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Impact of Artificial Lighting in the Auditorium Building Spaces of Ajayi Crowther University, Oyo, Nigeria

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Abstract

Purpose: *The study investigated the impact of artificial lighting in Auditorium building spaces in a typical private university. Artificial lighting is a useful architectural design factor of auditorium building spaces; for enhancing the spaces and setting the mood for creating functional environments.*

Design/methodology/approach*–The methodology obtained primary quantitative data from 45 respondents (n=45); from three (s=3) selected auditorium buildings within the University adapting purposive sampling from the initial sample size due to some research limitations and analysed statistically using the Statistical Package for the Social Sciences version 23.*

Findings*–It is noteworthy of the various existing artificial lighting design features; uniform light distribution had the highest mean score of 3.40 in the Auditorium Buildings while natural lighting had the highest mean score of 3.58 as influencing artificial lighting and visual comfort in the selected auditorium buildings while the availability of natural light sources with a mean score of 3.96 was the highest critical success factor.*

Research limitations*–It is essential to acknowledge the limitations of this research which lies in the selection of the Auditorium Buildings within the academic institution which could act as a bias in the deductions.*

Research Implications–*This study suggested further investigations on the critical success factors that may influence natural lighting via architectural design methods for the tropics serving as a reference point for implementation by policymakers.*

Originality–*The results obtained were based on original analysis of the selected auditorium buildings within the study area suggesting similar studies be carried out on other academic institutions.*

Keywords*: Accessing, Artificial, Auditorium, Buildings, Lighting, Space,*

1.0 Introduction

The impact of artificial lighting is an imperative aspect of designing and constructing auditorium buildings; especially in the territorial design regions with low natural light. It plays a significant role in enhancing space, creating mood and ordering of functional environment for the users (Kong, Liu Li, Hou and Xing, 2022). In the southwestern part of Nigeria, electricity supply is unreliable and the energy demand is more than the supply (Enongene, Abanda, Otene, Obi and Okafor, 2019). Despite all these challenges, social activities are also predominantly orchestrated in the buildings-auditoria, multipurpose halls, lecture theatres and other public buildings are used for various events. These events range from concerts, religious activities, political rallies and other forms of social gatherings. Thus, the quality of lighting in those spaces can greatly influence and enhance the audience's

experience (Sholanke, Fadesere, and Elendu, 2021). Therefore, it is essential to assess the impact of artificial lighting in space enhancement of auditorium buildings in Southwest, Nigeria.

The impact of artificial lighting in auditorium buildings has been extensively studied globally. The colour temperature, brightness and intensity of light, among other factors, affect the functionality and aesthetics of a space. Studies have shown that lighting design impacts user experience, emotional responses and physical health (Blume *et al*., 2019) Also, a study by Shishegar and Boubekri (2022), found that proper lighting design could enhance the cognitive performance and mood of an individual's indoor environment. Another study by LeGates, Fernandez, and Hatter (2014) showed that lighting design affects circadian rhythms and can therefore influence sleep and wakefulness patterns.

In Nigeria, there is a paucity of studies that have assessed the impact of artificial lighting on auditorium buildings. However, Azodo and Onwubalili (2019) examined the lighting levels in classrooms at a Nigerian University and found that illumination levels were inadequate, leading to poor academic performance and health issues for students. Similarly, a study by Akpan-Idiok and Ackley (2017) found that the quality of lighting in healthcare facilities in Nigeria impacted patient satisfaction and recovery rates.

The importance of auditorium buildings as spaces for various cultural, educational and entertainment activities has grown significantly in recent years. As a result, there has been increasing demand for well-designed auditorium buildings that offer an enhanced experience for both performers and audiences. One crucial aspect of this enhancement is the implementation of appropriate lighting systems, including artificial lighting which plays a vital role in creating a visually stimulating and immersive atmosphere within the auditorium (Andrick, 2021). However, in the context of South West Nigeria, there is a lack of comprehensive research on the assessment of the impact of artificial lighting on space enhancement of auditorium buildings (Okecchukwu, Okafor and Okeke, 2020). The research problems stem from the recognition that the proper utilization of artificial lighting can significantly contribute to the functionality, aesthetics, and overall experience within auditoriums. Conversely, inadequate or inappropriate lighting solutions can lead to suboptimal performance spaces, hindered audience engagement and diminish overall satisfaction (Sanmargaraja, Wei and Ponniah, 2021).

There are several challenges that need to be addressed which is centred around understanding the design principles and requirements for effective lighting in auditorium spaces which involves evaluating the appropriateness of existing artificial lighting system, in terms of luminance levels, uniformity, colour rendering, colour temperature and overall visual comfort (Sanmargaraja *et al*, 2021) and also examining whether the current lighting solutions can accommodate diverse performance genres, investigating the influence of artificial lighting on stage performance and the visual experience of the audience which explains the relationship between lighting design, stage visibility, performers visibility, emotional connection and overall aesthetic appeal (Hax *et al*, 2022) while focusing on energy conservation patterns for lighting systems for the purpose of maintaining optimal lighting quality (Mahandran, 2021).

Therefore, there is a need to assess the impact of artificial lighting on Auditorium Buildings in Southwest, Nigeria to enhance users' visual comfort and health and wellness-associated advantages. The study evaluates lighting design, indoor colour temperature, intensity and brightness and assess how they affect the functionality and aesthetics of the space. It also examines the user experience, including emotional responses and the impact of lighting on physical health. The findings of this study provide insight into how artificial lighting can be improved to enhance the functionality and user experience of auditorium buildings at Ajayi Crowther University and other potential regions in Nigeria.

2.0 Literature Review

2.1 Stenography of Light in the Architecture of Modern Auditorium Buildings

The use of light in the Auditorium has long been recognized as a crucial element in creating a captivating and immersive experience for the audience (Yativ, 2020). This study explores the significance of artificial lighting in auditoriums, considering its role in shaping the architectural form, mood, and atmosphere of the theatrical space. The study also examines the evolving relationship between architecture and light, highlighting the impact of social changes, construction technologies, and lighting methods on the organization of natural lighting in contemporary Auditorium buildings. The study begins by emphasizing the central role of light in immersing viewers in a theatrical atmosphere (Yativ, 2020). It highlights how light, as the first hypnotic impulse, actively influences the viewer and serves as a means of artistic expression. The study highlights that set design can be seen as the dynamic construction of light streams (Smith, Yu, Zakharov and Durand, 2019). The study also acknowledges the historical significance of natural light in shaping the perception of architectural objects and environments, and how it influences emotions associated with visual perception.

2.2 The Functionality of Light in Auditorium Buildings

Artificial lighting serves as a communicative-directional function by guiding and focusing the attention of visitors (Gusev, 1973). Artificial lighting further plays a typologically hierarchical role, creating lighting conditions that facilitate the perception of architectural forms and align with the architect's design. Additionally, light contributes to the imaginative-associative-creative level of illumination, evoking associations with natural landscapes or anthropogenic elements. Therefore, it is believed and emphasized that every kind of light in an auditorium building fulfils aesthetic, artistic, and utilitarian technological tasks, enabling viewers to evaluate the culture and aesthetics of the auditorium space (Gusev, 1973).

2.3 Evolution of Lighting Practices in Contemporary Auditoriums

It has been observed that the changes in lighting practices are driven by architectural paradigm shifts, social changes, construction technologies, and artistic aspirations. There is an evolving understanding of light in interior spaces and its emotional impact on both viewers and actors (Smith *et al*., 2019). Therefore contemporary set design considers light not only as a design element but also as a powerful means of artistic expression and the creation of a spatial form. Researchers and architects are exploring the various aspects of light and its interaction with auditorium spaces, focusing on its psychological and emotional effects.

2.4 Importance of Natural and Artificial Lighting with Visual Comfort

Natural light plays a crucial role in the human daily rhythm, affecting body temperature, sleep, hormonal changes, and overall well-being. However, in Nigeria, the lack of constant electricity supply presents a challenge in achieving well-lit interiors. Therefore, integrating natural and artificial lighting techniques in building design becomes essential. Techniques such as orientating buildings in an east-west direction, using narrow blocks, and incorporating atriums and courtyards can help optimize natural light penetration (Papa, Lewis, Falk, Zhang, Silvestri, Giordano and Wang 2012). Artificial lighting is used to supplement natural light, particularly in areas where natural light diminishes away from windows (Perkin, 2013). Achieving a balance between natural and artificial lighting is crucial to provide visual comfort and enhance the overall occupant experience. Visual comfort, which refers to users' perception of brightness or darkness within a building interior, is a key consideration in lighting design. Insufficient lighting levels can negatively impact task performance and cause discomfort, leading to decreased productivity and even potential health issues such as depression (Sassi, 2006). Green rating systems, such as the Building Research Establishment Environmental Assessment Method (BREEAM) and Leadership in Energy and Environmental Design (LEED), emphasize the importance of daylighting and access to views for occupants' well-being (Hepner and Boser, 2006). Thus, achieving adequate light levels in Auditorium Buildings is

crucial for providing a conducive learning environment. Additionally, limited studies have been conducted on adequate light levels in Nigerian Auditorium Buildings.

3.0 Research Methods

This study focused on auditorium buildings in Ajayi Crowther University, Oyo, Nigeria and specifically investigated the impact of artificial lighting on space enhancement. The selection of Ajayi Crowther University as the study area is based on several factors. Firstly, the university represents a significant educational hub, hosting a large number of lecture theatres for several students. This provides a diverse range of lecture theatre settings for examination and analysis. Secondly, the region exhibits a mix of urban and rural areas, presenting different lighting infrastructures and environmental conditions that may influence the impact of artificial lighting in lecture theatres. Through the assessment of lecture theatres at Ajayi Crowther University, this study seeks to uncover the strengths and weaknesses of the current lighting systems and identify areas for improvement to enhance the learning environment in lecture theatres.

Based on the aim of the research, the research is designed to assess the impact of artificial lighting in space enhancement in lecture theatres, to improve functionality, visual comfort, and aesthetics and space perception within the spaces.
The study focuses on understanding how artificial lighting can improve the functionality, aesthetic appeal and overall user experience within auditoriums. For this study, Data were obtained from both primary sources and secondary sources of data collection. Data were sourced primarily from the field survey. This involved taking detailed and easily understandable data from the study area in other to find out and analyse the current condition. In this case study, three lecture theatres at Ajayi Crowther University were investigated. The secondary source of data collection involves obtaining data through evaluating previously published literature (i.e., articles, journals, thesis and essays) relating to this study. Data collected were analysed by reading and learning from previous works related to the study. The respondents were chosen using the purposive sampling methods. The purposive sampling method was also used to pick out the auditorium building space users who have day-to-day activities and have adequate information on the auditorium buildings that were chosen. Primary data collection involved the administration of a set of questionnaires concerning the impacts of artificial lighting in space enhancement in auditorium buildings in Ajayi Crowther University, Oyo, Nigeria. The questionnaire had 39 questions and was administered to respondents who received their lectures in the three (3) selected auditorium buildings in the study area. It also ensured that the results answered the questions earlier raised to guide the study. The results and analyses presented here cover respondents' demographic characteristics, Current State of Artificial Lighting in the Auditorium Buildings, Influence of Artificial lighting on Visual Comfort in the Auditorium Buildings and Major Factors that determine the use of Artificial lighting in the selected auditorium buildings within the study area. For easier understanding, the results are presented systematically and in a chronological sequence in line with the research objectives beginning with Objective 1 and ending with Objective 3.

Secondary data collected for the study were analysed using textual analysis while primary data were analysed in the using Frequency Tables and charts.

4.0 Analysis and Discussions

This section presents the analysis of data obtained from respondents in the survey and the demographic details are shown in Table 4.1.

Table 4.1 Names of Auditorium Buildings and Characteristics of Respondents

Characteristics	Categories	Frequency n=45	Percentage 100%
Name of Auditorium Building	Alakija auditorium	15	33.30

Characteristics	Categories	Frequency n=45	Percentage 100%
	Faculty of Natural Sciences Auditorium	15	33.30
	Professor Olaniran Auditorium	15	33.30
Gender	Male	24	53.30
	Female	21	46.70
Age of Respondent	16-20	24	53.30
	21-25	20	44.40
	26-30	1	2.20
Status in the institution	Undergraduate	43	95.60
	Graduate	2	4.40
Years in the university	1-2 years	12	26.70
	2-4 years	31	68.90
	5-6	1	2.20
	7 and above	1	2.20
Level in the Institution	100 Level	5	11.10
	200 Level	7	15.60
	300 Level	16	35.60
	400 Level	16	35.60
	500 Level	1	2.20
Age of Respondents	5-10 years	3	6.70
	11-16 years	10	22.20
	17-22 years	29	64.40
	Above 22 years	2	4.40
Stay on campus	Yes	45	100

Table 4.1 shows a summary of basic information on the auditorium buildings investigated. Table 4.1 specifically shows the names of the auditorium buildings that were studied namely the Alakija Auditorium Building, the Faculty of Natural Sciences Auditorium Building and the Professor Olaniran Auditorium Building all domiciled within Ajayi Crowther University Campus. The results in Table 4.1 further show that a majority (53.30%) of the respondents sampled were male, while the remaining few (46.70%) were female. In addition, most (53.30%) of the respondents were between 16 years and 20 years old and around (95.60%) of the respondents were undergraduates. However, around (68.90%) of the respondents had spent between 2 to 4 years in the University (Table 4.1). Further, a majority (35.60%) of the respondents were in the 300 and 400 Levels within the Institution. Whereas the highest number (100%) of the respondents sampled agree that they stayed within the campus accommodation. (Table 4.1). These results generally indicate that the respondents who participated in the research were mainly middle-aged male and female students and are therefore considered well-qualified to provide valid data for this research.

This section presents the results on the current state of artificial lighting in the selected auditorium buildings. Table 4.2 shows the results of the descriptive analysis of the 10 existing artificial lighting design features in the selected auditorium buildings as documented by the 45 respondents sampled in the survey. The results show that in terms of ranking, the respondents mostly agreed on the uniform light distribution in the auditorium buildings and noiseless operation since these have mean scores of (3.40) and (3.38) respectively followed by flicker-free operation and glare reduction and with mean scores of (3.36) and also (3.36) respectively from Table 4.2. In line with these results is also the evidence that around 35.60%, 37.80%, 24.40% and 40.00% of the respondents mostly agree that there is uniform light distribution and noiseless operation in the auditorium buildings, and flicker-free operation and glare reduction in the auditorium buildings as shown in Table 4.2.

Table 4.2: Descriptive Statistics of the Current State of Artificial Lighting in the Auditorium Buildings

S/No	Artificial Lighting Design Features	Current State of Artificial Lighting in the Auditorium Buildings					Mean	Std Deviation	Ranking
		Very Poor (1) n(%)	Poor (2) n(%)	Not Sure (3) n(%)	Very Good (4) n(%)	Excellent (5) n(%)			
1	Lighting Colour	6(13.30)	9(20.00)	4(8.90)	21(46.70)	5(11.10)	3.22	1.277	6th
2	Brightness of Lighting	1(2.20)	12(26.70)	9(20.00)	19(42.20)	4(8.90)	3.29	1.036	5th
3	Natural Lighting	4(8.90)	13(28.90)	9(20.00)	13(28.90)	6(13.30)	3.09	1.221	8th
4	Intensity of LED Lighting	3(6.70)	11(24.4)	12(26.70)	14(31.1)	5(11.1)	3.16	1.127	7th
5	Dimming Capabilities	8(17.80)	7(15.60)	17(37.80)	11(24.40)	2(4.40)	2.82	1.133	10th
6	Noiseless Operation	4(8.90)	6(13.30)	11(24.4)	17(37.80)	7(15.60)	3.38	1.173	2nd
7	Glare Reduction	1(2.20)	10(22.2)	11(24.40)	18(40.00)	5(11.10)	3.36	1.026	4th
8	Low Heat Emission	4(8.90)	12(26.70)	9(20.00)	16(35.60)	4(8.90)	3.09	1.164	9th
9	Uniform Light Distribution	3(6.70)	10(22.2)	7(15.60)	16(35.60)	9(20.00)	3.40	1.232	1st
10	Flicker-Free Operation	1(2.20)	9(20.00)	16(35.60)	11(24.40)	8(17.80)	3.36	1.069	3rd

n=frequency, %=percentage

However, the respondents were found to least agree on the brightness of lighting, lighting colour, intensity of LED lighting, natural lighting, low heat emission, fire and dimming capabilities. This informed the low mean values of 3.29, 3.22, 3.16, 3.09, 3.09, and 2.82 respectively, as shown in Table 4.2. These results indicate that the respondents who were involved in the study listed in Table 4.2 are more agreed on the uniform light distribution, noiseless operation, flicker-free operation and glare reduction in the auditorium buildings. This implies that the respondents agree about the excellent current state of uniform light distribution, noiseless operation, and flicker-free operation and glare reduction in the auditorium buildings.

Table 4.3: Inferential T-Test Statistical Analysis of Use of Artificial Lighting in the Auditorium Buildings With Uniform Light Distribution

On Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Uniform.D	45	3.4000	1.23215	.18368

Table 4.4: Uniform Light Distribution

One-Sample Test

	Test Value = 3					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Uniform.D	2.178	44	.035	.40000	.0298	.7702

Decision rule for assessing if the test is significant (α=0.05)

If p≤0.05, the test is significant
If p≥0.05, the test is not significant
p value =sig.(2-tailed)

The t-test results indicate that the average satisfaction value of 3.4000 is significantly different from the test value of 3, as evidenced by a p value of 0.035. This value is below the conventional alpha level of 0.05, suggesting that there is strong evidence to conclude that participants are more satisfied with uniform light distribution than neutral (neither satisfied nor dissatisfied).
The analysis indicates that participants express a significant level of satisfaction with uniform light distribution in the auditorium buildings Table 4.3 and Table 4.4

This section presents the results on the influence of artificial lighting on visual comfort in the selected auditorium buildings. Table 4.5 shows the results of the descriptive analysis of the 10 artificial lighting design features in the selected auditorium buildings as documented by the 45 respondents sampled in the survey. The results show that in terms of ranking, the respondents mostly agreed on natural lighting in the auditorium buildings and noiseless operation since these have mean scores of (3.58) and (3.36) respectively followed by the flicker-free operation and brightness of lighting with mean scores of (3.33) and (3.31) respectively. Table 4.5. In line with these results is also the evidence that around 44.40%, 46.70%, 31.10% and 42.20% of the respondents agree that the following features are adequate in terms of the influence of artificial lighting on visual comfort in the selected auditorium buildings; natural lighting, noiseless operation, flicker-free operation and brightness of lighting as shown in Table 4.5.

Table 4.5: Descriptive Statistics of the Influence of Artificial Lighting on Visual Comfort in the Auditorium Buildings

S/No	Artificial Lighting Design Features	Level of Agreement of the Influence of Artificial Lighting on Visual Comfort in the Auditorium Buildings					Mean	Std Deviation	Ranking
		Never Influential (1) n(%)	Little Influential (2) n(%)	Not Sure (3) n(%)	Very Influential (4) n(%)	Extremely Influential (5) n(%)			
1	Lighting Colour	3(6.70)	12(26.70)	11(24.40)	16(35.60)	3(6.70)	3.08	1.083	8th
2	Brightness of Lighting	3(7.70)	11(24.40	6(13.30)	19(42.20)	6(13.30)	3.31	1.184	4th
3	Natural Lighting	-	8(17.80)	10(22.20)	20(44.40)	7(15.60)	3.58	0.965	1st
4	Intensity of LED Lighting	1(2.20)	13(28.90)	18(40.00)	9(20.00)	4(8.90)	3.04	0.976	9th
5	Dimming Capabilities	3(6.70)	14(31.10)	14(31.10)	11(24.4)	3(6.70)	2.93	1.053	10th
6	Noiseless Operations	1(2.20)	9(20.00)	11(24.40)	21(46.70)	3(6.70)	3.36	0.957	2nd
7	Glare Reduction	1(2.20)	9(20.00)	17(37.80)	17(37.80)	1(2.20)	3.18	0.860	6th
8	Low Heat Emission	3(6.70)	10(22.20)	16(35.60)	11(24.40)	5(11.10)	3.11	1.092	7th
9	Uniform Light Distribution	1(2.20)	12(26.70)	10(22.20)	20(44.40)	2(4.40)	3.22	0.974	5th
10	Flicker-Free Operation	-	7(15.60)	20(44.40)	14(31.10)	4(8.90)	3.33	0.853	3rd

n=frequency, %=percentage

However, the respondents were found to least agree on the adequacy of the uniform light distribution, glare reduction, low heat emission, lighting colour, intensity of LED lighting and dimming capabilities. This informed the low mean values of 3.22, 3.18, 3.11, 3.08, 3.04, and 2.93 respectively, as shown in Table 4.3. These results indicate that the respondents who were involved in the study listed in Table 4.5 are more agreed on the influence of natural lighting, noiseless operation, flicker-free operation and the brightness of lighting in the auditorium buildings. This implies that the respondents agree about how influential natural lighting, noiseless operation, flicker-free operation and the brightness of lighting in the auditorium buildings are.

Table 4.6: Inferential T-Test Statistical Analysis of Use of Artificial Lighting in the Auditorium Buildings With Flicker Free Operation

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
FF.Operation	45	3.3333	.85280	.12713

Table 4.7: Flicker Free Operation

One-Sample Test

	Test Value = 3					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
FF.Operation	2.622	44	.012	.33333	.0771	.5895

Decision rule for assessing if the test is significant (α=0.05)
If p≤0.05, the test is significant
If p≥0.05, the test is not significant
p value =sig.(2-tailed)

The t-test results indicate that the mean value of 3.3333 is significantly different from the test value of 3, as evidenced by a p-value of 0.012. This value is below the conventional alpha level of 0.05, suggesting that there is strong evidence to conclude that participants view flicker-free operation of lighting as a significantly important factor in enhancing visual comfort in the auditorium building.
The analysis indicates that participants express a significant level of agreement regarding the importance of flicker-free operation of lighting in enhancing visual comfort in the auditorium buildings Table 4.6 and Table 4.7.

In this study, 11 factors that determine the use of artificial lighting in the selected auditorium buildings from the review of literature were investigated. Table 4.8 shows the results of the descriptive analysis of the factors that determine the extent to which artificial lighting is applied in the selected auditorium buildings as rated by the 45 respondents sampled in the survey.

Table 4.8: Descriptive Statistics of Factors That Determine the Use of Artificial Lighting in the Auditorium Buildings

S/No	Critical Success Factors	Level of Agreement of Factors That Determine the Use of Artificial Lighting in the Auditorium Buildings					Mean	Std Deviation	Ranking
		Strongly Disagree (1) n(%)	Disagree (2) n(%)	Not Sure (3) n(%)	Agree (4) n(%)	Strongly Agree (5) n(%)			

1	Cost	6(13.30)	5(11.10)	15(33.30)	12(26.70)	7(15.60)	3.20	1.236	11th
2	Policy Framework	1(2.20)	3(6.70)	22(48.90)	16(35.60)	3(6.70)	3.38	0.806	9th
3	Conservation of Energy	6(13.30)	4(8.90)	8(17.80)	19(42.20)	8(17.80)	3.42	1.270	6th
4	Maintenance	6(13.30)	8(17.80)	7(15.60)	19(42.20)	5(11.10)	3.20	1.254	
5	Lighting Control and Flexibility	5(11.10)	6(13.30)	6(13.30)	19(42.20)	9(20.00)	3.47	1.272	5th
6	Appearance of Colour	2(4.40)	8(17.80)	12(26.70)	17(37.80)	6(13.30)	3.38	1.072	7th
7	Availability of Natural Light Sources	1(2.20)	11(24.40)	21(46.70)	12(26.70)	12(26.70)	3.96	0.852	1st
8	Brightness Level	1(2.20)	10(22.20)	8(17.80)	23(51.10)	3(6.70)	3.38	0.984	8th
9	Seating Arrangement and Audience Visibility	-	6(13.30)	8(17.80)	20(44.40)	11(24.40)	3.80	0.958	3rd
10	Expertise and Resources	3(6.70)	7(15.60)	14(31.10)	14(31.10)	7(15.60)	3.33	1.128	10th
11	Audience Comfort	2(4.40)	4(8.90)	11(24.40)	10(22.20)	18(40.00)	3.84	1.186	2nd

n=frequency, %=percentage

Results of the descriptive statistics reveal that the mean scores for each of the 11 factors range from 3.20 and 3.96 (Table 4.4). The results also reveal that of the 11 factors investigated, the respondents in the selected auditorium buildings agreed that 8 (72.72%) of these factors ranked 1st to 8th have an influence on artificial lighting in the auditorium buildings, while three factors ranked 9th to 11th do not have any significant influence on artificial lighting in the selected auditorium buildings in the study area (Table 4.8). Ranked in the order of influence of each of the factors, the results further show that the three top most influential factors with mean values of 3.96, 3.84 and 3.80 were availability of natural light sources, audience comfort and seating arrangement and audience visibility respectively.

The factors considered to have the least influence are policy framework (3.38), expertise and resources (3.33) and cost (3.20), respectively. Generally speaking, it can also be seen in Table 4.8 that factors ranked 1st to 6th with mean values of between 3.96 to 3.42 can be considered as having the highest influence on artificial lighting in the selected auditorium buildings; those ranked 7th to 9th with mean values 3.38 to 3.38 have moderate influence, while that ranked 10th to 11th position and have mean values 3.33 to 3.20 have the least influence on this. These results generally show that 6(54.55%) of the 11 factors have a high influence on artificial lighting in the selected auditorium buildings, while 5(45.45%) have a low influence on artificial lighting in selected auditorium buildings. Based on these, it can be inferred that a majority of the factors investigated have influenced artificial lighting in the selected auditorium buildings investigated in this research.

Table 4.9: Inferential T-Test Statistical Analysis of Use of Artificial Lighting in the Auditorium Buildings with Audience Comfort

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
AUDIENCE.C	45	3.8444	1.18620	.17683

Table 4.10: Audience Comfort

One-Sample Test

	Test Value = 3					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Audience.C	4.776	44	.000	.84444	.4881	1.2008

Decision rule for assessing if the test is significant (α=0.05)
If p≤0.05, the test is significant
If p≥0.05, the test is not significant
p value =sig.(2-tailed)

The t-test results indicate that the mean value of 3.8444 is significantly different from the test value of 3, as evidenced by a p value of 0.000. This value is well below the conventional alpha level of 0.05, suggesting that there is strong evidence to conclude that participants view audience comfort as a significantly important factor in the use of artificial lighting.
The analysis indicates that participants express a very high level of agreement regarding the importance of audience comfort in determining the use of artificial lighting in the auditorium buildings Table 4.9 and Table 4.10.

4.1 Discussion

The concepts of visual comfort and lighting quality are among the key components of Architectural Design and as such, emphasis needs to be prioritised while addressing this fundamental deliverable in auditorium building designs in academic institutions (Lorfabadi and Hancer, 2023). Other deliverables to be achieved in space planning concepts and artificial lighting strategies are human well-being within the designed spaces which necessitates that space planners in addressing space planning issues (Mahmoud, Samanoudy and Jung, 2023) agree are essential ingredients in achieving a successful interior functionality when it comes to space lighting and illumination. These are key determinants regarding students learning abilities and assimilation of knowledge which these auditorium building spaces provide for the academic environment in which they are domiciled. In addition, Samiou, Doulos and Zerefos (2022) highlight that artificial lighting plays an active role in educational environments which affects the execution of all educational activities within the auditorium spaces thereby enhancing the healthy development of the student's visual perceptual systems. The authors further believe that it is the need for the circadian rhythm of humans which are physical, mental, and behavioural changes that follow a 24-hour cycle that has resulted in the use of artificial lighting in educational building spaces. Further studies by Kharat and Dhamankar (2023) believe that lighting plays a crucial role in educational environment spaces thereby enhancing better performance and sharper and improved learning rates and has a very significant impact on the visual comfort of the students for which the auditorium spaces should be carefully considered. While it is important to emphasize the architectural design of building spaces, a poor conception of lighting strategies can have negative implications such as increased use of alternative energies thereby directly affecting users and creating situations of visual discomfort among building occupants (Moyano, Fernandez and Lazcano, 2020). In addition, Sharma and Rakshit (2016) are of the view that the environment of a regularly occupied space like an auditorium building can be maximally improved by enhanced artificial lighting sources but they suggest that energy savings and carbon mitigation strategies due to emphasis on the use of artificial lighting that emit a lot of energy and cause harm to the environment should be mitigated against. While it has become expedient that artificial lighting is necessary in auditorium building spaces because reliance on natural lighting cannot be guaranteed throughout the day, artificial lighting is very necessary in complementing natural lighting sources and as such artificial lighting requires the provision of even lighting sources over a vast space like it is in

auditoriums (Tedjawinata and Jurizat, 2021). The right mix of artificial lighting it has been observed can directly affect users' experiences in building spaces (Liu, Han, Yan and Ren 2023) and as such harnessing the great potential of artificial lighting sources enhances assimilation and educational productivity levels of students within the auditorium spaces.

5.0 Conclusion and Recommendations

The study concludes that more attention needs to be placed on the impact and influence of artificial lighting on space enhancement by considering the comfort of the users in that environment. These are critical success factors that can improve the level of student learning concentration (attention span), visual comfort, space functionality, good illuminance and spatial ambience. This study recommended that these findings should be deciphered and integrated into the operational and maintenance manual instruments of these auditorium buildings; as it will help to improve the overall functionality, energy efficiency and user satisfaction experience of the selected auditorium buildings studied and other auditorium buildings in Nigeria, Africa and the global world.

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