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Architecture as a tool for sustainable learning in a primary school in Ota, Ogun State, Nigeria

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Abstract: ***For sustainable learning to take place, a learning center must offer a comfortable, healthy, secure, approachable, well-lit, well-ventilated, and aesthetically pleasing physical environment. The United Nations has seen the need for quality education and coined the phrase "Sustainable Learning" which refers to the integration of play and creativity into learning. This study assessed the learning methods and learning spaces used in a private Nursery and Primary School, located in Ota, Ogun State, Nigeria. This was done to have a better understanding of the sustainability of the educational facilities provided. The qualitative method was used for the research. First, the learning characteristics and learning methods of pupils were identified through focus group interviews. Secondly, abstract elements of architecture found within learning spaces were identified using literature and nonparticipant observation. Data gathered was assessed using documentation and content analyses. Findings showed that children are unaware of how their learning environment can affect their ability to learn, and further revealed that most learning spaces for children in the study area do not have adequate spaces that will accommodate and facilitate all types of learning and learning methods. It is recommended that all learning facilities for children should not only be accredited based on the subjects and teachers' qualifications, but also the quality and design of the physical structure provided as learning spaces.***

Keywords: Children's Learning, Learning Environment, Learning Methods, Space, Sustainable Learning, Primary School

1. Introduction

A learning centre is a highly specialized space that provides students with interactive and intriguing opportunities to practice, enhance, relearn, and improve their learning skills (Janes et al., 2020; Zhao and Kang, 2020). It should provide a pleasant, healthy, secure, approachable, well- lit, well-ventilated, and aesthetically pleasing physical environment. In 2015, the United Nations established a special programme called the 17 Sustainable Development Goals (SDGs), which is a strategy aimed at improving economic growth by addressing a set of public needs such as education, health, social protection, and job opportunities, while tackling the problems of climate change and environmental protection in the 21st century (Nogueiro et al., 2022). One of the SDGs is Quality Education and the three fundamental cornerstones of quality education include providing access to qualified educators, providing access to quality learning resources and professional development, and establishing safe and supportive learning environments (Slade, 2016). The term "Sustainable Learning" was coined as a response to the new in-depth understanding of quality education. According to Samuelsson & Park, (2017), sustainable learning should include creativity, play, and attentiveness to reality. It was emphasized that play and creativity should not be isolated from learning, but rather, should be used as a dimension for the teaching and learning process.

Despite the early adoption of western education in Nigeria, few modern public learning centres have purposely designed facilities specialised for children's learning requirements. A study carried out by Amoo, (2014), showed that research on children's learning centres in Nigeria is quite limited, and these facilities are mostly designed without primary emphasis on the users' viewpoints and how they want the facilities to be designed. In the same vein Habibu & Ejembi, (2011), stated that the absence of adequate public learning centres, as well as the contribution they make in improving educational standards, is erroneously ignored. There is therefore a need to assess learning spaces and methods provided in the study area to have a better understanding of their provisions.

2. Literature review

2.1 Overview of Primary Education in Nigeria

Child education is the most basic form of education available to individuals. It is the foundational instruction upon which all subsequent educational achievement is built. As a result, fundamental education decides to a considerable part in the success or failure of all subsequent levels of education (Akor and Amsdioha, 2020). There has been a continuous need to redefine the definition of childhood education, leading to new angles of meaning. Social policy on daycare, educational policy on childhood education, and changes in educational standards, as well as changes in philosophical and theoretical perspectives on children, education, learning, and knowledge, have all had an influence, resulting in a broader variety of implications on the true meaning of childhood (Harkonen, 2004). Primary school is a learning environment for the primary education of children. Primary education is very important as it enables the child to grasp a good foundation in the education process where the child learns the '3Rs' which are Reading, Writing, and 'Rithmetic'. The 3Rs ensure a child is literate. Along with these, the child learns character, moral training, and living together with others. Thus, a child is prepared for trade and craft in the locality or for further education. Hence, it can be stated that a child's future could depend largely on the education received at the primary level.

2.2 Impact of Primary Education

Great personalities like Friedrich Fröbel, Maria Montessori, Rudolf Steiner, and many others have had a very strong influence on childhood education (Saracho and Evans, 2021; Taylor and Boyer, 2020). They have transferred their educational philosophy to the future either directly or through the proxy of others. As a result of these policies and philosophies, child education has been divided into two categories: Early Childhood Education (ECE) and Elementary Education. Children in ECE are typically between the ages of 0 and 3. They are newborns, babies, and toddlers who learn more effectively through creative means such as storytelling, art, and music, as well as the fundamentals of academics. In Elementary Education, the children range in age from 4 to 12. Mathematics, science, English, and history are taught as foundational subjects (Goodwin University, 2018). Primary education gives the child the ability to communicate and contributes to economic development and poverty reduction. It also proffers an awareness of improved health and nutrition and promotes behavioural change and attitudes among primary school pupils.

Primary education also leads to the acquisition of skills such as knitting, beading, sewing, and many others. Another impact of primary education is that it provides a platform for the learning of societal norms, and learning of cultures.

2.3 Evolving Primary Education in Nigeria

In Nigeria, as far back as the 1950s a child is seen fit to attend primary school only when the palm of the right hand, when raised over the head, touches the left ear. This act is usually achieved when the child is around six (6) years of age. At the time there was no kindergarten school. Primary education takes place over six (6) years and is regarded as the bedrock of the development of a child's educational and professional future.

Primary education in Nigeria has evolved from the study of the 3Rs along with social/moral instruction to a much more cumbersome fifteen (15) subject timetable. This drastic change is not accompanied by a correlating increase in funds, classrooms, laboratories, and adequately trained teachers. These multiple subjects are taught with little or no upgrade of the classroom and laboratory setting. Needed upgrades include, but are not limited to, an art studio, agricultural garden, home economics room, musical instruments, and specially trained teachers. These shortcomings can be frustrating to the pupils, their parents, and the education system in Nigeria. The inadequate enabling environment to cope with the large number of subjects taught in a primary school is a great challenge that leads to poor performance of the pupils. The Nigerian primary education system of the 21st century places a lot of emphasis on examinations and has therefore roped many a parent and children into examination malpractices. These challenges lead a majority to believe there is a fall in the educational standard of the nation. However, there could never have been a fall because the facilitators and suppliers of education infrastructure never provided what could be termed as adequate for the needs of the upgraded subjects in the first place. Thus, the evolution of primary education in Nigeria can be made robust if a corresponding evolution of educational infrastructure is experienced.

2.4 Architectural Design Requirements for Primary Education in Nigeria

Basic education in Nigeria has its origins in the British-designed educational system for Nigeria, which began when Reverend Thomas Birch Freeman and Mr. and Mrs. Degraft of the Wesleyan Methodist Church arrived in Badagry and started a school, namely a private home school (Amadioha, 2011). According to Imam, (2012), basic child education covers nine years of

formal schooling. It is divided into 2 sections. Pre-primary (Nursery) education, and Primary education. The design of these learning spaces is dependent on the use of the elements of architecture in an advantageous manner for quality education. Elements of architecture have to be considered in the course of designing a children's learning centre. Various research has been carried out to identify the best practices for the use of these elements. According to (Chowdhury et al., 2023; Watchman et al., 2022); Unwin, (2009), the elements of architecture are light, colour, temperature, airflow, sound, scents, textures of the materials used, size, and the impacts and experience of time.

a. Lighting Considerations

Students require adequate general light for both work and play. According to studies, overhead cool-white fluorescent lighting bounces off surfaces and into students' eyes, causing an unintentional glare known as veiling reflection (Farnsworth, 2022). These fluorescent lamps are also prone to flickering which is a major distraction for pupils and increases the tendency for emotional distress (Order, 2015). Full-spectrum lighting (similar to natural light) is the most effective for improving behaviours, reducing anxiety and stress, and improving general health. Blue light aids in the reduction of the sleep hormone melatonin, making individuals energetic, alert, and ready to learn (Hakimi, 2011). Leaving the lights on toward the front of the room might help to draw attention to the lesson.

b. Colour Scheme

Straight white walls, single-colour walls, or repetitive settings can make youngsters introverted which can lead to anxiety, panic, dissatisfaction, and discontent due to a lack of stimulation (Dinsmore, 2022). According to studies, the walls that youngsters spend the most time staring at should be painted in light colours, whereas walls that they make less eye contact with should be painted in darker hues to break up the monotony (Hawley, 2019). Applying slight red and yellow paint on the opposing or side walls of a classroom can grab the child's attention and ease their eyes when they raise their heads from their task (Atray, 2022). Warm colours like cream, taupe, and peach are better alternatives to white. If the classroom furniture is vibrant, the walls should be painted in neutral or relaxing hues. If the desks, seats, and tables are not in bright and exciting colours, the materials lining the walls might be in bright colours instead of putting an exciting hue on the walls. Pre-schoolers are active and enjoy bright colours, but the walls should be in soothing tones of green, blue, and beige (Soni, 2019).

c. Thermal Comfort

In the tropics, natural ventilation, sun shading, and clever building design are the greatest strategies to reduce thermal heat. Highly reflecting paint coatings including pigment, butyl acetate, and ethylene should be used on external walls exposed to direct sunlight to prevent heat absorption from the walls (Shen et al., 2011). To limit heat gain in the mornings and evenings, louvred shading devices should be used to cover windows on the east and west facades. When done correctly, green roofs might be the most effective method to insulate a roof (Jaffal et al., 2012). Ceilings can be raised to create a buffer zone for the hot air that rises. Water features, such as fountains and ponds can be strategically placed around classrooms to cool the air via evaporation (Qiu and Riffat, 2006). Keep the electric lights off whenever possible because they generate heat (Gorman, 2015).

d. Ventilation Requirements

The structure should be oriented to take advantage of the wind flow. The building's general design should be thin to allow for natural ventilation (Kleiven and Hestnes, 2022). Without employing any form of mechanical system, wind catchers and towers may be utilised to provide fresh air to students. Cobogós can help with ventilation without jeopardizing privacy or security (Hensel, 2011). The refusal to cool buildings at night is largely due to security concerns and the potential of severe weather but this may be addressed by installing windows and skylights that can be partially opened to allow cold air in while keeping intruders and rain out (Venux, 2018).

e. Acoustic Quality

Acoustically treated rooms provide great classroom and learning experiences because they enable much higher sound quality which leads to improved focus, success, and well-being for both students and instructors. Sound panels, soundproofing, and ceiling baffles can all be used to reduce reflected sound. By absorbing the majority of sound waves, these materials prevent sound from bouncing back and reverberating. Moss walls, cork panels, insulation foam, and acoustic foam made with fibreglass should all be used in the design (BigRentz, 2021). To limit the amount of external sound waves (noise) that enter the classrooms, hallways, and high-traffic areas should be made soundproof. To capture sound waves, a buffer gap can be created between the classrooms and the halls (Sound-zero, 2021).

f. Olfactory Considerations

One sustainable way to incorporate fragrances into a design is to appeal to nature. Having the appropriate plants around the area can boost the scent in the learning environment. Smells like lemon and rosemary improve students' attention and recall, which had a good impact on learning (Akpinar, 2005). It has been revealed that rosemary fragrances raise blood levels which subsequently improve brain functions by increasing its activities (Lange, 2013). The smell of lavender should be avoided in learning areas since it is sedating and causes youngsters to have slower reaction times for memory and attention- based tasks (Haranburu et al., 2010).

g. Texture

Materials with textures such as carpets, plants, and fabric window shades should be included in a learning space to make it more aesthetically attractive (Nollmeyer, 2018). A bad approach to introduce texture is with piles of paper or a huge bookcase with the spines visible. Textures linked with happiness, such as fur, velvet, and silk should be included in the design whereas marbles and sponges, which are connected with anxiety, melancholy, disgust, and hostility should be avoided (Iosifyan and Korolkova, 2019).

h. Proportionality

Students should never be intimidated by the building's overall size. The inside should not be congested, since this will prevent the kids from establishing their limits and exploring. The minimum classroom size for a nursery student should be 5m², and for a primary school student should be 7m² (Scott, 2010). No pathways leading to a learning area should be less than 2.5m if the classroom is on one side and 3.5m on both sides of the hall (Supreme Education Council, 2022). The ceiling height should be at least 3 meters and should be higher in a larger space. In general, classrooms should have a width-to-length ratio of 2:3 or 3:4. Style rooms that are long and narrow are not suitable (University of Connecticut California, 2016).

i. Time

The building changes over time and materials used to finish the interiors of learning spaces should be easy to maintain over time and should be easily replaceable. In general, they should be reusable, biodegradable, recyclable, renewable, and energy-efficient. Bamboo, cork, wood, and recycled plastic are some examples of ideal materials for school design (Valle, 2019).

3. Research Method

The research employed a qualitative approach to gather data. A learning facility that caters to children with ages ranging from 0 – 12 was purposely selected for the study. A privately run learning centre was used for the study because it had more diverse working facilities than public/government-owned ones. The study area is Southwest Nigeria with Ogun State as the primary location for the selected school. This is because Ogun State has the highest density of educational facilities in Southwest Nigeria which are highly competitive.

The first phase of the study examined the children's characteristics and level of independence using focus group interviews. The second phase identified learning and understanding methods used by children and the spaces required to carry out these methods. A literature review and focus group interview was used to gather the data and analysed using documentation and content analyses. Focus group interview was conducted with the primary school children according to their class and age group with the permission of the management and parents. The third phase employed a literature review to understand elements of architecture that could affect the learning outcome of children. This was analysed using documentation analysis. Fourthly, a non-participant observative assessment of the existing learning spaces used by the focus group was done and analysed using content analysis of the observed data.

4. Analysis and Discussion

4.1 Children's Characteristics – Independence and Attention Span

The focus groups were asked questions about their level of independence and learning habits. The responses showed that the majority of pupils in Primary 4 and 5 were permitted to walk alone to school, whereas the majority of pupils up to Primary 3 were escorted to school by either parents, elder siblings, trusted commercial cyclists/drivers, or school buses. Findings also revealed that the majority of upper primary pupils could learn for two hours before needing to take a thirty-minute break while a majority of lower primary pupils could learn for two hours before needing to take a one-hour break. Whereas, nursery pupils could learn for one hour and thirty minutes before taking a one-hour break. Creche pupils could learn for thirty minutes before taking a one-hour break. The break from studying is normally taken in the learning area or close by,

and the activities carried out during the break period include eating and playing with friends. However, some pupils like to sleep while others prefer to stroll about. Table 1 presents a summary.

Table 1: Summary of the Characteristics of the Pupils

Characteristic	Upper Primary (4 & 5)	Lower Primary (1,2 & 3)	Nursery	Creche
Age Range of Pupils (years)	9 - 12	5 - 8	1 ½ - 4	3 months - 1 ½
Level of Independence	Free	Slightly Free	Not Free	Not Free
Attention Span	2 hours	2 hours	1 ½ hour	30 minutes
Break	30 minutes	1 – 1 ½ hours	1 hour	1 hour

Source: Researchers' compilation (2022)

4.2 Learning Methods Used by Children

Documentation analysis of the literature revealed that the concept of learning methods plays a key role in the everyday learning of a child. This is becausechildren have a unique way of processing information which is different from adults (Sharaffitdinov and Yusupov, 2022). Literature also showed that study habits reflect students' usual act of studying and also call forth and serve to direct the learner's cognitive processes during learning (Çakıroğlu, 2014). Figure 1 gives a graphical summary of this finding.

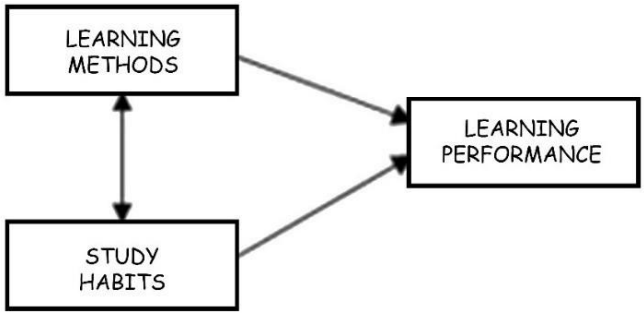

Figure 1: Relationship Between Learning Methods, Study Habits, and Learning Performance

Literature also reveals that there are seven (7) basic learning methods namely; Visual, Auditory, Kinaesthetic, Verbal, Logical, Social, and Solitary learning methods. These learning methods mostly take place within educational facilities that offer activities and instructions that complement or enhance school-based education (Teachmint, 2021).

The focus groups were presented with pictures representing the seven (7) learning methods and were asked to identify the methods used more within their educational facility. Responses showed that although visual learning is the most common approach utilised in the school, auditory and kinesthetics learning methods are also employed on occasion. A majority of upper primary students preferred solitary studying because it provided them with fewer interruptions, allowing them to concentrate better. Some students preferred social learning because studying with friends is more pleasant, while others preferred it because they could ask their instructor(s) or parent(s) for additional and more detailed explanations. A majority of lower primary pupils preferred social learning and partnering with their desk mates when studying. Others, preferred auditory learning since it was more exciting and retained their attention for longer. A majority of nursery pupils preferred verbal learning techniques because they found that recitation helped them absorb and recall information more rapidly. The auditory learning strategy was preferred by creche pupils since they loved viewing their favourite instructional programmes. Table 2 presents a summary.

Table 2: Summary of the Learning Methods Used More by the Pupils

Learning Method	Upper Primary (4 & 5)	Lower Primary (1,2 & 3)	Nursery	Creche
Visual	Always	Always	Always	Always
Auditory	Rarely	Rarely	Rarely	Always
Kinesthetics	Rarely	Rarely	Rarely	Rarely
Verbal	Sometimes	Often	Always	Always
Logical	Often	Often	Sometimes	Rarely
Social	Often	Often	Always	Always
Solitary	Sometimes	Rarely	Rarely	Never

Source: Researchers' compilation (2022)

4.3 Basic Abstract Elements of Architecture that impact Children's Learning

Further study of the literature revealed that learning spaces can be enhanced by the basic abstract elements of architecture. These elements are not actual construction materials such as bricks and mortar, glass, or wood. They are architectural concepts that are physically implemented to provide consumers with an experience. A place can be perceived through Light, Colour, Temperature, Ventilation, Sound, Smell, Texture, Scale, and Time (Bellini et al., 2023; Foroudi et al., 2020; Zhao and Li, 2022). Table 3 presents a summary of the abstract elements of architecture and how they should be used in children's learning spaces.

Table 3: Basic Abstract Elements of Architecture required for Children's Learning Centres

Element	Summary
Light	Natural lighting, Full-spectrum lighting (similar to natural light) and blue lights should be the type of lights in a learning facility. Direct sunlight should not be allowed into the learning spaces because of glare.
Colour	Straight white walls, single-colour walls, or repetitive settings should be avoided. Warm colours like cream, taupe, and peach are a better alternative to white. The wall with the board should be painted a lighter colour than the side walls. Bright colours like blue, yellow, and red should be slightly applied on the side walls.
Ventilation	The structure should be thin and oriented to take advantage of the wind. Cobogós can help with ventilation without jeopardizing privacy or security.
Temperature	Natural ventilation, sun shading, highly reflecting paint coatings, and clever building design are the greatest strategies to decrease thermal heat. Louvred shading devices should be used to cover windows on the east and west facades. Fountains and ponds can be used to cool the classrooms via evaporation.
Sound	Sound panels, soundproofing, and ceiling baffles can all be used to reduce reflected sound. Moss walls, cork panels, insulation foam, and acoustic foam made with fibreglass should all be used in the design. Buffer gaps can be created between classrooms and halls to capture sound waves.
Smell	Plants with pleasant smells should be planted close to or within the learning environment. Lemon and rosemary scents should be introduced to the classroon
Texture	Carpets, plants, and fabric window shades should be included in a learning space. Textures like fur and silk should be included in the design whereas marbles and sponges should be avoided.
Scale	The minimum classroom size for a nursery student should be 5m², and for a primary school student should be 7m². The ceiling height should be at least 3 meters and the classrooms should have a width-to-length ratio of 2:3 or 3:4.
Time	Materials should be biodegradable and easily replaceable at all times.

Source: Researchers' Compilation (2022)

4.4 Architectural Characteristics of Existing Children's Learning Spaces

Physical observation of the learning spaces used by the children was carried out and the focus groups were questioned on how the nine (9) abstract elements of architecture affect their learning process. Table 4 presents a summ

Table 4: Summary on the Characteristics of the Learning Spaces

Element	Summary
Light	Natural lighting was used more but there was an issue of glare.
Colour	The primary colours of the learning spaces were drab yellow and dark brown.
Ventilation	The building is slim and natural ventilation is the primary source of ventilation within the learning spaces. Cross ventilation is achieved by having two windows on one wall and a door and window on the opposite side.
Temperature	The temperature in the learning spaces is usually cool in the morning, mildly hot in the afternoon, and cold during or after rain.
Sound	Sounds from passers-by, vehicles, motorcycles, and schoolmates can be heard

	within the learning spaces.
Smell	Some learning spaces had a neutral smell while other spaces had a pungent odour. Especially rooms located close to the public toilets.
Texture	Concrete floors, tiles, glass windows, emulsion paints, and cement fibre ceilings were among the textures found in the classroom.
Scale	The height of the ceiling was 2.5 meters and it followed the standard width- to-length ratio of 2:3 or 3:4. Floor area of the classrooms was too small for the number of pupils and they were clustered together.
Time	The school is renovated once a year and minor repairs are carried out within the school year.

Source: Researchers' compilation (2022)

Natural illumination was employed more than artificial lighting in the classrooms. The blackboard and reading materials were well-lit, with no glare from the board. However, pupils sitting near the window were affected by direct sunshine. The classroom colours were chosen to complement the school's theme. The pupils enjoyed the colour of their classrooms, but when asked to choose a different colour for their classroom, they all chose red, violet, pink, or blue which were their favourite colours or the colours of their home. This demonstrates that the students have little understanding of colour psychology and simply favour colours that they are familiar with. Windows were located on opposite walls of each classroom; thus, natural ventilation was enhanced. This improved cross ventilation in the classroom, reducing the need for artificial ventilation.

The free flow of air in the classroom encouraged students to concentrate on their studies, but when asked whether they prefer learning in the morning or afternoon, a majority said they preferred learning in the afternoon because they are more alert in the warm-hot afternoons and sleepy in the cool mornings. Within some classrooms, the noise sounds from motorbikes, automobiles, and playing classmates could be heard, but the students stated they could hear the teacher clearly and that the disturbances did not interfere with their studying. Most classrooms had a neutral smell, but others had a powerful odour, due to the location close to toilets, which did not interfere with the learning process since the students and teachers had gone nose blind and were no longer sensitive to the smell. Concrete floors, tiles, glass windows, emulsion paints, and asbestos ceilings were among the materials that gave visual textures within the classroom. All the students preferred soft items such as curtains and chairs with soft cushions, however, they were split on whether to use a soft rug or hard tiles. Some pupils preferred the soft rug because it would protect them from injury if they fell, while others preferred tiles because they are very easy to clean. Despite the assumption that large rooms might intimidate youngsters, students preferred a larger classroom and school in general. Some students preferred it because it meant they would have more classmates and friends. Others preferred it because it meant they would have more space to carry out activities and have personal space in the classroom. The number of students enrolled grows over time, and to meet the new needs, additional amenities are introduced to the learning centres to make them more enjoyable for the children. The facilities are renovated yearly, although minor repairs are consistently carried out throughout the school year.

5. Conclusion

The study assessed selected public buildings in Lagos to have a better understanding of their visual quality. The findings will help designers and developers have pointers towards the achievement of visually appealing public buildings. The study concluded that point, lines, shape and form, colour, texture, pattern, and space are universally accepted elements of visual quality. Point signifies the main area where construction activities will commence. The line must be well defined and failure to do so might affect building construction in terms of measurements as it is the basic graphic sign for all plans and section drawings in architectural language. Lines also form words and numbers by defining spatial edges, rendering volume, creating texture, and connecting them. Other visual elements are also important. Therefore, architects should pay more attention to the visual elements.

The study further established that walls and columns, roofs, windows, doors, and stairs (steps/ramps) represent the external building components that affect visual quality in architecture. These components work together to form an integral part of a building's exterior. Hence, a building is incomplete without them. Thus, establishing the importance of the

components. Also, the components must be in good condition to make a building habitable and appealing.

The study finally unfolds the conditions of the components that make visual quality of public buildings in Lagos appealing architecture. These findings revealed that celebrated entrances, large windows/curtain walls, and external walls with minimal recesses or balconies are viewed as the most appealing characteristics of public buildings. Hence, to design visually appealing public buildings in Lagos it is reiterated that an architect should respectfully employ elements of visual quality while complying with the findings on ways in which building components should be employed to encourage visual appeal. This study can be replicated in other parts of Nigeria and the diaspora to have a comparative analysis of how users of public buildings view their visual quality.

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