The Role of Colour Perception in Visual Sustainability: a Survey of Senate Building Facades in Selected Universities in Southwest, Nigeria

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Abstract. Colour perception is essential in the appreciation of the physical world. The inclusion of colour in the consideration of sustainable development of buildings is an important environmental and social factor which calls for distinguishing different colours for diverse building typology. This paper was aimed at identifying public colour preference for senate building facade in selected universities in southwest Nigeria, with a view to establish distinct colour scheme for office buildings. A survey research design was adopted with the stratified random sampling technique used in selecting respondents. Primary data were obtained through the administration of questionnaire to 577 users from ten selected universities. Photographs of 10 selected university senate building façade were attached to the questionnaire to serve as bases for assessing the buildings. Data was analysed using frequencies, percentages and mean ranking. The study revealed that façade colour is an important architectural element for visual sustainability and lighter shades of different colours were observed to be most preferred by the respondents in the study area. The study recommended the need for equipping the design professionals on the fundamentals of colour choices as an architectural design element for building façade attractiveness.

Keywords: Colour Perception, Visual sustainability, Users Perception, Senate Building, Visual Quality

1. Introduction

Colour is essential to the way humans experience the world physically, emotionally and psychologically. The world without colours will look uninteresting, drabbing and monotonous. Colour is one of the most visible elements of the physical environment which gives it accent, distinctness and variety, but remains one of the least understood in terms of dynamism and application in architecture [1]. The importance of colour in the physical environment can never be overemphasised as it creates a world of high visual experience. Agoba [2] posits that of all design elements, colour stands as the most complex and that no other visual element gives as much pleasure as colour. The use of colours is visible in the presentation of all products, either tangible or intangible. For instance, in the field of marketing, colour effectively communicates concepts and ideas, and products are made appealing through excellent colour branding. The use of colours as an attribute of visual sustainability plays a critical role in prequalifying a building as a piece of architecture and the level of appreciation by the public [3]. This can be seen in the case of Guggenheim museum in New...
York which original colour was brownish-red hue as preferred by designer, but eventually changed to gray based on users' demand. The colour applied to a building façade as the first physical representation of the architectural piece plays a significant role in determining the sense of place of the users and crystallizes into the external attractiveness of the building and the streetscape [4]. Considering their attributes, colours are known to have psychological effects on the users and this has been used effectively over the decades in fine arts and architecture to attribute certain colour to some functions consistently [1]. For example, red is synonymous with commercial spaces such as stores and fast food outlets; orange is used more in creative environments such as offices, studios and schools; and green used more in spaces associated with health and well-being such as hospitals and relaxation centres [5]. In testing the preference of distinct colour for a specific building type, this study focused on the senate building façade from selected universities in southwest Nigeria.

The university senate building is one out of several building types in a university campus. Building types on a university campus can be categorised based on function into public buildings, academic buildings, sport facilities and residences. These can be further subdivided into specific building types such as the Senate building, library, college buildings, and chapel among others [6][7]. This array of buildings can be perceived differently based on their functional characteristics both internally and externally. The choice of the senate building façade for this study was hinged on the facts that the Senate building is the seat of power in the university environment which consistently commands a central position and most often is clearly identified by its elegance and dominance over all other campus buildings [8]. Furthermore, the senate building houses the university senate as the chief academic organ of a University which takes final decision on academics and general administration of a university. The senate building is often positioned strategically for easy visibility and accessibility to all segments of the university as the main facilitator of growth of a university. The function of the university senate building is expected to be the same for all universities and as such, they are expected to have similar physical characteristics such as colour.

The senate building of a university is expected to have a unique colour for its identity. This building typology as seen in universities across southwest Nigeria has no distinct colour identity. This paper therefore was aimed at identifying the public colour perception of senate building façades in universities in southwest Nigeria, with a view to establish distinct colour scheme most preferred for the building type. The objective considered in achieving this aim were: (i) to identify the importance of colour in relation to other aesthetic elements on a building façade; (ii) to examine public perception of colours of selected university senate building façade from universities in Southwest Nigeria. The ‘façade’ in this study represented the approach elevation of ten selected university senate buildings in study area. The respondents for this study were drawn from the ten selected universities and comprised of staff and students as a representation of the public in the study area.

For a better understanding of the Role of colour perception and visual sustainability in university senate building façade, the next section is dedicated to literature review.

2. Literature Review

2.1. Colour

Agoba [2] posit colour as the most complex among the design elements and no other visual element gives as much pleasure as colour. [9] defined the dynamism of colour from the objective and subjective viewpoints. Colour objective definition puts it as an art element which is produced when light strikes an object and it is reflected back to the eye. The subjective definition on the other hand puts colour as a sensation of human response to hue arising partly from the optic nerve, from education and largely from the human senses. According to [10], colour is an external and internal sensation of three main dimensions: hues, values and intensities. [11] emphasises that colour is an attribute of man’s visual perception in relation to how light is perceive by the eye. [12] maintains that the word colour is the compound term which applies to the entire subject of red, orange, yellow, green, blue, violet, black, white and their possible combinations. Hue is the distinct quality that differentiates
one colour from another and it can be described as the redness, greenness or blueness of the colour. Value according to [2] is the relationship between the light and dark of a specific colour or hue resulting from the quantity of black or white within the colour. Getty [13] described value as the colour brightness which designers or artists employ in the creation of different moods, while [12] defined value as the lightness or darkness of a colour which is an essential tool for the designer in the definition of form and creation of spatial illusions. Intensity as the third dimension of colour connotes the purity or strength of a colour. This can be seen in bright colours as being undiluted, synonymous with positive energy and high emotions. For example, the intensity of a dull colour can be softened by mixing with other colours to create a serious mood. The three dimensions of colour gives it wide use in arts and architecture as well as other field of human endeavour. However, for the next section focuses on colour and its effect on architecture.

2.2. Colour and Architecture

Colour is consistently significant in human evolution of the physical environment and has always been associated with architectural design. The goals of colour application in architecture are not limited to decoration only, but it encompasses psychological effect, communication, and influence on the psyche of our perception processes [5]. According to [5], colour influences users’ experience of space and historically, architecture, painting and sculpture as encompassed in the artist’s profession, were expressed greatly in the use of colours. Furthermore, all through history, rich painting and colour symbolism was adopted. This can be seen in works such as: the Egyptian pyramids and temple complexes; the ancient Greek stone temples; the medieval Europe cathedrals, as well as the temples and palaces of China. Colour is continually seen in architecture as a visual language in transmitting or communicating something in building design. Colour plays a key role in the way spaces are perceived by the human mind, and influences the atmosphere of the building. It further conveys great importance in creating the psychological atmosphere that enhances the function of an architectural space. Colour is a very powerful tool in architecture, hence understanding it would help in figuring out which colour works in a building. For example, black is associated positively with deep and abstract while negatively it is associated with dungeon-like, night, grief and death [5][14]. Colours are known to have universal meaning and any choice of colour blend used within a space can affect the way people think, feel or act in that environment [1]. Kamaruzzaman, Marinie and Zawawi [15] carried out a research on perceptions of employees on colour preferences for productivity in Malaysian office buildings. Three office buildings were used as case study. The study concluded that there is lack of preference for any colour schemes for office buildings. Omale[1] conducted a similar study by assessing colour schemes developments on the obanla campus of the Federal University of Technology, Akure, Ondo State, Nigeria. The study categorized 39 buildings on the campus into three distinct colour schemes and concluded by recommending the adoption of diverse colour schemes based on the function of the building into groups for easy identification.

2.3. Visual Sustainability

Sustainability has become a strategic imperative for almost all ventures from the early parts of this century which has evolved into a fundamental force affecting long-term viability and success [16]. Sustainability in lexical terms means the maintenance of a process or state at a desired level over a period of time necessary. It is the achievement of the present needs of a development without compromising the ability of the future generation in meeting theirs. In other words, sustainability focuses more on a long-term vision. Sustainability of the built environment encompasses all man-made structures which include buildings, infrastructural elements such as waste management, transportation and utility transmission systems put in place to serve the building space [16]. Visual sustainability according to [17] can be described as the process by which people are sustained and enriched in daily life through the visual relationship they hold dear to their surroundings. It is hinged on the visual sense which gives timely knowledge of our spatial surroundings and identifying all objects to our consciousness [18]. Visual quality studies in enhancing visual sustainability is one of the
most important aspects in determining user experience. It also plays a critical role in prequalifying a building as piece of architecture and the level of appreciation by the users and the design professionals.

Colour as one of the significant elements of visual sustainability is often overshadowed in studies on environmental sustainability. However, it plays a strategic role from the expressive point of view and also controls the internal and external environmental quality of buildings as well as their microclimate [19]. Visual sustainability entails the use of colour as a design tool to achieve certain effects that influence the perception of the building in its context. The colour of architectural surfaces will be more "sustainable" when it will succeed in time to maintain or positively change the relationships with the environment so that the project idea will keep its full effectiveness.

2.4. Aesthetic Perception

The first use of the word ‘aesthetic’ was by philosopher Alexander Baumgarten, in the eighteenth century. The word aesthetics originated from the Greek words "aisthanesthai" and "aistheta" which mean “to perceive” and “perceivable objects” respectively. Aesthetics can be defined as a discipline that studies the beauty and attributes of an object and their perception through our taste [20]. Similarly, [11] defined aesthetic as an art that deals with the beautiful and judgement of beauty. It focuses on beauty appreciation and the philosophy anchoring a pleasing appearance. It is a guiding principle followed by the architects or any designer for the ultimate production of a building or art piece that is pleasing to the eye. Aesthetic values can either be objective and universal, or subjective, tied to viewers’ perception [21]. Aesthetics of a building as an architectural piece is made easy to identify and evaluate if the "façade" or views of the building is treated as an artistic work of painting. This can be broken down further into aesthetic elements for easy comprehension and visual analysis. Aesthetic study directly or indirectly addresses and has great influence on the users. Therefore, users’ perception is of great importance to the designer before taking decision for an objective view [21].

Perception in lexical sense is the ability to see, hear, or become aware of something through the senses. According to [22], perception in philosophy and psychology is the process of achieving awareness or comprehension of sensory information. Perception is further described as the process of identifying and interpreting sensory stimuli from the physical world, using one or more of the senses [6]. These involve the way people think about or understand things in their natural and built environment. Qiong [22] in an extensive discuss identified the stages of the perception process in three distinctive stages namely: selection, organisation and interpretation. Selection involves the conversion of the environmental stimuli gathered by the sensory organs into meaningful experience. Organisation as the second stage of the perception process according to [22] involves the categorisation of the selected information from the outside world into meaningful patterns such as shape, colour, and texture among others. This stage gives human perception definite form and stability. Interpretation as the third stage of perception deals with the attribution of meaning to the selected stimuli. This stage of interpretation differs from one person to another based on their culture. According to [23], culture makes available a perceptual lens which has great influence on how we interpret and evaluate what we receive from our environment. Further to the stages of perception process, for a better understanding of how we develop structure, stability and meaning for selected stimuli, [22] identified two fundamental dimensions. They are the physical and the psychological dimensions. These two dimensions working together are responsible for our perceptual outcomes.

In the light of the foregone definition of colour as an aesthetic element relevant for building appreciation, the next section is centered on the methodology adopted in this study for the identification and assessment of the selected university senate building façade colour in southwest Nigeria.
3. Methodology
The data used in this article is part of the data derived from a larger study on visual quality assessment of university senate building facades in southwest Nigeria. The methodology involved the sample size of ten universities in southwest Nigeria from a sample frame of thirty-four universities [24] using the proportionate sampling technique. The sample size consisted of 2 federal, 3 state and 5 private owned universities (Table 1). The façade colours of ten senate buildings from the selected ten universities were considered for public perception. The facades were presented to respondents in high quality, A5 (14.8x21cm) sized, still photographs. Quantitative data were collected using close-ended questionnaire and based on the 5 Likert-type scale rating of not attractive, less attractive, un-attractive, attractive or very attractive. Data analyses were done using simple univariate method of analysis which involved frequencies, percentages and mean ranking. The questionnaire was distributed to students and staff of 10 universities in southwest Nigeria using the stratified random sampling. The sample size for respondent was calculated using the Yemane formula for calculating a finite population:

\[ n = \frac{N}{1+N(e^2)} \]

Where, “n” is the minimum sample size for the sample, “N” is the population size which is 164,622 for student users and 15,327 for staff users. “e” is the precision level which is 0.05 at a confidence level of 95%. Sample size for students: n = 399.03 (approximately = 399), while sample size for staff: n = 389.83 (approximately = 389). A total of 788 questionnaires were distributed and 73% or 577 were subsequently analysed. Data analysis was done using SPSS Version 20.

Table 1 Universities in Sample Size

| Ownership | S/N | University                                      | Location | Year Established |
|-----------|-----|------------------------------------------------|----------|------------------|
| 01 Federal| 01  | University of Ibadan                            | Oyo      | 1948             |
|           | 02  | University of Lagos                             | Lagos    | 1962             |
| 02 State  | 03  | LadokeAkintola University of Technology, Ogbomos | Oyo      | 1990             |
|           | 04  | AdekunleAjasin University, Akungba              | Ondo     | 1999             |
|           | 05  | Tai Solarin University of Education Ijebu Ode   | Ogun     | 2005             |
| 03 Private| 06  | Covenant University, Ota                        | Ogun     | 2002             |
|           | 07  | Fountain Unversity, Oshogbo                      | Osun     | 2007             |
|           | 08  | Adeleke University, Ede                         | Osun     | 2009             |
|           | 09  | Elizade University, Ilara-Mokin                  | Ondo     | 2012             |
|           | 10  | Augustine University, Epe                       | Lagos    | 2015             |

Source: [6]

4. Results

4.1 Images of Selected University Senate Building Facades
Plates 1 to 10 represent the images of the ten selected university Senate building facades from Southwest Nigeria under consideration.

4.2 Socio-Economic Characteristics of Respondents
The socio-economic characteristics of 577 respondents comprised of age groups of 20years and below (15.1%), 21-30 years (44.2%), 31-40 years (11.6%), 41-50 years (15.3), and those above 51 years (13.9%). Gender distribution has a predominant male respondent of 337(58.4%), while the female respondents were 240 (41.6%). The statuses of respondents in the university revealed 205 (35.5%) were staff and 372 (64.5%) were students. It is evident that most of the respondents were between the age group of 21 and 30 years, predominantly male, and majority were students.
Fig. 1: Ten Selected University Senate Building Facades

4.3 Identification of Design Elements considered in the Visual Sustainability

Table 2 presents the mean ranking of 14 design variables shortlisted by researcher based on observation of ten selected senate building facades and adaptation from literature. The design variables were treated in line with [8], Aesthetic Concept Model classification of sensory elements and physical cues observed from the selected façade images. The respondents’ ranked the elements based on their perceived importance to the visual sustainability of the university senate building façade.
Table 2: Summary of Building Elements Identified by Users

| S/No | Variables          | Mean Score | Rank |
|------|--------------------|------------|------|
| 1    | Façade Shape       | 4.27       | 1    |
| 2    | Façade Colour      | 4.18       | 2    |
| 3    | Façade Height      | 4.16       | 3    |
| 4    | Foreground         | 4.01       | 4    |
| 5    | Fenestrations      | 4.00       | 5    |
| 6    | Texture            | 3.83       | 6    |
| 7    | Entrance Design    | 3.79       | 7    |
| 8    | Columns            | 3.65       | 8    |
| 9    | Roof Shape         | 3.63       | 9    |
| 10   | Screen Walls       | 3.5        | 10   |
| 11   | Inscriptions       | 3.38       | 11   |
| 12   | Terraces/Balconies| 3.33       | 12   |
| 13   | Services           | 3.31       | 13   |
| 14   | Railings           | 3.15       | 14   |

From the result presented in Table 3, façade shape had a mean score of 4.27, while façade colour and height had mean score of 4.18 and 4.16, respectively. Other façade elements ranked high by respondents were foreground and fenestration with mean score of 4.01 and 4.00, respectively. The lowest ranked façade elements by respondents were terraces/balconies, services and railings with mean scores of 3.33, 3.31 and 3.15, respectively. It is evident from Table 3 that building shape, façade colour and building height were ranked highest by the respondents. Façade colour was ranked 2nd highest next to shape.

4.4 Respondents’ Perception of Façade Colour of Building Images

The façade colour assessment by respondents was based on the 5 Likert-type scale rating of not attractive, less attractive, un-attractive, attractive or very attractive. These ratings are represented in Table 4 showing the mean score and colour of building façade images 1 to 10. Respondents were asked to rate their perception of the façade colour of the selected senate building façade images.

The study in Table 3 revealed that images 9, 8 and 6 have the highest mean scores of 4.37, 4.32 and 3.98, respectively, while images 1, 2 and 7 with the mean scores of 2.85, 3.13 and 3.34 respectively have the lowest mean scores. This implies that the colours of building façade in images 9 which is predominantly cream was considered most attractive by respondents. Rated next to this is image 8 with Light green and grey and then image 6 which is also predominantly cream coloured. Image 1 with the lowest mean score and predominant brown colouration was considered as not attractive. This was followed by image 2 with a combination of colour green and brown, and also image 7 with a combination of colour pale pink and white consecutively.

5. Discussion

The ranking of façade colour as 2nd out of 14 other elements by respondents in identification of aesthetic façade elements suggests that colour is of great importance in the appreciation of the university senate building façade. This affirms the views of [1] and [2] that described colour as one of the most visible elements of the physical world. However, the ranking of façade shape by respondents ahead of façade colour, suggests that colour can be accentuated by the façade shape. The shape of an object or surface determines the angle at which light falls on it and ultimately determines the colour sensation reflected back to the eye as suggested by [9] in the dynamism of colour. Furthermore, other elements such as façade height, foreground and fenestration with equally high mean scores (above 4.00) can be of influence to the appreciation of façade colour.
In the colour assessment of the 10 selected university building façade images, it was observed that images with similar colours such as images 9, 6 and 10 with predominantly cream colour were rated differently. Also, images 8, 3 and 2 which are predominantly green of diverse shades were also rated differently. This is an indication that similarity in colour does not imply the same level of appreciation of the university senate building façade. This confirms the findings of [15] on lack of awareness for preference of any distinct colour for office buildings. On the contrary, this is not in direct agreement with colour psychologists [5] who attributed distinct colours to specific functions. However, in conformity with the complexity of colours according to [7], different colour types in two distinct categories of light and dark shades were observed to govern the public assessment. The lighter shades of façade colour were observed to be most preferred over the darker shades. This shade categorisation of colours confirms with [1] for university campus building appreciation. The finding of this study further authenticates that other façade elements such as façade shape and height contributes greatly to the colour appreciation.

| Colour                | Mean Score | Rank |
|-----------------------|------------|------|
| Image 9 - Cream       | 4.37       | 1<sup>st</sup> |
| Image 8 - Light green & grey | 4.32       | 2<sup>nd</sup> |
| Image 6 - Cream       | 3.98       | 3<sup>rd</sup> |
| Image 4 - Yellow & brown | 3.76       | 4<sup>th</sup> |
| Image 10 - Cream      | 3.74       | 5<sup>th</sup> |
| Image 3 - Light green | 3.62       | 6<sup>th</sup> |
| Image 5 - Brown       | 3.35       | 7<sup>th</sup> |
| Image 7 - Pale pink & white | 3.34       | 8<sup>th</sup> |
| Image 2 - Green & brown | 3.13       | 9<sup>th</sup> |
| Image 1 - Brown       | 2.85       | 10<sup>th</sup> |

6. Conclusion
The study was able to establish that façade colour is a very important architectural element for visual sustainability of the university senate building façade. Secondly, in the perception of the façade colours by respondents, no distinct colour was found to be most preferred for the university senate building façade visual sustainability. However, lighter shades of different colour types were most preferred. This study implies the need for a more creative use of colours beyond psychological recommendations. This should involve the effective harmonisation of institutional colours for cooperate identity with the overall façade shape and the surrounding environment. The study recommends the need for equipping the design professionals on the fundamentals of colour shades for building façade attractiveness. This study was limited to staff and students within the university campus in southwest Nigeria and their senate building façade colour only. Similar study can be carried out using respondents from outside the university environment as well as professional opinions sort. Senate buildings in other geopolitical zones can also be assessed and other campus building facades treated for possible divergent views on the subject of colour perception.

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