up with action plans that will aid future building projects within the school community and higher education institutions at large.

Objectives of the Study

In order to achieve the research aim, the following objectives were set out;

1. To review and establish the functional, technical and behavioral performance indicators for educational facilities during a Post Occupancy Evaluation.
2. To take inventory and document the design attributes of the selected academic building in Nuhu Bamalli Polytechnic.
3. To evaluate the buildings performance and to sort to which extent the building have satisfied its occupants
4. To propose action plans that will aid future building projects within the school community and Higher education institutions at large.

Literature Review

Higher Education Institutional Buildings and its Performance Evaluation

For every individual, both young and old, education is vital to his/her progress and success in life. Consequently, educational activities which includes teaching and learning takes place within spaces provided by buildings. As noted by Okolie (2011), most assets of higher education institutions are buildings.

Buildings play vital roles in the daily running of human activities and in so doing, a number of factors come into play which results in the increasingly rise in operating costs of built facilities due to high amount of power required to run them; increasing competition and rising user expectations. With these notable issues in respect to usage of buildings, maximum return in building investment can only be achieved if higher education institutions seek other avenues. In light of the aforementioned, Building performance evaluation will help ensure that this aim is achieved (Amaratunga and Baldry 2000). According to Douglas (1996); Amarantunga and Baldry (2000); Sanoff (2003), buildings constitutes most educational institutions assets, and so their performance level in relation to operating cost and users satisfaction is paramount to the educational effectiveness of the facilities. Mayaki (2005), also noted that for a building to be

measured as successful, it must meet the purpose it was designed. In this context, Okolie (2011) opines that educational buildings are designed to facilitate learning process, which is, knowledge transfer, promotion, and management. Sanoff (2003) also stressed that modern educational building designs should be adaptive and flexible enough to accommodate functional changes within the building space environment. This will stimulate the adoption of various teaching styles and learning process within the facilities. Also, OECD (2006) opines that building facilities should be able adapt to the inevitable challenge of changing needs and demand in a knowledge economy. As the regular adage says, change is the only constant phenomenon and the change and transformation within the academic environment, is not totally predictable. The educational programmes in the polytechnic institutions of Nigeria are positioned towards mostly technical and technological- based approach to learning. The learning process involves a lot of practical-oriented courses in their academic curriculum which is to aid students to obtain academic, technical skills and professional competencies. For the aforementioned to be met, a lot is dependent on the students and staffs being supported by the adequate built asset environment. In regards to the adequacy of built asset environments, OECD (2003), stated that certain design conditions must be met for effective classroom communication, such conditions were the acoustic, visual, and physical.

Facilities Users' Needs

As it is well known, occupants of any building project are called facilities users or the end users. Building projects are usually carried out to serve the needs of these facility users. Consequently, facilities users are not directly part of the design team which usually is constituted of the built environment professionals. But, the interaction between the buildings and the users is what determines the successful performance such building facilities. This is to say, facility user needs form a major part of a successful building design. Hakkinen and Nuutinen (2007) in their contribution observed that without end users requirements in a building design the possibility of providing an unsuitable working environment high. In this regard, the study called for inclusion of end users and facility managers in the design process so as to understand the precise functional requirements of the building being provided. As Okolie (2011), will also note that, building designs should be collaborative and integrated in nature so as improve functional performance of building facilities. Cain (2003) in this regard also called for an

integrated design team approach based on a thorough and detailed understanding of the precise functional requirements and interrelated values of the end-user . In a nutshell, several studies have shown that the end users are hardly carried along during the design and construction of most public facilities especially educational facilities in Nigeria and this has resulted in an increase in the dissatisfaction levels.

Overview of the Concept of Post Occupancy Evaluation (POE)

Going through history, it will be observed that the practice of Post occupancy evaluation (POE) has been in existence for a while. It is thought to have evolved from the architectural programming techniques of the late 1950s and early 1960s. As noted by Ilesanmi (2010), early evaluative efforts in the built environment were as a resultof issues experienced in institutions such as mental hospitals and prison. Another boost to the emergence of POE were the researches which were geared towards relationships between human behaviour and building designs. It grew in the 1960s and this led to the emergence of a new disciplines in environmental design and the creation of interdisciplinary professional associations. Preiser and Vischer (2004), in their study regarded POE to be the reoccurring term used for the activity of evaluating buildings in use. Watson (2003) defined POE as a systematic evaluation of opinions about buildings in use, from the perspective of users. As Watson (2003) also noted, POE in its nature has multiple features of assessing building qualities and this is by identifying of successful design features, and problems to rectify. What makes up the evaluation as identified by Preiser *et al*, (1988), was the gap between the actual performance and the explicitly stated performance criteria of the building.

Preiser's (2001) study showed that POE differs from other building evaluations in four ways. The first, is the evaluation of the building performance from the occupants' point of view. Secondly, the stated design goal forms the basis for evaluation. Thirdly, the evaluation is based on the measure of the occupants' perception and satisfaction, and to whether the designed environment supported their ability to perform. Fourthly, the evaluation could include various issues about functionality of the environment as well as the occupants' satisfaction based on their psychological and social needs due to the method that involves human subjects.

As Ilesanmi (2010) cites Preiser and Vischer (2004) ,three levels of effort can be identified in a typical POE work. They include; the indicative, Investigative and

Diagnostic. As Preiser and Vischer (2004) noted, 'effort' refers to the amount of time, resources and personnel put into a process or procedure of investigation using a POE approach.

The Indicative approach to POEs identifies the major strengths and weaknesses of a particular building's performance.

Investigative approach to POEs on the other hand seeks more depth in the understanding the performance of the building and so leads to the establishment of clearly stated objective evaluation criterias;

Diagnostic POEs requires a greater level of effort and expense, hence the need to use sophisticated measurement techniques.

As the importance of POE is being increasingly recognized, it is becoming necessary to be undertaken on many public projects. POE is a very valuable tool in all construction sectors, it highlights any immediate teething problems that can be addressed and solved. It also highlights where there is a need for design adjustments and improvements while also attracting the needed support to changing practices, markets, legislation and social trends.

Examples of some current POE toolkits used for educational facility assessment

As the need for building performance evaluation grew over the years, a number of establishments with POE goals worldwide came up with different toolkits. The various toolkits established had differences in their approaches and was due to their set objectives. As stated by El-Darwish and El-Gendy (2017), some of the most common resources that can assist in POE development and implementation are as follows:

PROBE: It was established and funded by the UK government. The toolkit is geared towards the gathering of previous results of building performance and putting them into the public domain for future assistance. It is considered the first establishment that conducted POE from 1995 to 2002.

The Building Use Studies (BUS): It was developed in the UK.. A database was developed from their questionnaire results which is compared against other benchmarks. 12 topics are outlined in their questionnaires.

The Construction Industry Council Design Quality Indicator (CIC DQI): They have online questionnaire, in which their concerns are on building function, build quality and impact. It is also designed to suit a diverse range of people at almost any stage of the building's life cycle.

The Higher Education Design Quality Forum's (HEDQF): This is geared towards educational facilities. It provides discussions between architectural professionals and the procurement officers of higher educational institutions.

The Association of University Directors of Estates (AUDE): They published a guide intended for professionals working on benchmarks, management and operation toolkits for educational buildings.

ii. POE categories based on building performance elements

Preiser etal.,(1988) and Blyth et al.,(2006) in their different studies identified that POE parameters of measurement can be classified into three broad categories which are the technical performance elements, functional performance elements, and behavioral performance elements. Each performance element was shown to consist of performance indicators. Such indicators represent signs, markers, attributes, and items that evaluate specific qualities of an element to be measured.. Performance indicators can differ based on the case study and evaluation purpose (Kim et al.,2005; Sanni-Anibire et al.,2016).

Functional performance elements

The functional performance category of a building evaluation looks at the issues that concerns functionality and efficiency level of the features in buildings facilities. Items of concern in the functional performance categories include the adequacy of the necessary facilities, accessibility within the building and the capacity of spaces for activities. Other indicators in these category also include the effectiveness of the communication and circulation , utilities, and telecommunications as they are linked to the activities within the facility.They are required to be in line to the specific needs of the occupants (Preiser et al.,1988).

Table 1: Performance indicators for Functional Category Elements

Functional Categories

Performance Elements	Performance Indicators	References
Overall building	Building Ceiling height Quantity of elevators in the building Circulation in the building Wayfinding within building Overall layout of the building Operation of doors Cleanliness in the building	Preiser (1995), Borys et al. (2001), Hassanain (2008), Gorgievski et al. (2010), Inah et al. (2014), Leung et al. (2014), Khajehzadeh and Vale (2016), Sanni-Anibire et al. (2016), Babatunde and Perera (2017), Hassanain et al. (2018), Rieh (2018), Abisuga et al. (2019), G€oçer et al. (2019) and Hassanain

		Accessibility to disabled people Quality of sidewalks outside the building Adequacy of parking	et al. (2020)
Classrooms/Lecture rooms		Number of seats in classrooms Overall Size of classrooms Flexibility of furniture in classrooms Quality of furniture in classrooms Classroom amenities (board and projector)	Leung et al. (2014), Hassanain and Iftikhar (2015), Babatunde and Perera (2017), Hassanain et al. (2018), Abisuga et al. (2019) and G€oçer et al. (2019)
Computer laboratories		Number of computer laboratories in the building Size of computer laboratories Overall satisfaction with computer laboratory layout Quality of furniture in the computer laboratories Adequacy of data points (Internet) in the computer laboratories	Borys et al. (2001), Hassanain and Mudhei (2006), Meir et al. (2009), Khalil et al. (2011), Leung et al. (2014), Hassanain and Iftikhar (2015), Babatunde and Perera (2017), Hassanain et al. (2018) and Abisuga et al. (2019)
Science laboratories		Adequacy of space in the lab. Storage space in the laboratories Overall space layout of the laboratories Amenities within the laboratories Quality of furniture in the laboratories	Marmaras and Nathanael (2012), Inah et al. (2014) and Amin et al. (2015), Hassanain and Iftikhar (2015), Khajehzadeh and Vale (2016)
Offices		Number of offices in the building Size of individual offices in the building Flexibility of furniture in the offices	Marmaras and Nathanael (2012), Leung et al. (2014), Hassanain and Iftikhar (2015), Babatunde and Perera (2017) and Hassanain et al. (2018)

		Quality of furniture in the offices	
Student & Faculty lounges		Number of student & faculty lounges in the building. Size of lounges Quality of furniture in the lounges Adequacy of data points (Internet) in lounges	Marmaras and Nathanael (2012), Leung et al. (2014), Hassanain and Iftikhar (2015), Babatunde and Perera (2017), Hassanain et al. (2018) and Rieh (2018)
Toilets/Washrooms		Number of toilets/washrooms in the building Size of washroom in the building Functionality and quality of fixtures Cleanliness in the washroom	Leung et al. (2014), Khajehzadeh and Vale (2016), Babatunde and Perera (2017) and Rieh (2018)

Source: Adapted from Hassanain et al, 2020

Technical performance elements

The Technical performance indicators are attributed to issues which deal with survival such as the structure of the building, sanitation, fire safety, and security (Preiser et al.,1988). From the environmental angle, technical performance also looks at matters than deals with comfort, health, indoor environmental quality (IEQ) and productivity. (Choi et al.,2012). IEQ parameters has to do with thermal comfort (HVAC system and natural ventilation system), indoor air quality, visual comfort and acoustic comfort (Hwang and Kim, 2011).

Table 2: Performance Indicators for Technical Performance Elements

Performance Elements		Performance Indicators	References
Technical Categories			
Thermal comfort		Indoor temperature Control of thermostat Overall satisfaction with the thermal comfort of classrooms Overall satisfaction with the thermal comfort of offices	Preiser (1995), Borys et al. (2001), Hassanain and Mudhei (2006), Meir et al. (2009) Gorgievski et al. (2010), Driza and Park (2014), Hassanain and Iftikhar (2015), Lawrence and Keime (2016), Hassanain et al. (2018) and Abisuga et al. (2019)

Indoor Air quality		Air freshness Overall satisfaction with indoor air quality throughout the building	Khalil et al. (2011), Driza and Park (2014), Lawrence and Keime (2016), Hassanain et al. (2018) and Murgu (2020)
Acoustic comfort		Noise from adjacent rooms Noise from HVAC systems Audio quality of classroom speakers Ability to hear the lecturer in the classroom Overall satisfaction with classroom acoustics	Borys et al. (2001), Hassanain (2008), Nawawi and Khalil (2008), Meir et al. (2009), Potthoff (2009), Hassanain and Iftikhar (2015), Khajehzadeh and Vale (2016), Lawrence and Keime (2016), Abisuga et al. (2019), Kamaruzzaman and Azmal (2019) and Murgu (2020)
Visual comfort		Amount of daylight throughout the building Level of brightness (artificial lighting) in classrooms Level of brightness (artificial lighting) in the laboratory spaces Control of artificial lighting Adequacy of lighting levels in the buildings' corridors Outdoor views from the building	Preiser (1995), Meir et al. (2009), Potthoff (2009), Khalil et al. (2011), Driza and Park (2014), Khajehzadeh and Vale (2016), Kamaruzzaman and Azmal (2019) and Hassanain et al. (2020)
Safety & security		Ease of identifying emergency/escape routes Ease of exiting the building in case of fire emergency Number of fire drills during the term Overall satisfaction with safety and security systems in the building	Hassanain and Harkness (2000), Hassanain (2008), Hassanain and Iftikhar (2015), Rieh (2018), Leung et al. (2014), Khajehzadeh and Vale (2016), Babatunde and Perera (2017) and Rieh (2018)
Maintenance & management		Elevators Washrooms Lighting in the building HVAC in the building Handling of users' complaints	Preiser (1995), Hassanain and Harkness (2000), Hassanain (2008), Potthoff (2009) Gorgievski et al. (2010), Khalil et al. (2011), Driza and Park (2014), Hassanain and Iftikhar (2015), Babatunde and Perera (2017), Abisuga

			et al. (2019), Kamaruzzaman and Azmal (2019) and Murgu (2020)

Source: Adapted from Hassanain et al, 2020

Behavioral performance elements

The Behavioral performance category elements has to do with the link between occupants' activities and the physical environment. Behavioral performance indicators have to do with the effect of size of space and the number of persons that share it and the effect of functional distance between spaces upon the frequency of use. Another factor considered, is the configuration of circulation routes on social interaction, and the features that affect the building's image and outlook(Preiser et al.,1988; Sanni- Anibire etal.,2016).

Table 3: Performance Indicators for Behavioral Category Elements

Behavioral Categories

Performance Elements		Performance Elements	References
Privacy		Users density within the building Users density within the classrooms/lecture rooms Users density within the laboratories Users density within the washrooms/toilets	Hassanain (2008), Gorgievski et al. (2010), Leung et al. (2014) and Khajehzadeh and Vale (2016)
Building location		Appropriateness of location within the campus Classrooms location within the building Laboratories location within the building Offices location within the building Common areas location within the building Canteen location within the building	Borys et al. (2001), Hassanain (2008) and Inah et al., 2014)

		Washroom/toilet location within the building	
Building proximity		Proximity to place of worship Proximity to the central dinning facility Proximity to the parking area Proximity to the transportation amenities/bus stations Proximity to the library	Fatoye and Odusami (2009) and Inah et al. (2014)
Appearance		Exterior design of the building Interior design of the building	Babatunde and Perera (2017) and Kamaruzzaman and Azmal (2019)
Quality of materials used		Classrooms/lecture rooms/auditoriums Computer laboratories Science laboratories Student & Faculty lounges Canteen Offices Washrooms	Khalil et al. (2011), Jylh€a et al. (2015), Hassanain and Iftikhar (2015), Pissourios and Lagopoulos (2017), Hassanain et al. (2018), Boge et al. (2019), Br€ochner et al. (2019) and Hassanain et al. (2020)

Source: Adapted from Hassanain et al, 2020

Methodology/Research Design

The study is all about gaining an insight on the building performance of the School of Environmental Studies(SES) building in Nuhu Bamalli Polytechnic, Zaria using the POE. As acknowledged by some authors, POE has no standard methodologies as the surveys are diverse in respect to subjective perspectives of the evaluators and quite a number of methods are available (Bordass, 2003; Vásquez-Hernández and Restrepo Álvarez , 2017; Li *et al.,* 2018). As reviewed by Li *et al.* (2018) on the POE approach, the study showed that occupant survey is the most widely used method, presumably because it could help quantify subjective opinions through the use of questions with scaled responses and then benchmark the results. Hence, occupant survey is largely dependent on in this study while the

walkthrough tour/observation and interview was used to complement the study. The research time frame is cross-sectional which is dependent on a single moment in time data. The study is a mixed method. It is qualitative because it involves collecting empirical materials through case study, walkthrough observations and interviews while it is quantitative as questionnaire survey was used to generalize some of the findings from the qualitative approach. The interview was directed at the administrators of physical planning and procurement of the institution. This was to understand how the process of building delivery was carried out and if it worked, if the original goals were met, if anything went wrong and if so, why. The observations were carried out through a series of inspections/walk-throughs of the selected building to investigate the current condition of the building's physical parameters and the occupants in their natural settings. The observation was aided by visual survey (such as sketch plans and pictures) and an observational sheet. The observations were carried out within two periods of the working hours within the day. That is, between 8am to 12noon and 1pm to 5pm. A web based questionnaire was employed in which thirty five (35) performance indicators were adapted from Hassanain's (2020) study as seen from tables 1-3 in the literature review, which captures the functional, technical and behavioral performance elements. Seventy five (75) responses from both students and staff were used to get mean scores of opinions on each of the adopted performance indicator.

Data Presentation and Results

Interview with the Physical Planning department and the Procurement department

This section presents the data gotten from the interviews carried out. The interviewees were the administrators of the physical planning (PP) and procurement department (PD) of the polytechnic. The interview question line for the physical planning and procurement staff was to understand how the process of building delivery worked, if the original goals are usually met, if not, why?

Interview Responses

A summary is provided of the interview findings in the order of the questions asked:

Q1. What role do you play in building project delivery in the institution?

Physical planning office major role in building project delivery is supervision and implementation of construction of buildings and other infrastructure.

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Procurement office role in building project delivery is to establish procedures that assures prompt delivery of projects. They are responsible for negotiating, preparing contracts and monitoring of the building projects.

Q2. In your opinion, would you say the desired objectives of building projects are usually attained? If not, why?

They all agreed that to a great extend that their set objectives are usually accomplished as there is no project without a challenge. They noted that most of the challenges had to do with project delays and use of inferior materials.

Q3. Is there any form of building evaluation after the construction phase? If no, why?

The physical planning and procurement noted that there is no formal evaluation process in place once the construction is completed and building is being used. But the physical planning do an observational check during the 6months defects liability period for issues that might arise due to defects in the building before releasing the retention sum to the contractor. The procurement on their own part ensure that the building project are carried out according to the contract documents. The reason they gave for not having any form of building evaluation is because it is not part of the contract and it will increase the contract sum.

Q4. What do you think about adopting Post Occupancy Evaluation of building facilities within the institution?

They all agreed it will be a good process for achieving design goals. The physical planning staff was of the opinion it will help them in their maintenance task as they usually have mechanical and electrical issues after buildings are being delivered.

Q5. In your opinion, do you think end users opinions in the design and construction of the buildings will make a big difference in attaining your design and build objectives?

They all agreed to end users being major stakeholders and their opinions will contribute immensely to achieving the set building design objectives. The procurement manager in line with this question said the rector had mandated them to engage the end users during the procurement process.

Q6. Are there any challenges that make attaining your set objectives cumbersome?

The procurement manager highlighted issues of delays in project completion time which was mostly not the fault of the contractor but bureaucratic hitches in the procurement processes. Issue of a singular consultant been used for most of the projects held the polytechnic aback in terms design choices but in the last two

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years the polytechnic has been opened to quite a number of consultants which has resulted in different styles of buildings.

Post Occupancy Evaluation: Observational survey and Application of the Questionnaire Survey

Here, a detailed discussion of the post occupancy evaluation based on the observational study and occupants feedback of the selected school.

Case Study : The School of Environmental Studies (S.E.S)

The S.E.S. is located in the polytechnic main campus. The S.E.S. building is a one-storey structure comprising of six departments namely; Architecture, Building, Estate management, Land and Geo-informatics, Quantity surveying and Urban and Regional Planning. The S.E.S. building is a compact structure consisting of a central hub which houses the administrative section of the school and all other departments radiate from this central hub as wings which houses the various departments, classrooms, studios and other common areas. It consists of eighty six (86) office spaces, seven (7) boardrooms, twenty four (24) lecture room, two (2) laboratories, two (2) workshops and fifty six (56) toilets. For the data collection in this study, the staff office areas and students areas were all included.

Figure:1 Google earth image of site
Source: Google earth & Author's work

Figure 2: Sketch plan of the SES Complex

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Plate 1: Exterior view of SES Plate 2: Lobby within the office space Plate 3:Arch. Studio
Source: Author's fieldwork



Plate 4: Typical office Plate 5: Corridor & Courtyard within class space Plate 6: Toilet
Source: Author's fieldwork

Observational Survey

Staff offices, student classrooms, toilet, lobbies, and studios were observed (see plates 1-6) .

Staff Office Area:

Size: Most office spaces were approximately 10sqm in size except for some offices in the central hub that houses senior academic and administrative staff. 30

Activities: The major activities going on within these spaces were staff attending to students assignments in their offices or working on their computers if light was

available. The lobby between offices are usually crowded by students especially department of architecture due to the learning/teaching pedagogy which requires students/mentees consulting their mentors.

Privacy: Offices are enclosed spaces which encourages privacy and reduces interaction. Most offices were shared between two staff except for a few that had a single occupant.

ICT/Internet: There are no provision for ICT/internet points in the office spaces.

Toilets: Toilets provided for staff are hardly used because it is usually unclean so the one provided in Head of department office is used mostly by both male and female staff. Most boardrooms in the various departments were used as extra office spaces, libraries and storages due to the inadequacy of such spaces.

Cleanliness: The offices and support spaces were fairly tidy

Acoustic Comfort: There was a lot of noise from within the building due to the use of generators to power the buildings while outside the building was moderate except for students commuters passing behind some office windows.

Accessibility: Accessibility for persons with disability was not highly considered except for the central hub entrance area.

Student Areas:

Size: Classrooms and studios were about 60sqm in size. Students of architecture used their classrooms as studios and so the furniture there are different from the other classrooms. **Activities:** Activities in the classroom were mostly receiving lectures and usually empty whenever no lectures are going on except for the architectural studios.

Privacy: Classrooms are large enclosed spaces with rows of seats which doesn't give any form of privacy or territoriality except for studios which every student has his work table, a level of privacy is attained.

ICT/Internet: There are no ICT/Internet points within their classrooms or laboratories.

Toilets: Toilets for student usage are attached to the staff office areas and are mostly locked and not accessible to them.

Cleanliness: The classrooms and support spaces were untidy

Acoustic Comfort: Noise level from within was moderate except classrooms that had their windows to activity areas like parking lots.

Socialization and Interaction: Interaction for students is limited to the formal classroom areas as there are no spaces within the complex that promotes socialization and informal learning.

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Table 4: Evaluation Table for Staff and Students Spaces from Observation.

ITEM	DESCRIPTION/EXPLANATIONS
Floor Finish	**Office:** It is a cement sand finish except for the central hub offices and so carpets/rugs are used to give it a more aesthetically pleasing finish. Maintenance is less difficult the rugs tend to wear. **Classrooms/Laboratories:** Terrazzo finish. It is highly suitable and easy to maintain. It is aesthetically pleasing if kept clean. **Lobby/Corridors:** Terrazzo finish. It is highly suitable and easy to maintain. It is aesthetically pleasing if kept clean.
Wall Finish	**Office:** It is green emulsion paint on cement-sand plaster. It is suitable and easy to maintain **Classrooms/Laboratories:** It is green emulsion paint on cement-sand plaster. It is suitable and easy to maintain.
Ceiling Finish	**Office:** It is a painted concrete deck on the ground floor and cellotex boards for the upper floors. It is suitable and easy to maintain. **Classrooms/Laboratories:** It is painted concrete deck on the ground floor and cellotex boards for the upper floors. It is suitable and easy to maintain. **Lobby/Corridors:** It is painted concrete deck on the ground floor and celotex boards for the upper floors. It is suitable and easy to maintain.
Doors	**Office:** Green coloured purpose made 900mm by 2100mm steel doors. They are suitable for security, durable and easy to maintain. They are aesthetically pleasing. **Classrooms/Laboratories:** Green coloured purpose made 1200mm by 2100mm steel doors. They are suitable for security, durable and easy to maintain. They are aesthetically pleasing.
Windows	**Office:** Aluminium sliding windows. They are suitable for security, durable and easy to maintain. They are aesthetically pleasing. **Classrooms/Laboratories:** Steel casement windows with glass panels. They are suitable for security, durable and easy to maintain. They are aesthetically pleasing.
Lighting	**Office:** Both natural and artificial lighting are sufficient except for a few offices who have their windows opening to a lobby where there is insufficient natural lighting. Occupants have control over the natural and artificial lighting. **Classrooms/Laboratories:** Both natural and artificial lighting are sufficient. Occupants have control over the artificial lighting.
Ventilation	**Office:** Both natural and artificial ventilation are sufficient except for a few offices who have their windows opening to a lobby where there is insufficient natural ventilation. Occupants have control over the natural and artificial ventilation.

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	Classrooms/Laboratories: Both natural and artificial ventilation are sufficient. Occupants have control over the natural and artificial ventilation.

Questionnaire Survey

1. Participants Specific Information

Table 5: Gender of Respondents

	Frequency	Percentage (%)
Male	66	88
Female	9	12
Total	75	100

Table 6: Categories of Participants

	Frequency	Percentage (%)
Academic staff	**35**	**47**
Students	**40**	**53**
Administrative staff	**0**	**0**
Total	**75**	**100**

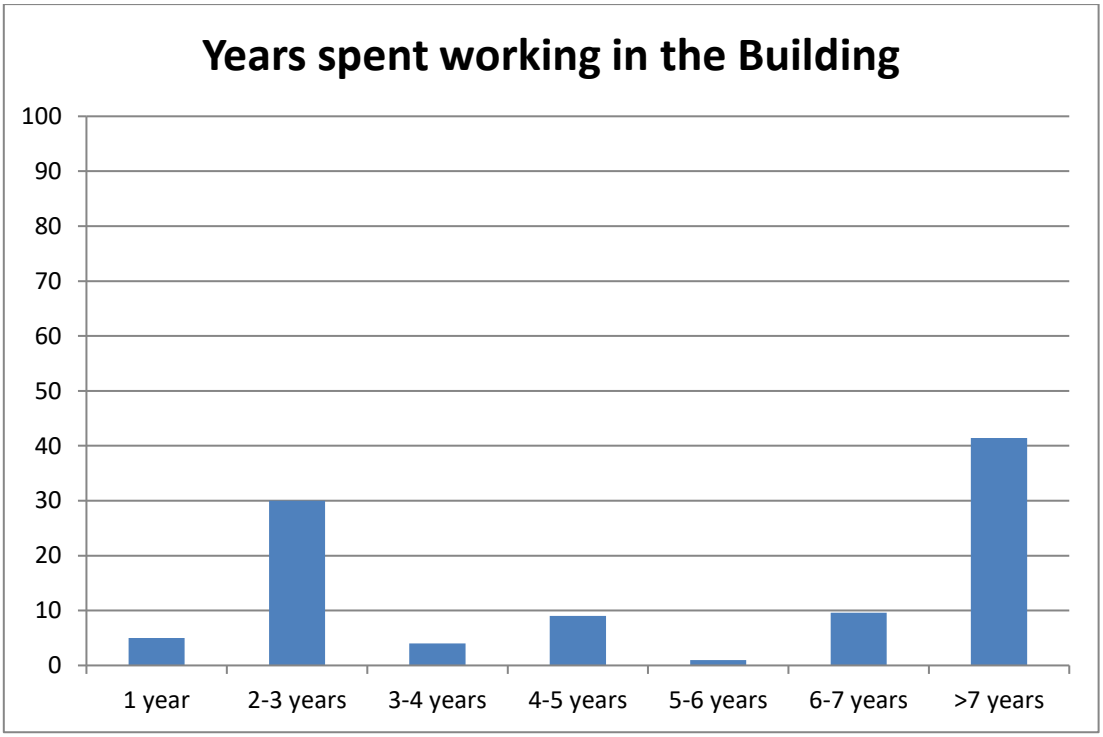

Figure 3: Years spent working in the building
Source: Author's work

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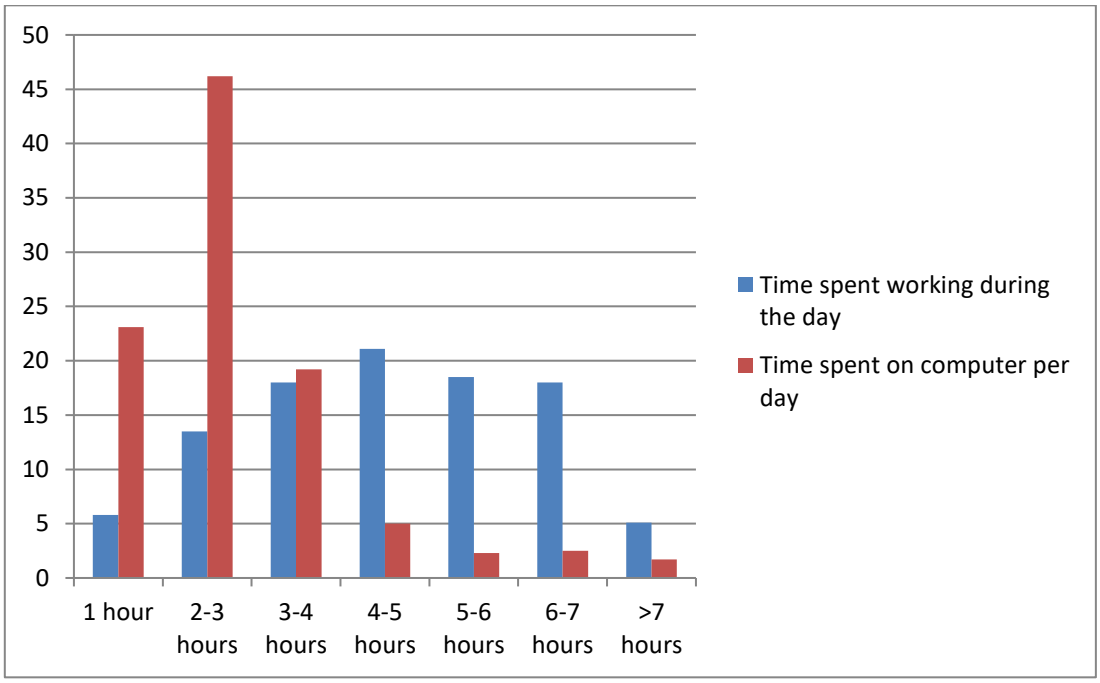

Figure 4: Time spent working during the day in the building & on the computer per day

Source: Author's work

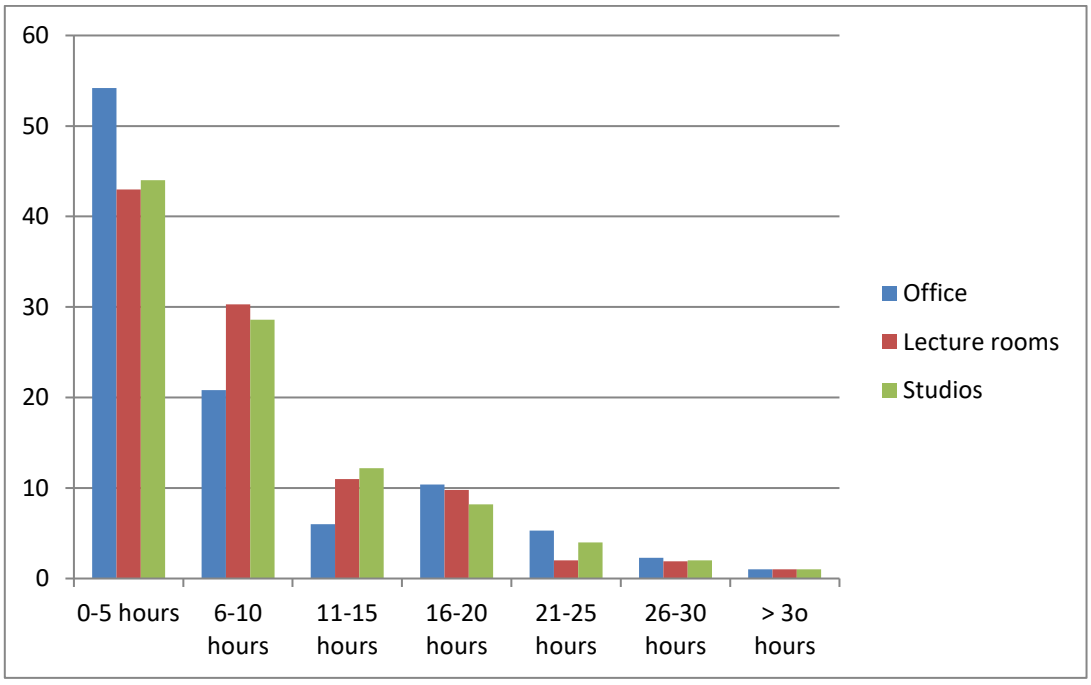

Figure 5: Time spent within the week in various spaces in the Building

Source: Author's work

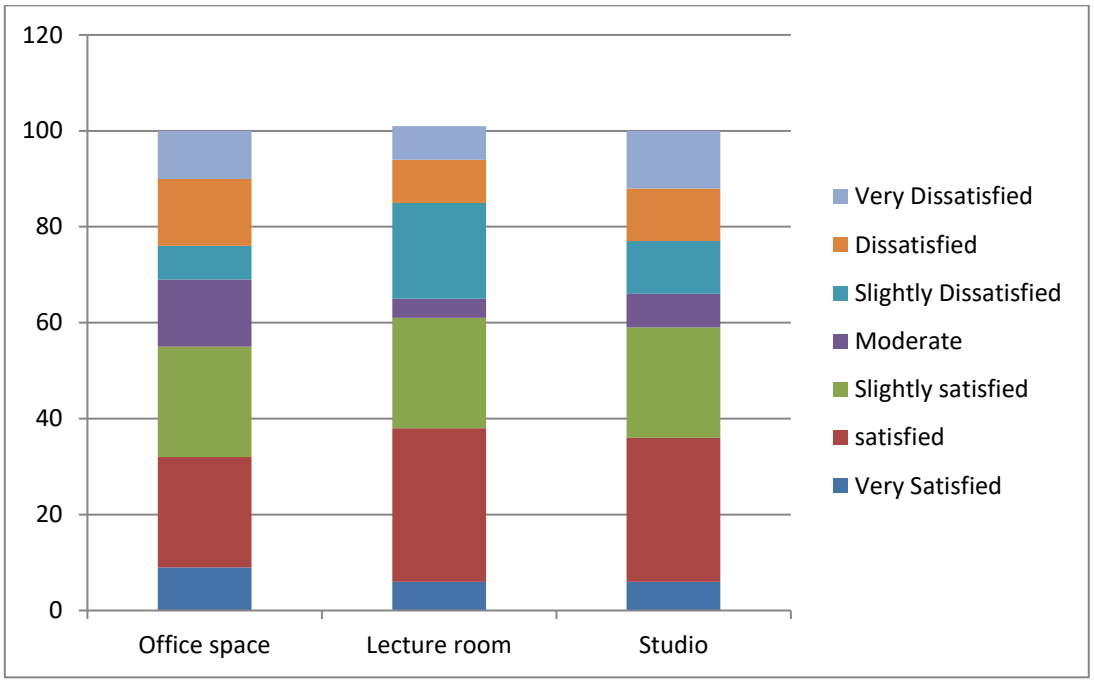

Figure 6: Satisfaction level of spaces by occupants
Source: Author's work

Tables 5 and 6 above presents specific information about the occupant population that participated in the survey in the SES complex. It showed that seventy five (75) persons participated and was categorized by 47% academic staff and 53% student population from which 88% were males and 12% females. Figures 3 & 4 highlights number of years spent working in occupants specific workspace and the maximum hours they typically spend in the building working from within their workspaces and on their computers respectively. It shows that 41% have spent above 7 years which is the highest, 30% have spent 2-3 years which is second while 2% spent 5-6 years signifying the lowest in the chart. In respect to hours spent during the day in offices and working on personal computers during the day, 4-5 hours had 21% which was highest and close scores of 18% for 3-4hours, 5-6hours and 6-7hours respectively for time spent during the day in the office while above 7 hours had 5% which is the lowest. For time spent on computer during the day 2-3 hours had 46% which was the highest and above 7hours had 2% which was the lowest. Figure 5 showed the total time spent within the week in spaces such as offices, lecture rooms and studios, a score of 55%, 42% and 43% were recorded respectively as highest for 0-5hours, while above 30hours had the lowest score of

1% each for the respective spaces. Figure 6 showed the satisfaction level of occupants within the various spaces, for which 70% indicated satisfaction for office spaces, 62% indicated satisfaction for lecture rooms and 63% for the studio rooms.

Building Performance Specific Findings

Here, discussion of the building specific findings from the analysis of the S.E.S. survey responses are presented. Respondents were asked to rate their satisfaction level based on 35 performance indicators based on the functional, technical and behavioral attributes. Respondents were required to rate their satisfaction level based on seven-point scale: "1" (very dissatisfied), "2" (dissatisfied), "3" (slightly dissatisfied), "4" (moderate), "5" (slightly satisfied), "6" (satisfied) and "7" (very satisfied). Table 7 illustrates the users' satisfaction level toward the listed performance attributes.in the order of the different sections in the survey.

Results of the Functional Design Performance (FDP) Elements

Three of four items related to the accessibility (ease of access from entrance to office, horizontal circulation, and adequacy of vertical circulation) recorded mean scores of (4.60), (4.16), and (4.86), respectively, indicating that their satisfaction degree is higher than moderate. Ease of movement for the disabled achieved mean value of 3.21 meaning that users satisfaction level for this item was lower than the moderate level. For the quality, cleanliness of toilets and overall building a mean value of 3.25 was achieved indicating that users satisfaction level was lower than moderate. Also, for adequacy of storage spaces in the building a mean value of 3.41 was achieved indicating that the satisfaction level was below moderate. Based on users' responses, the mean value of the overall quality and adequacy of accessibility attributes was 4.21 suggesting that the adequacy of accessibility achieved a degree of satisfaction above the moderate.

Results of the Technical Performance (TP) Elements

Two out of the five items relating to safety and aspects of the environment that make one feel safe (lighting within and around the building and spatial configuration of building) recorded mean values of 4.05 and 4.21 respectively indicating users satisfaction level above moderate. The remaining items and attributes (Visibility of security, Ease of exiting building, Ease of identifying emergency route) achieved mean scores of 3.80, 3.16 and 3.86 respectively,

indicating satisfaction level below moderate. Based on users' responses, the mean value of the overall adequacy of safety within the building was 5.03 suggesting it achieved a degree that was slightly satisfactory.

Eight of nine items relating to indoor environmental quality (Quality of air in offices, classrooms, ease of control over natural ventilation, thermal satisfaction with working spaces, noise level from outside, noise level from adjacent spaces, quality of natural lighting within the building, Level of artificial lighting within the building and ease of control over artificial lighting) achieved mean scores of 5.15, 4.84, 4.54, 4.27, 3.80, 4.47, 4.23, and 4.80 respectively indicating users satisfaction level above moderate. Ease of control over natural lighting achieved a mean value of 3.92 indicating satisfaction level below moderate. Based on users' responses, the mean value of the overall quality of IEQ was 4.03 suggesting it achieved a degree of satisfaction above moderate.

Results of the Behavioral Performance (TP) Elements

Three of four items related to the density of users per space (density of occupants in the overall building complex, density of users in an office and density of users within classrooms,) recorded mean scores of (4.67), (4.64), and (4.48), respectively, indicating that their satisfaction degree is higher than moderate. Density of users within washrooms/toilets recorded mean value of 3.55 signifying users satisfaction below moderate. Based on users' responses, the mean value of the overall adequacy of users per space was 4.03 suggesting it achieved a degree of satisfaction above moderate.

Three of four items related to the location of spaces (location of building within campus, location of offices within the building and location of classrooms within the building) recorded mean scores of (4.39), (4.59), and (4.53), respectively, indicating that their satisfaction degree is higher than moderate. Location of toilets within the building recorded mean value of 3.93 signifying users satisfaction below moderate. Based on users' responses, the mean value of the overall adequacy of location was 4.03 suggesting it achieved a degree of satisfaction above moderate.

Two of three items related to the proximity to facilities within the campus (proximity to places of worship and proximity to the parking area,) recorded mean scores of (4.03) and (5.11) respectively, indicating that their satisfaction degree is higher than moderate. Proximity to the transportation amenities/bus station recorded mean value of 3.87 signifying users satisfaction below moderate. Based

on users' responses, the mean value of the overall adequacy of the proximity to facilities was 4.03 suggesting it achieved a degree of satisfaction above moderate. Two of two items related to the building appearance (external design of building and internal design of building) recorded mean scores of (4.29) and (4.11) respectively, indicating that their satisfaction degree is higher than moderate.

Table 7: Results of Occupants Satisfaction level with Specific Building Performance Indicators

POE Performance Indicators			VD 1	D 2	SD 3	M 4	SS 5	S 6	VS 7	Mean (X)
FDP	**Accessibility**	Ease of access from entrance to personal workspace	6	8	6	9	11	26	9	4.60
		Vertical circulation	6	7	7	9	14	23	9	4.16
		Horizontal circulation	4	7	6	6	14	31	7	4.86
		Ease of movement for the disabled	20	11	12	11	9	10	2	3.21
	Cleanliness	Quality, cleanliness of toilets & overall building.	7	10	15	18	10	10	5	3.85
	Storage spaces	Adequacy of Storage spaces	16	7	14	25	7	3	3	3.41
TP	**Safety/aspects of the environment that make one feel safe**	Adequacy of safety within the building.	2	1	9	14	15	23	11	5.03
		Visibility of security	14	7	8	6	19	9	12	3.80
		Ease of exiting building	18	15	15	8	8	5	6	3.16 3.89
		Ease of identifying emergency route.	13	12	5	15	10	10	10	4.05
		Lighting within/around building	18	8	5	7	10	12	15	4.27
		Spatial configuration of building	13	6	8	7	15	14	12	
	IEQ	Quality of air in offices, classrooms, studio and labs.	3	4	5	12	11	23	17	5.15

		Ease of control over natural ventilation.	8	5	5	7	16	16	18	4.84
		Thermal satisfaction with working spaces.	4	8	5	15	22	11	10	4.54
		Satisfaction level with noise from outside the building.	11	4	8	15	16	10	11	4.27
		Satisfaction level with noise from adjacent spaces.	13	11	9	10	17	7	8	3.80
		Quality of natural lighting within the building.	8	4	9	16	10	13	13	4.47
		Level of artificial lighting within the building.	6	7	7	24	13	11	7	4.23
		Ease of control over natural lighting	13	4	4	16	10	12	4	3.92
		Ease of control over artificial lighting	6	5	7	13	10	17	17	4.80
BP	**Density of users /space**	Density of occupants in the overall building complex	9	5	6	9	15	15	16	4.67
		Density of users in an office.	7	11	3	9	11	19	15	4.64
		Density of users within classrooms	11	5	8	7	14	17	13	4.48
		Density of users within washrooms/toilets	18	14	6	10	8	11	8	3.55
	Location of spaces	Satisfaction with location of building within campus.	13	6	4	12	7	19	13	4.39
		Satisfaction with location of offices within the building.	7	8	9	5	14	20	12	4.59
		Satisfaction with location of classrooms within the building.	5	10	10	8	13	15	14	4.53
		Satisfaction with location of toilets within the building.	13	11	9	8	13	11	10	3.93
	Proximity to facilities within the campus	Proximity to places of worship	14	9	10	7	11	11	13	4.03 5.11

		Proximity to the parking area.	4	7	4	4	13	25	16	3.87
		Proximity to the transportation amenities/bus station	15	6	8	7	17	12	5	
	Building Appearance	Satisfaction level Exterior design of the building	8	10	3	11	25	10	8	4.29
		Satisfaction level internal design of the building	10	11	5	8	24	11	6	4.11

Ratings: 1- Very Dissatisfied (VD); 2- Dissatisfied (D); 3- Slightly Dissatisfied(SD); 4- Moderate (M); 5- Slightly Satisfied (SS); 6- Satisfied (S); 7- Very Satisfied (VS) .

Discussion

This study captures the opinions, feelings and experiences of respondents (staff and students) about the performance of the building they are occupying in the institution. Table 7, summaries the mean scores of the user's perception of the facilities in the building examined. The responses indicated concerns regarding such building performance issues as ease of movement for the disabled, quality and cleanliness of toilets/washrooms and overall building, adequacy of storage spaces, density of users within toilets/washrooms, location of toilets within the building complex, proximity of building to worship spaces and proximity to amenities and bus stations as evident from the overall mean scores of each of the item mentioned.

The walkthrough observation also indicated concerns in respect to facilities such as toilets, in which they were mostly found to be not functional and untidy due to lack of water within the building and also not accessible to students. There was no adequate power supply and so most users resulted to alternative power sources such as generator to power their departments which resulted to so much acoustic discomfort especially between 10am to 2pm office hours. Also, due to the lack and epileptic power supply, most staff are hardly found in their offices as they cannot work on their computers.

Conclusion and Recommendations

An investigative assessment of School of Environmental Studies (SES) building was carried out in Nuhu Bamalli Polytechnic, in which a representative sample of the building users opinions was solicited. The study determined the degree of

satisfaction obtained for thirty five (35) identified performance indicators using a web based questionnaire survey. The findings were further supplemented with a walkthrough tour/ observation. The results shows satisfaction with staff offices, classroom space, studios/laboratories/workshops, air quality (ventilation) and security but had concerns with quality and cleanliness of toilets, storage spaces, internet facilities, inconsistent power and water supply and general maintenance of facility. The aforementioned outcomes showed that the challenges facing the academic facilities in the polytechnic are somehow similar to the studies carried out on such facilities in other higher education institutions in Nigeria. However, the study revealed that the deficiency in some of these facilities resulted in some certain behavioral patterns among the staff and students which directly or indirectly affected their comfort and performance level within their work spaces. Such issues were the lack of power and water supply within facility, density of users within toilets, location of these toilets and proximity to amenities. As staff and students had to seek favorable alternatives which kept them away from their workspaces and in turn affecting productivity and learning process.

Recommendations

All concerns identified through the multiple evaluation techniques adopted resulted in the following recommendations.

i. Users' opinion should be incorporated right from the initiation stage of the design for future infrastructural developments in the Polytechnic so as to achieve a high performance building for learning.
ii. The quality of features and fittings like sanitary fittings and internet facilities should be highly considered when designing and constructing subsequent projects.
iii. There should be purposeful design for spaces that will accommodate alternative power plants which should be outside the facility so as to control the noise level in the building and health risk of its occupants.
iv. Future infrastructural projects in the polytechnic should highly ensure the universal design approach so as to accommodate persons with physical challenges.
v. A Building maintenance policy should be adopted that will require for regular updating of the polytechnic facilities.
vi. There is a need for the Polytechnic management to be enlightened on the benefits of conducting POE so that they can support the process.

vii. In the procurement process, building performance evaluation should be included. This will provide feedback if the building performance objectives are met during the design and construction.

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