Application of Design Principles and Theories for Achieving Optimized Aesthetics in Designs and Electrical Installations

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Abstract
Aesthetics is beauty. Although may be functional, many electrical installations in developing countries yet suffer dearth of acceptable aesthetic sense mostly due to lack or laxity in the knowledge and application of basic design theories. This study therefore examined design principles and theories used in graphic design and how these theories apply in electrical installations as a contribution to fostering a more aesthetically sensible and functional environment. Adopting a descriptive approach, a sample size of 398 respondents was taken in selected cities in Nigeria. The study showed a significant relationship between application of graphic design theories and the rendering of attractive-functional electrical installations. It also revealed that users consider electrical installations as more aesthetically satisfactory with the application of graphic design theories even though many practitioners in the study area do not consider them during installations. This study therefore established the significance of aesthetics, attainable through proper application of design theories and principles, in achieving a more sustainable environment as people tamper less destructively with structures and installations possessing greater aesthetics.

Keywords: *Aesthetics, Electrical-Installations, Environmental-sustainability, Functionality, Graphic-Design, Theory.*

1. Introduction

Sustainability has become a very important goal in the world today and environmental-sustainability is a major part of this world goal. The sustainability of the built environmental is central to the sustainability of the greater environment. Nigeria, like some other African countries, has begun to take the issue of the sustainability of the environment serious. As a contribution to the promotion of environmental sustainability in developing countries, without necessarily overly increasing the cost of development, this study considers environmental aesthetics as a factor for the alleviation of destructive environmental interferences as a means of promoting sustainability in the built environment, adopting an approach proposed by Dietrich (2004).

Dietrich (2004) proposed two major approaches in design namely:

1. The whole is the sum of the parts.
2. The whole is greater than the sum of its parts.

The former approach forms the theoretical basis for this research. This is applicable in the built environment which is made up of estates, streets, avenues, plazas, parks, public infrastructure and so on. These set ups or structures are further made up of individual sub-structures and installations which, when viewed as a whole, make up the greater picture called the city or urban area. Hence, a question like 'What makes an environment beautiful?' querying the source of beauty of the environment, should, according to Cuthbert (2011), lead to a greater specificity. This insinuates that the beauty and functionality or aesthetic value of the greater

whole is dependent on the aesthetic value of the minor parts that make up the whole. Therefore, further questions arise: what makes the smaller parts beautiful? What makes a house beautiful? What makes an installation beautiful or aesthetically valuable? If the issues of the 'little bits' are properly addressed, then the whole would have been taken care of. That is where electrical and design installations, a very vital part of the rural and urban system, come into the picture as well as the various professionals that work in these fields.

Various professionals and practitioners work on a building, for example, to make it both functional and beautiful ranging from the Architect, the builder, civil engineer, the carpenter or wood worker to the electrical engineer or electrician and painter. However, few or no public literature has ever added the Industrial Designer prominently to building or structural projects. Yet, the prints of the Industrial Designer, the theories guiding him, and the Electrical Engineer are all over the buildings/structures and installations. For instance, almost all the installations designed and rendered into the building by the architect, the civil engineer, the painter, the carpenter etc. were either created by the designer or had the inputs of the Industrial designer in the production process, especially in terms of aesthetics (see figures 1A, B and C). For example, the POP-ceiling and its electrical fittings in figure 1a at one of the research sites of this study, was rendered by an industrial designer working alongside electrical practitioners. All aforementioned fields are relatively interwoven.

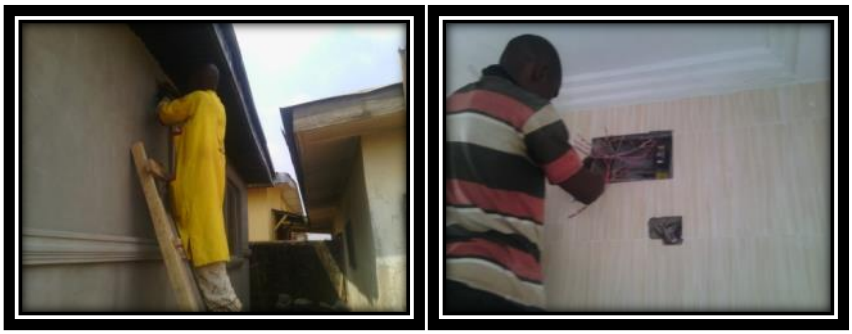
(A) (B) (C)

Figure 1: The products, fittings and installations, in buildings are created or designed by an industrial designer alongside other professionals.

Electricity is everywhere in our lives (OSHA, 2008). It lights up our structures, powers our computers, television sets, and other electronic devices, provides heat or cold where applicable and even cooks our foods (OSHA, 2008). However, the bid to channel this technological gift into our homes and structures, especially in developing countries like Nigeria, have been yielding major aesthetic nuisance and dangers. Installation, continuous use and subsequent repairs of electrical installations can constitute major aesthetic backwardness in the built environment (see figure 2A and 2B).

Figure 2A and B: A poorly executed electrical installation: untidy and aesthetically assaulting. It is a common feature in many Nigerian buildings or structures.

It is believed that most problems could be solved by using a combination of training, experience and applied intuition (Jay, 1990). This has been the practice in both the electrical and the industrial design fields in Nigeria as observable in the field of practice. Many electrical installations are carried out by practitioners (commonly referred to as 'Electricians' in the research area), some with little or no formal education, who rely traditionally on their experiences and intuitions (figures 3 and 4). However, according to Jay (1990), as the world has become more complex, traditional approaches have become less effective. This less effectiveness is noticeable in the dwindling aesthetics in design and electrical installations for example even though such installations may be functional. The notion of applying design theories to electrical installations may seem irrelevant to the average electrical engineer, technician or designer, but it has a place in environmental sustainability as theory can provide a structure for understanding problems and help generate methods for solving them (Jay, 1990). It is commonly accepted that there are some shared features in design, shared among all design fields (Leif, 2009). Most, if not all, technological cum environmental fields, like architecture, industrial design, urban and regional planning, building technology, engineering for example, involve some forms of design. Therefore, design is a kind of knowledge necessary in all professional activities (Leif, 2009). One major aspect of industrial design is the field of graphics. Reconciling this field with the field of electrical technology, this study proposes, will have a major influence on the built and aesthetic environment.



Figures 3a and b: Non-formally educated electricians at work in the study area.
Source: Author's Work, 2018.

There are various theories that guide the designer in the field of graphics, graphic design or industrial design. If these graphic design theories and or principles are applied to the execution of electrical or other engineering, design or technological installations, this study proposes, will yield, in the long run, a, not just functional but, more aesthetically valuable and sustainable environment. A similar step is already being taken in the architectural field (Dietrich, 2004).

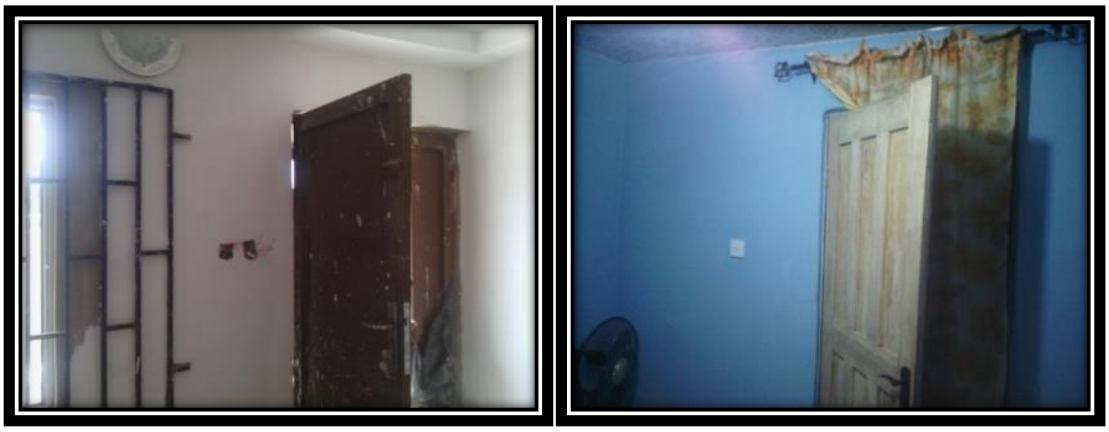


Figure 4: Poorly executed electrical installations/fittings: the doors open to cover the main-switches.
Source: Author's Work, 2018.

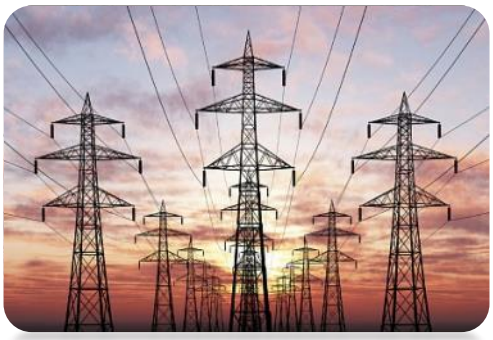
1.1 Design Principles, Aesthetics versus Functionality

Aesthetics deals with beauty. Functionality, on the other hand, is the capacity of an installation to perform the purpose for which it is rendered. Although, aesthetics apparently concerns majorly with surface appearances, achieving beauty during electrical installations may get in the way of functionality and vice versa. However, this research is of the position that a design-theories-and-principles-guided installer, designer, technologist or engineer, should be able to strike a balance in solving this problem and execute, not just functional installations but, aesthetically sensible ones.

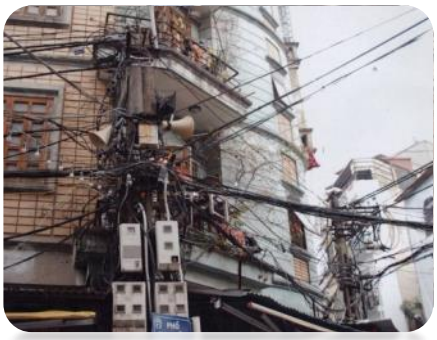
Aesthetics as used in this study encompasses, aside from being pleasing to the sight:

1. Neatness or tidy arrangement of constituting elements (See figure 5B). Many installations in the research area did not meet this criterion (e.g. figures 2A, 2B and 5H).
2. Balance e.g. in terms of weight, arrangement and colour, etc. The components of the installation or parts of the design are equally distributed over the installation space to create a sense of both physical and visual stability. This balance can be symmetrical in which similar components are used as necessary for proper functionality (see figure 1A and 1B) or asymmetrical, radial, vertical or horizontal.
3. Pattern: (See figure 5J; the air-conditioning units on the building)
4. Proximity: Beauty in designs or installations is created with the proper use of space and distance apart or closer of connecting components parts to achieve better organization (See figures 5J and 5A; the air-conditioning units). This is closely interwoven with balance.
5. Rhythm: This could be random, regular, gradated or graduated.
6. Emphasis: A designer or installer may choose to make a particular part of the installation more pronounced than the others. This can be done in terms of shape, form, line use, scale/size/weight or colour of component parts. Lights are effective components in achieving emphasis.
7. Movement: This gives a sense or feeling of flow or action in an installation or design (see figure 5A).
8. Unity: This involves the consistent use of a particular e.g. type, colour or size of materials or component during installation (see figure 5J).
9. Proportion or scale: This involves comparative relationships between various components in an installation or design especially with respect to size.

10. Ideal positioning: this is especially significant with electrical fixtures or installations around locations of businesses, organizations, schools and homes etc. For example, it will make no much sense having the distribution box hanging on the walls in the living room.
11. Proper colour coding: Although figures 2A, 2B and 5B are relatively functional but rowdy, the proper colour coding of figure 5C makes a major difference. The theme colour of an installation also matters. For instance, the water pump in figures 5E and 5F was green in colour originally which is in contrast with the theme colour of the installation. That necessitated the choice of colour for the protective cage being black (see figure 5D) giving it a sense of balance. The colour of the air-conditioning units in figure 5G blends them well into the building structure.



(A)



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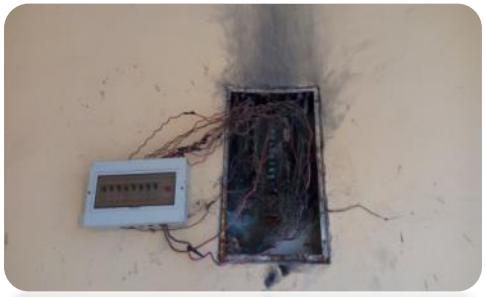

(H)

(I)

(J)

Figures 5A-I: Installations/fixtures showing adherence to, or breaking of, design principles.
Source: Author's work, 2018 except 5A, 5B and 5C.

Hence, aesthetic cannot divorce from design principles and theories. The average electrical or engineering practitioner should perceive the components of the electrical or design installations as elements of design or the pieces with which he or she, not only meets functional user needs but also, creates beauty by rendering aesthetically valuable installations. And aesthetically valuable installations tend to enjoy more sustainability as people tend to tamper less destructively with what they consider beautiful (Douglas, 2003). This little aesthetics achieved in the smaller components in the environment should translate into the broader citywide aesthetics in the built environment if religiously practiced and sustained, this paper posits. This will contribute immensely, not just to urban beauty but, to improved safety and environmental sustainability especially in a developing country like Nigeria and other sub-Saharan countries that are still backwards in urbanization. Hence, it is relatively safe to assume that optimized aesthetics often leads to improved sustainability.
In the words of Charles Eames, design is a plan for assembling elements or components in such a way as to best achieve a particular purpose (Faimon and Weigand, 2004). No design or installation is rendered for no reason. One of the primary germane purposes of electrical installation is functionality. Hence, this paper suggests that all the above mentioned design/aesthetic principles should be executed, of course, without compromising functionality. However, when aesthetics is completely forgone for the purpose of achieving functionality, then the question of sustainability arises.

1.2 Aesthetics, Design Theories and Sustainability

The beauty of most urban areas is a function of the sum of the aesthetics of the various installations that constitute their built environments. Beauty is essential in every field, whether it is in Art, design, Engineering or technology especially as it concerns sustainability of both the environment as well as the electrical or other forms of art, technological or engineering installations. However, aesthetic preferences are expressions of the taste of the specific observer, not a statement about objects or installations (Graham, 2005). This means that beauty is subjective. Hence, it cannot be generalized. What a consumer or user of an electrical installation considers as beautiful may not be considered the same way aesthetically by another user or consumer. According to Graham (2005), there could be "shared taste", but not necessarily any validated "standard of taste". Therefore, it will be wrong to claim that an installation is generally accepted as aesthetically sensible just because a group of people consider it sensible or beautiful, irrespective of functionality. How then can one measure the aesthetical value of an installation? That is where design theories and principles is involved as the aesthetic value of an installation, this research proposes, is dependent on how well it obeys design rules, theories or principles, irrespective of whether or not the installer is consciously guided or not by these rules. Since design theories and principles are universally accepted

standards, therefore, they were adopted as the standard for judging the sense of aesthetic value of installations.

Design theories have, over time, been viewed in different ways by different researchers and authors. It can be considered as an exploration of a subject matter through the development of propositions (Mautner, 1996). Another author, Weick (1989), considered it a controlled imagination that proceeds like synthetic selection, where the researcher defines, conducts and interprets imaginary experiments. They influence design practices, installations and further design research that consequently dictates design outcomes. We are possibly on the verge of a revolution in design research that can advance beyond current forms of design (Dorst, 2008). Some popular theories related to design include: Gestalt theory, the colour theory, functionalism, symbolic Interaction, change theory, meaning of Place, place identity and social cognition theories. Knowing which design theory to adopt for a project, from the level of product design to the level of installation, depends on various factors depending on the users' priorities. For instance, users' needs that relate to function will suggest the adoption of the functionalism theory, while users' needs that relate to change in technology and the need to conform will suggest the use of the change theory. However, for electrical installations, a combination of these theories will prove most useful in rendering functional and aesthetically sensible installations. Most of these theories work based on the interaction of design elements and principles.

Graphic design elements are the building blocks of any design project. They include: lines, shapes, texture, space, size, value, colour, balance, rhythm, emphasis and unity. A simple mismanagement of these may, according to the Gestalt theory, lead to misinterpretations (see figure 7) in designs (Graham, 2008) and or installation safety hazards (see figures 2A, 2B, 5B and 6). As stated earlier, the electrical practitioner should see the components of installations as elements of design or pieces with which he creates a perfect mix of functionality and aesthetics.

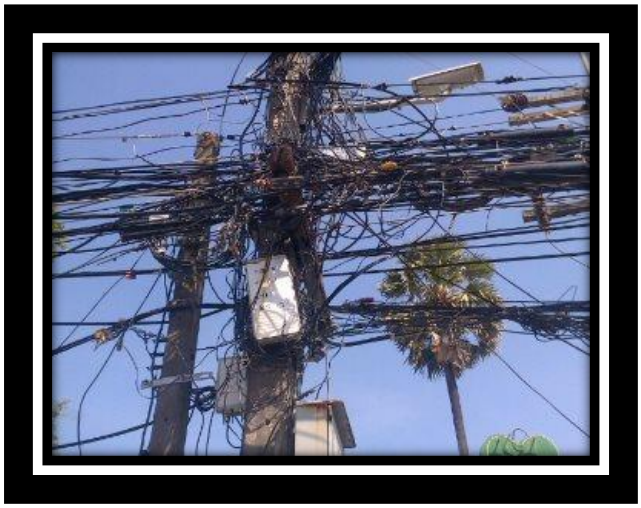

Figure 6: A functional but aesthetically poor and hazardous electrical installation.
Source: Arrive Alive (2018).

P S Y C H O T H E R A P I S T

PSYCHO THE RAPIST

Figure 7: Possible simple misplacement of space and possible misinterpretation
Source: Graham, 2008.

1.3 Aesthetics, Functionality and Electrical Hazard Prevention

If most of the practitioners who carry out electrical installations, from the structures' electrical design to the 'fit-outs', rely traditionally on their experiences and intuitions mostly rather than on viable safety, functional and design principles and theories, then functionality and aesthetic abuse is often eminent. Quite a volume of the resulting ugliness (figures 2A, 2B, 5B and 5H) and common electricity hazards can be avoided if only these principles are followed religiously. For example, it will not be surprising if installations or wiring executed as shown in figure 6, which breaks the place identity, functionalism and Gestalt theories, lead to electrical accidents and electrical accidents have been estimated to be exceptionally severe (Cawley and Homce, 2003; Tulonen, T., 2010) and costly (Wyzga and Lindroos, 1999; Tulonen, 2010).
Other factors, of course, may precipitate in electrical hazards and poor aesthetics such as were listed by OSHA (2008): the presence of faulty insulation, improper grounding, loose connections, defective parts, ground faults in equipment, unguarded live parts, and underrated equipment are some of the common electrical hazard causal factors. However, some of these loose-ends would be otherwise relatively easily noticeable and rectified if electrical connections and installations had more aesthetic sense. For example, a faulty insulation or naked cable will be more noticeable in a more aesthetically valuable connection (see figure 5C) than in a poorly aesthetic installation or connection (see figure 5B, 5H and 6). Hence, unnecessary hazards may be readily averted with a little bit of aesthetic value.

2.0 Research Method

The study adopted the descriptive survey research method for the purpose of eliciting self-reports from the respondents. The opinions of respondents were sampled based on the respondents' personal experiences in engaging the services of electrical practitioners in relation to design theories. The researcher, a practicing electrician himself, crosschecked the respondents' claims by sighting and examining the electrical installations on which respondents based their responses. Rather than sampling the opinions of the service providers, the researcher considered it better to sample the opinions of the service consumers instead in this study so as to alleviate biasness in the responses. The cross-sampling of both the service providers and the consumers was proposed for further research.

The sourced data included both primary and secondary data. Primary data was obtained through structured questionnaires, interview and direct observation. Secondary data included information obtained from the research work of other scholars, textbooks and or journals.
The target population of this study was the users of electrical installations and or consumers of design and electrical installation services. The consumers of electrical services within the adult age (18-30years and 31 and above years) range living in selected south-western states namely: Lagos, Osun, Oyo and Ondo state, Nigeria were sampled. According to Singh and Masuku (2014), if the sample size is too small, even a well conducted study may fail to detect important effects or associations, or may estimate those impacts or associations too imprecisely. Similarly, if the sample size is too large, the study would be more complex and may lead to inaccuracy in results (Singh and Masuku, 2014). Moreover, taking a too large sample size would also escalate the cost of study (Singh and Masuku, 2014). Therefore the Yamane formula

(Yamane, 1973), Eq. (1), with +/-5% precision level for large sample (>100,000) was applied for the purpose of determining the sample size:

$$n = \frac{N}{1+N(e)^2} \quad \textbf{Eq. (1)}$$

Where n = the sample size (=398 after calculation), N = the size of the population (which is >100,000), e = the level of significance (or limit of tolerable error) i.e. 0.05 and 1 = Unit. A sample size of approximately 398 was obtained which was considered suitable for the study. The population sample was however selected using simple random sampling. In order to extract information from the selected sample group, a questionnaire was constructed and adopted as a suitable instrument for data collection. Administering the research tool was preceded by a brief discussion with the respondents to educate them on design theories as well as the purpose of the research where needful, without influencing the respondents' opinions (see table 1). Frequencies, percentages and mode were used in analyzing the collected data. Equal number of males and female adults were sampled for even representation of gender opinions. Author received no external funding whatsoever and so was solely responsible for all expenses incurred in the course of this research work.

Table 1: Consumers' knowledge of Graphic Design Principles and theories (Deduced from interview with individual respondents)

Do you have knowledge of Graphic Design theories?			
	FREQUENCY	**PERCENTAGE (%)**	**MODE**
YES	**82**	**20.6**	**2**
NO	**316**	**79.4**	
TOTAL	**398**	**100**	

Source: Researcher's fieldwork, 2018.

From table 1 above, it can be deduced that the majority (79.4%) of the respondent had little or no prior knowledge of design theories. This prompted the researcher to have brief discussion with each respondent before administering the research tool. Details of their responses are as presented in tables 2 to 6.

Chi-square, Eq. (2), was the statistical tool adopted for the testing of the hypotheses. The decision rule was to reject H_0 if significance level (p-value) is less than alpha (α=0.05, the predetermined significance level). Mathematically, Chi-square is represented thus:

$$X^2 = \sum\left[\frac{(f_o - f_e)^2}{f_e}\right] \quad \textbf{Eq. (2)}$$

Where X^2= Chi-square, f_o= Observed frequency, f_e = expected frequency.

2.1 Research Questions

The following research questions were developed to guide this study:

1. Do users prefer functionality at the expense of aesthetics during electrical installations?
2. Do users prefer both functionality and aesthetics combined during installation?
3. Do electrical practitioners apply appropriate design theories in rendering electrical installations?
4. Can design theories have significant effect on the aesthetic sensibility of electrical installations?
5. Do Electrical practitioners prioritize/invoke functionality at the expense of aesthetics during electrical installations?

2.2 Research Hypotheses

Two hypotheses were tested for the purpose of achieving the objectives of this study:

Hypothesis 1

H_{01}: Design principles and theories need not be applied during electrical or design installations to achieve a more acceptable, sustainable and functional design.

H_{A1}: Design principles and theories need be applied during electrical or design installations to achieve a more acceptable, sustainable and functional design.

Hypothesis 2:

H_{01}: There is no significant relationship between aesthetic sensibility and acceptability of electrical or design installations.

H_{A1}: There is a significant relationship between aesthetic sensibility and acceptability of electrical or design installations.

3.0 Results and Discussion

Presented in this section are the data collected, the analyses followed subsequently by brief discussion of each set presented. The results of the research hypotheses tests were also presented in this section.

3.1 Data Presentation, Analysis and Discussion

398 questionnaires were distributed to respondents with a 100% return rate and validity. Data collected were as presented below:

Table 2: Users' preferences in terms of functionality vs. aesthetics

Do you prioritize/prefer functionality at the expense of aesthetics during electrical installations?					
	AGE RANGE	**FREQUENCY**	**FREQUENCY Sub-total**	**PERCENTAGE (%)**	**MODE**
YES	**18-30**	**83**	**184**	**46.2**	**2**
	31- above	**101**			
NO	**18-30**	**116**	**214**	**53.8**	
	31- above	**98**			
TOTAL		**398**	**398**	**100**	

Source: Researcher's fieldwork, 2018.

The study revealed, from table 2, with a mode of 2, that most users do not prefer functionality at the expense of aesthetics during electrical installations. However, from the above table 1, it is obvious that this preference is common mostly to the younger respondents relative to the older ones. This trend suggests an increase in the desire for aesthetic sensibility in installations as urbanization and civilization increase. This suggests that, in the past, functionality perhaps had more preference votes meaning that some people didn't really cared if installations were aesthetically sensible or not, provided they were functional. This is however not exhaustive. Perhaps, a further detailed research in this field may suggest other significant reasons why users show these tendencies.

Table 3: Users' preferences for both functionality and aesthetics combined during installation

Do you prefer both functionality and aesthetics combined during installation?					
	AGE RANGE	FREQUENCY	FREQUENCY Sub-total	PERCENTAGE (%)	MODE
YES	18-30	190	291	73.12	1
	31- above	101			
NO	18-30	59	107	26.88	
	31- above	48			
TOTAL		398	398	100	

Source: Researcher's fieldwork, 2018.

The study revealed, from table 3, with a mode of 1, that most users prefer combination of both functionality and aesthetics during electrical installations. This reflects the need of the users for aesthetics-functionality combination rather than just functionality or aesthetics alone at the expense of the other. This also suggests that, in the past, functionality perhaps had more preference votes than aesthetics but the function-aesthetics combination is beginning to attract more attention. Perhaps, in the past, the aesthetics option was not really of much significance as the older respondents tended more towards functionality in their preferences in contrast with the younger adults. However, as the built environment is becoming increasingly complex and aesthetic needs and orientation is becoming more profound as a criterion for urbanization classification, aesthetics in installation is becoming of more relevance.

Table 4: Users' opinion on whether electrical practitioners apply appropriate design theories in rendering electrical installations.

Do you think, based on your experiences with service providers, that electrical practitioners apply appropriate design theories in rendering electrical installations?					
	AGE RANGE	FREQUENCY	FREQUENCY Sub-total	PERCENTAGE (%)	MODE
YES	18-30	100	141	35.43	2
	31- above	41			
NO	18-30	119	257	64.57	
	31- above	138			
TOTAL		398	398	100	

Source: Researcher's fieldwork, 2018.

The result recorded in table 4, with a mode of 2, shows that most users (64.57%) perceive that most electrical practitioners do not apply design principles during electrical installations. This was based mostly on the premises of the users' perception of the quality of the installations and quality of maintenance. This tendency on the path of the practitioners is reflected, not just in installations but also, in maintenance. For example, most often than not, most practitioners leave their installations or workstations less tidy than it originally is which ultimately results in aesthetic absurdity (see figures 2A, 2B and 5H). The layman will refer to many resulting installations as 'eyesores'. This suggests that graphic design principles should not just be applied during installations but also in the process of maintenance. Hence, aesthetics should not merely be attained but also maintained if sustainability is to be achieved and sustained.

Table 5: Users' opinion on whether or not Design theories have significant effect on the aesthetic sensibility of electrical installations.

Do you think design theories can have significant effect on the aesthetic sensibility of electrical installations?					
	AGE RANGE	FREQUENCY	FREQUENCY Sub-total	PERCENTAGE (%)	MODE
YES	18-30	162	358	89.95	1
	31- above	196			
NO	18-30	14	40	10.05	
	31- above	26			
TOTAL		398	398	100	

Source: Researcher's fieldwork, 2018.

The result recorded in table 5, with a mode of 1, shows that the majority of users (89.95%) perceive that design theories can have significant effect on the aesthetic value of design and electrical installations. This was based on the premises of the users' perception of the aesthetic quality of the current electrical installations around them cum possible projections into the future. This suggests that users will derive more satisfaction, and not just usability or functionality, from electrical, design or other engineering installations if more attention is given to the aesthetic value of installations. And aesthetics and design principles/theories are concomitantly interwoven.

Table 6: Users' opinion on whether electrical practitioners prioritize/invoke functionality at the expense of aesthetics during electrical installations.

Do you think Electrical practitioners prioritize/invoke functionality at the expense of aesthetics during electrical installations?					
	AGE RANGE	FREQUENCY	FREQUENCY Sub-total	PERCENTAGE (%)	MODE
YES	18-30	134	233	58.54	1
	31- above	99			
NO	18-30	71	165	41.46	
	31- above	94			
TOTAL		398	398	100	

Source: Researcher's fieldwork, 2018.

Users' preference for functionality, aesthetics or both functionality and aesthetics may differ from professional preferences. However, as a means of avoiding possible bias on the paths of the professionals or practitioners, users were asked to rate practitioners' priority during installations in terms of functionality and aesthetics, since they are the consumers of these professionals' services. Results presented in table 6 show that the users, in observing the works of these professionals or practitioners during installations or routine maintenance, opined that most practitioners/professionals prioritize functionality at the expense of aesthetics, thereby reducing aesthetic value which users/consumers, from table 3, consider a priority (although, not at the expense of functionality).

3.2 Hypotheses Testing

The proposed hypotheses were tested using Chi-Square, Eq. (2). In order to determine the significance, computed values were compared with appropriate critical values. The decision rule was to reject H_0 if significance level (p-value) is less than alpha (α=0.05, the predetermined

significance level). The significance of the Chi-Square statistic also took into consideration the degree of freedom of the cross-tabulation of the variables.

3.2.1 Hypothesis 1:

H_{01}: Design principles and theories need not be applied during electrical or design installations to achieve a more acceptable, sustainable and functional design.
H_{A1}: Design principles and theories need be applied during electrical or design installations to achieve a more acceptable, sustainable and functional design.

Table 7: Test of relationship between graphic design theories/principles and rendering of acceptable, aesthetically sensible and functional electrical and design installations.

Variable	Observed N	Expected N	Residual
Design theories/principles guided	358	199	159
Non-Design theories/principles guided	40	199	-159
Total	398	398	

N	DF	Chi-Square	Significant	Decision
398	1	151.17	< 0.00001	RejectH_0

Rejected at p<0.01

Since the p-value obtained from the Chi-square is < 0.00001 which is far less than the predetermined significance level (α=0.01), the result is significant at p<0.01. Therefore, we strongly reject the null hypothesis (H_{O1}) and, hence, the alternate hypothesis (H_{A1}), which establishes a significant relationship between relevant graphic design theories and greater acceptability, sustainability and functionality of installations, is thereby accepted.

3.2.2 Hypothesis 2:

H_{02}: There is no significant relationship between aesthetic sensibility and acceptability of electrical or design installations.
H_{A2}: There is a significant relationship between aesthetic sensibility and acceptability of electrical or design installations.

Table 8: Test of relationship between aesthetics and acceptability of electrical and design installations to users.

Variable	Observed N	Expected N	Residual
Aesthetics and Functionality	291	199	92
Functionality only	107	199	-92
Total	398	398	

N	DF	Chi-Square	Significant	Decision
398	1	44.9336	< 0.00001	RejectH_0

Rejected at p<0.05

Since the p-value obtained from the obtained Chi-square is < 0.00001 which is less than the predetermined significance level (α=0.01), the result is significant at $p<0.01$. Therefore, we reject the null hypothesis (H_{O2}) and, hence, the alternate hypothesis (H_{A2}), which establishes a significant relationship between aesthetics and greater acceptability and, hence, sustainability of installations, is thereby accepted.

4.0 Summary of Findings and Recommendations

This section presents a summary of the research findings as well as recommendations based on the presented findings.

4.1 Summary of Findings

The era of shabby installations, when functionality alone made up for aesthetic insensibility, is gradually wrapping up even in less urbanized countries like Nigeria and other sub-Saharan African countries. More attention is being given to aesthetics as consumers/users are beginning to demand for higher degrees of sensibility in both industrial designs and electrical or other engineering installations. The purpose of electrical and design installations is to create the potential built solution to satisfy the purpose or need of the client. This research reflects a major need of users, being aesthetics. The hypothesis two test result (see table 8) shows that consumers/users are beginning to demand more of aesthetically sensible installations and designs rather than just functional ones. This suggests an increasing need for better aesthetic sensibility on the path of users/consumers. This trend seems to possess an increasingly progressive tendency as can be deduced from tables 2 and 3. Therefore, this paper recommends that any professional or practitioner, in the electrical or design fields that intends to continue enjoying user patronage and relevance in the industry should start prioritizing aesthetics.

Hypothesis one test result, in the opinions of users, shows a significant relationship between the application of relevant graphic design theories and the rendering of quality aesthetic and functional electrical installations and or designs. This indicates the significance of the application of graphic design theories and or principles both during installations and in the course of maintenance of designs and electrical installations.

4.2 Recommendations

Since graphic design theories and or principles application help enhance installations' aesthetics without necessarily diminishing functionality, then this paper recommends that:

1. Design principles and theories should be incorporated into the curriculum of the electrical and other engineering and design fields as it is in the Industrial design field. If professionals or practitioners have good knowledge of these theories and principles, from their training days, the built environment will ultimately enjoy more aesthetic sensibility and sustainability and less destructive intrusions and aesthetically-assaulting installations.
2. Companies or organizations producing or manufacturing electrical components or parts should also put into consideration the future use of these principles in order to foster easier adherence on the paths of the professionals or practitioners who install them.
3. Professionals and practitioners should consciously be guided by these principles/theories all through the stages of installations. For instance, professionals/practitioners intending to wire and or render appropriate installations in a building should consider, for example, the principles of design in making their electrical drawings and plans, choices of electrical or design components including their shapes, size, colours and so on especially in relation to other parts of the building or structure. For example, except for the purpose

of emphasis or contrast, installing a red component over a green wall will be aesthetically insensible (except of course that is what the consumer demands).

5.0 Conclusion

Sometimes, the basic difference between a beautiful urban environment and an aesthetically poor one is in the way their installations are rendered. While this study outcome is not exhaustive, it however showed a significant relationship between application of Graphic design theories and the rendering of attractive-functional electrical and design installations. It also revealed that users consider electrical installations as more aesthetically sensible with the application of graphic design theories even though many practitioners do not consciously consider them during installations. This study therefore established the significance of the application of design theories in achieving a more aesthetically sensible, functional and sustainable environmental development. From the results gathered from tables 2 to table 8, it could readily be surmised that optimized aesthetics is achieved with the proper application of graphic design theories and principles in the rendering of sensible and functional electrical and design installations. And when and if a part of what makes up the whole of the environment is aesthetically valuable, then the whole is closer to greater aesthetics which will translate into better sustainability by alleviating unnecessarily destructive interferences.

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