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INVESTIGATING DESIGN STUDIO FACILITIES AND STUDENTS' LEARNING OUTCOME: EMPIRICAL EVIDENCE FROM DEPARTMENT OF ARCHITECTURE, OBAFEMI AWOLOWO UNIVERSITY, ILE IFE.

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ABSTRACT

There is growing evidence of a link between the adequacy of design studio facilities and student learning outcome. This study therefore, explores which design studio facility affects learning outcome. The impact of eight design studio facilities were examined namely: thermal, visual, acoustic, fire safety, studio layout and quality, interior finishes, brainstorming space and support services.

The paper provides a logical approach for appraising the major performance requirements of an architectural design studio. Emphasis was majorly on the thermal, visual and acoustic comfort of the architectural design studio. Its importance to design professionals, facility providers/managers is the feature and uniqueness of this study.

KEYWORDS: *Thermal and Visual Comfort, Design Studio Facilities, Architectural Studio*

INTRODUCTION

Modern research continues to verify that educational facilities have an impact on the learning environment and student achievement (Stevenson, 2001). According to John Dewey, the learning environment was a humane place that is attentive to individual needs rather than those of the masses.

The learning environment must support learning. Learning was and is considered an understanding or ability to construct knowledge in meaningful ways for a practical purpose or solution to a problem. The physical learning environment should not be constructed to influence teaching or learning styles but should be responsive to individual student and teacher needs (Lang, 2005). This physical learning environment is created by the sum total of the factors affecting our perception of the facility that we occupy (Hawkins and Lilley, 1998).

Since valuable learning occurs as a result of student interactions, the designs of these spaces must include a variety of areas where students can interact, consult and socialize (Kuh et al, 2005; Chism, 2006). According to Deasy and Lasswell (1985) a learning environment functions both as a learning space and a complex social organization. The role of the studio in architectural education is very important. It has been suggested that approximately one third or half of the educational process of architectural students is spent in the studio (Stamps, 1994).

The twenty-first century is seeing greater emphasis being placed on student-centered learning approaches. Corresponding with this direction of thinking is the need for learning spaces to be designed to be flexible so that they can be used simultaneously by different groups. In addition, on the basis that much effective learning takes place as a result of interactions between students, designs also need to provide a variety of spaces where they can work and socialize together (Kuh *et al*, 2005; Chism, 2006). With respect to issues that need to be considered when designing learning environments, the involvement of intended users of the space (staff and students) during the design process is important. Other considerations include functionality, adjacencies (referring to connections to other people and spaces), physiological and psychological aspects, furnishings, group size and structural aspects (Temple, 2007).

This study is therefore significant in that it will add a new body of knowledge regarding design studio facilities and their impact on learning outcome.

RESEARCH OBJECTIVES

- Assess the performance appraisal of studio facilities among architectural students
- examine the impact of architectural design studio facilities on students learning outcome
- examine the relationship between studio environment and studio attendance among architectural students
- Effect of design studio facilities on studio attendance

LITERATURE REVIEW

The learning environment is made up of the physical surroundings present in a learning situation (Barker and Garvin-Doxas, 2004). These ambient factors are created by the commonly identified features of lighting quality, indoor air quality (IAQ), noise management, and size (Lang, 2005 Chan, 1996 Black, 2001). Several additional physical features are integral to the learning environment. Chan (1996) suggests that the aesthetic qualities in a building are part of the learning environment. In addition, the way we light our learning environments is one of the most important factors in learning. It affects mental attitude, class attendance, and performance (Lyons, 2002).

The design studio in architectural education is one of the renowned and most commonly used spaces for developing, evaluating and exhibiting collections of art and design works (Duggan, 2004). Design studio environments serve both as a learning center and as a multi-faceted social setting. Students enrolled in design courses usually work in these spaces during their free times, in addition to their scheduled class hours (Demirbas and Demirkan, 2000). Architectural design studios are becoming a significant resource for enabling students to gain applied and theoretical knowledge that could be transformed with creativity into design solutions.

Likewise, they also serve as a resource for developing and upgrading the level of practical knowledge especially computer-based drafting among the students of programs like architecture, architectural engineering and planning. Institutions around the world have become progressively more conscious of the need for continuous assessment of their educational facilities for architectural design. Recently, several studies have focused on exploring the role of the architectural design studio to prove its value as a significant resource to academic institutions. And, as a result, several schools of architecture or the built-environment are endeavoring now on means to improve their design studios in a way that respond to changes in the nature of higher education and different life style needs of the students (Duggan, 2004).

LEARNING OUTCOME

Studies about student academic achievement and building condition conclude that the quality of the physical environment significantly affects student achievement. 'There is sufficient research to state without equivocation that the building in which students spends a good deal of their time learning does in fact influence how well they learn' (Earthman, G., 2004:18).

According to (Lang, 2005), the physical learning environment should not be constructed to influence teaching or learning styles but should be responsive to individual student and teacher needs. These physical surroundings in the learning environment impact perceptual learning, concept formation, language development, socialization, creative growth, attitudes towards school, reduction of vandalism, and attrition rates in schools (Lackney, 1999b).

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Lang (2005) describes the components of these aesthetic qualities. Lewis (1995), Earthman (2002), and Chan (1996) emphatically present the factor of facility condition as a component of the learning environment. Heath and Mendell (2002), Lackney (1999a), and Lyons (2002) stress the criticality of indoor air quality (IAQ) as a key component of the learning environment. The very center or focal point of the learning environment is the classroom.

Performance Appraisal OF Design Studio Facilities

Several studies have examined the effect of the physical conditions of teaching spaces (which includes seating, furnishings, spatial density, privacy, noise and acoustics, climate and thermal control, air quality, windowless classrooms and play-yards, light and colour) on students' engagement, attainment, attendance and wellbeing (Keep, G., 2002; Higgins et al 2005; Lackney & Jacobs, 2002; Earthman 2004; McNamara & Waugh 1993).

1. Visual Comfort: Sufficient amount of illumination at desks in design studios can be provided naturally or by artificial means. Heschong (2003) affirms that provision of suitable amount of daylight in educational facilities has a positive and highly considerable connection with improved student performance. However, too much lighting can impair task performance through glare especially during the summer (Winterbottom and Wilkins, 2009).

Classroom lighting plays a particularly critical role in student performance (Phillips 1997). Obviously, students cannot study unless lighting is adequate, and there have been many studies reporting optimal lighting levels (Dunn et al. 1985, 866). Jago and Tanner's review (1999) cites results of seventeen studies from the mid-1930s to 1997. The consensus of these studies is that appropriate lighting improves test scores, reduces off-task behavior, and plays a significant role in students' achievement. Students must have appropriate lighting in order to learn and thrive in their learning environment.

2. Thermal Comfort: Thermal comfort has been identified as one of the most influential technical performance requirements for consideration in learning spaces. According to (Earthman, 2004: 11–16), temperature, heating and air quality are the most important individual elements for student achievement.

Hwang et al (2006) demonstrate that air temperature, air movement and mean radiant temperature have significant effect on student thermal sensation in learning space. Shaughnessy et al (2006) and Seppanen et al (2006) indicate that a well-designed ventilation system in a space provides quality indoor air, which results in improving the performance and productivity of the occupants.

A study by McGuffy in 1982 was one of the first to recognize the impact of heating and air conditioning on the learning environment (Schneider, 2002). The foundation for this later work was laid 61 years ago by the New York Commission of Ventilation (1931). The Commission sought to determine the best classroom temperatures for the healthiest learning environment for students. This study tested city, rural, and experimental classrooms. "Students were subjected to varying temperatures while in the classroom and measures of the number of reported illnesses were taken to compare with the temperatures." (Earthman, 2002, pg. 4). The report concluded that temperature in the classroom must be maintained within a narrow band between 67 to 73 degrees Fahrenheit to reduce illness (Earthman, 2002).

As temperature increases, students report greater discomfort and inability to concentrate on tasks (Schneider, 2002). Poor thermal quality affects teaching ability as well. Ventilation, Humidity, Pollutants: While air temperature is a very tangible factor in air quality, ventilation, humidity, and pollutants are less so (Lyons, 2002). The interaction between temperature and these three factors can have a great impact on the learning environment.

3. **Acoustic Comfort:** Chronic noise exposure impairs cognitive functioning, with numbers of studies finding noise-related reading problems, deficiencies in pre-reading skills, and more general cognitive deficits. (Higgins et al, 2004:18).

Exchange of ideas through oral communication between the course instructor and the students as well as among the group of students is an essential learning activity in educational environments (Bradley, 2005). This learning activity could be adversely impacted when students fail to recognize all of the instructor's spoken communication as a result of inferior room acoustics or background noise originating from the heating, ventilating and air-conditioning systems. Crandell and Smaldino (2000), state that "inappropriate classroom acoustics can deleteriously affect not only speech perception, but also psycho-educational and psychosocial achievement. The speech perception deficits experienced by students highlight the need to strongly consider the acoustical conditions in listening environments used by such populations".

Lyons (2002) identifies three sources of noise in the learning environment. These sources are noise from outdoors, mechanical noise generated between rooms or corridors, and noise from within the classroom including ventilation systems. Noise reduction and control in the classroom is an important consideration in the design of schools (Schneider, 2002).

4. **Fire Safety:** The provision of and the regular upkeep of fire safety systems in architectural design studio space is an essential concern for design professionals and facility managers to ensure the safety of the occupants. Watson (2000) indicates that there are three major fire safety objectives. The first objective is primarily concerned with preventing ignition of building materials and contents.

This objective involves controlling ignition sources, controlling fuel characteristics and controlling fuel/heat interaction by maintaining adequate separation. The second objective focuses on controlling fire development. It involves detecting fires by means of heat, smoke and flame detectors, controlling combustion and limiting the rate of development

and spread of fire. The third major objective aims at protecting the exposed occupant. This objective entails notifying the occupants of the building, providing avenues for egress and protecting the in-place occupants.

5. Studio Quality and Layout: The quality of the design studio has a greater impact on the comfortability of the space for its users. The workspace in the design studio is the individual student cubicle which, in turn, is affected by the furniture size, furniture comfort, walkways and cubicle arrangement (Leung and Fung, 2005). Architectural design studios are unlike classrooms. While classrooms are only used during designated lecture times, students spend most of their remaining times during the day and night in the studio space to complete their design projects. This is mainly attributed to the fact that design studio courses carry the highest number of units or credit hours in both architecture and architectural engineering curriculums. As the design studio is a shared space among all students, privacy is a very important issue to consider in the design studio spaces. Studio spaces should not be over crowded as crowdedness could diversely affects students' concentration (Demirbas and Demirkan, 2000).

6. Interior Finishes: In general, decorative elements are known to provide a comfortable environment to occupant. In educational environments, such elements could range from cushioned seats, shelves for books and periodicals, lighting levels that could be fine-tuned, carpets with vibrant colors, plants, portraits and bulletin boards (Leung and Fung, 2005). Common performance problems associated with interior finishes are color fading, spills, stains, evenness of surfaces, cleanability and erosion (Preiser et al., 1988). Much research findings about colour is conflicting, and remains hotly debated (Higgins et al, 2004: 21–22).

7. Brainstorming (Group Gathering) Space: Apart from the design and drafting activities, the architectural design studio also host the theoretical aspect of these courses in form of lectures delivered to the students. The provision of instructional equipment like data viewers and white boards in brainstorming or group-gathering spaces can improve the general performance of the student by integrating the instructional requirement into the studio space. Students benefit enormously when a broad spectrum of communication tools is used in architectural educational environments (Mizban and Roberts, 2008).

8. Support Service: The expansion in the use of information technology has affected society and imposed demands on higher education to reshape their educational systems and utilize new technologies in their curriculum (Volery and Lord, 2000). It has been a practice in most schools of architecture to provide personal computers, plotters and printers to provide students with means to represent their work on a hardcopy form for submission and other requirements. Kalisperis and Pehlivanidou-Liakata (1998) have found that the utilization of computers in design studio courses has enabled students to develop multiple design solutions.

RESEARCH METHODOLOGY

The survey research design was adopted for this study. The population for this study covers all students from the Department of Architecture, Faculty of Environmental Design and Management, Obafemi Awolowo University, Ile Ife. The participants in this survey exercises were limited to students who have spent at least one semester. The primary source of data for this study was collected through a self-administered questionnaire which contained five sections – section 1: student's background characteristics; section 2: visual and thermal characteristics of architectural studio: section 3: Performance appraisal of design studio facilities among students: section 4: impact of architectural design studio facilities

on students learning outcome; section 5: Effect of design studio facilities on studio attendance. In order to ensure maximum responses to the questionnaires, respondents were briefed regarding the purpose of the survey and reassured that the information provided will be kept confidential and will be used for research purposes only. A total of one hundred and fifty (150) questionnaires were randomly administered across the selected studios (studio 2-4) and the postgraduate studio. Out of this number, 124 valid questionnaires were retrieved, representing a response rate of (82.7%). A Likert scale ranged from "1" = very dissatisfied, "2"=dissatisfied, "3"= satisfied, "4"= very satisfied, was used to measure respondents' level of satisfaction on various design studio facilities (Table 4.4.1).

DATA ANALYSIS

The analysis of data collected was accomplished by the use of Statistical Package for Social Science (SPSS) software. Data were analyzed using descriptive statistics such as frequency distribution and percentages and inferential statistics such as chi square test and multivariate level of analysis. The multivariate level of analysis involved the use of multivariate regression to predict the impact of each of the predictor parameters (design studio facilities) on the dependent variables-learning outcome and studio attendance.

RESULTS AND DISCUSSIONS

Background Characteristic of Respondents

Before going into the research objectives, the background attributes of the respondents need to be examined. The personal attributes examined are gender, age group and level. The gender distribution of the sample indicates that (62.9%) of them were male while (37.1%) were female. The proportion of respondents in the age group 25-31 years was (51.6%) while those in the age group 18-24 years were (34.7%). Respondents in the age group 32-39 years accounted for (13.7%).

Simple majority (37.1%) of the respondents who participated in the study were postgraduate students, (29.0%) were from the 300 Level class, (16.1%) from the 200 Level class and (17.7%) from the 400 Level class. Summary of the background characteristics of the respondents is presented in table 1.

Table 1: Respondents Background Characteristics

Gender	Freq	%	Age Group	Freq	%	Level	Freq	%
Male	78	62.9	18-24 years	43	34.7	200L	20	16.1
Female	46	37.1	25-31 years	64	51.6	300L	36	29.0
			32-39 years	17	13.7	400L	22	17.7
						PG	46	37.1
Total	**124**	**100.0**	**Total**	**124**	**100.0**	**Total**	**124**	**100.0**

Source: field survey, 2015

Studio Characteristics / Attendance

The general condition of the design studio can greatly affects student's attendance and ultimately determines how long they decide to stay. Findings from the survey reveal that majority (60.5%) of the respondents spent between 4-6 hours per day in their design studio. It was also observed that significant proportion (65.3%) of the students surveyed work in their design studio at night. Among respondents who claim to work in their design studio at night, (29.8%) spent above 6 hours, (25.0%) spent between 4-6 hours, while (10.5%) spent between 1-3 hours of work in their design studio at night. With respect to reasons for not working in the design studio at night, (24.2%) claim they just don't feel like, (19.4%) gave poor lighting system as their reason for not working at the design studio at night, while (10.5%) claimed unstable power supply.

Table 2: Studio Characteristics and Attendance among Architectural Students

Number of Hours Spent in Studio during the Day	Freq	%
1-3 hours	49	39.5
4-6 hours	75	60.5
Total	124	100.0
Do you work in your design studio at night?		
Yes	81	65.3
No	43	34.7
Total	124	100.0
How long do you spend working in your studio at night?		
1-3 hours	13	10.5
4-6 hours	31	25.0
above 6 hours	37	29.8
Not applicable	43	34.7
Total	124	100.0
Reason for not working in studio at night?		
It is not allowed	2	1.6
Just don't feel like	30	24.2
Poor lighting system	24	19.4
Unstable power supply	13	10.5
Not applicable	55	44.4
Total	**124**	**100.0**

Source: field survey, 2015

Performance Appraisal of Design Studio Facilities among Students

In other to measure the degree of satisfaction expressed by the respondents on a particular attribute, the following standardization was developed and adopted by the author for the purpose of this study.

Table 3: Rating Scale to Determine the Degree of Satisfaction of the Responses

Response Category		Range
Very Satisfied (VS)		80-100%
Satisfied (S)		51 – 79%
Dissatisfied (D)		30 – 50%
Very Dissatisfied (VD)		< 30%
VS = Very satisfied S = satisfied D = Dissatisfied VS = Very Dissatisfied		

The instrument for the study was a researcher developed questionnaire to rate the performance appraisal of design studio facilities. The items were structured on a 4 – point rating of very satisfied 4 points, satisfied 3 points, dissatisfied 2 points and strongly dissatisfied 1 point.

The reliability of the instrument was established using the Cronbach Alpha analysis via SPSS version 20 software. The reliability coefficient value yielded 0.725 which was considered adequate for the study. For decision making, any parameter item with a combined percentage value greater than 80% was rated as strongly satisfied, while item with percentage value less than 30% was rated as strongly dissatisfied. The rate of satisfaction of the respondents on the eight (8) parameters describing the performance of the design studio facilities is presented in table (4.4.1)

1. **Visual Comfort:** in this category, the percentage response from the respondents on the three attributes measured reveals that the respondents were very satisfied with all the three attributes in this category as shown in table 4.4.1 considering the fact that the combined percentage for very satisfied and satisfied was greater than (80.0%).

2. **Thermal Comfort**: the response in this category reveals that the respondents were satisfied with the space temperature during morning and evening times, while the overall perception of the thermal environment in the studio shows that they were very satisfied (83.8%).

3. **Acoustic Comfort**: three attributes were assessed in this category. The result reveals that the respondents were dissatisfied with two of the attributes namely: the level of noise generated in the studio space and the overall perception of the acoustical environment in the studio, while they were very dissatisfied with the level of noise generated from outside the studio.

4. **Fire Safety**: there were four attributes in this category. The result reveals that the respondents were dissatisfied with the first three attributes namely; ease to identify emergency exits for occupants and visitors, ease of evacuating the building in case of fire emergencies and ease to identify and reach the fire alarm system. In addition, the result reveals that the respondents were very dissatisfied with the quality and perception of fire safety systems in the building.

5. **Studio Quality and Layout**: a total of nine different attributes were identified and rated in this category. The result reveals that the respondents were very satisfied with eight (8) attributes in this category and satisfied with one attribute that measured sense of privacy while working at the studio.

6. **Interior Finishes**: four attributes were examined in this category namely; colour of studio's interior partition, quality of studio interior partition finish, quality of floor finish in the studio and quality and presentation of wall finishes. The result reveals that the respondents were very satisfied with all the attributes in this category as shown in table (4.4.1).

7. **Brainstorming (Group Gathering) Space**: three attributes were examined in this category namely; adequacy of the brainstorming (gathering) table to accommodate group discussion, adequacy of the white board in the studio and suitability of the slide projector and screen. The result reveals that respondents were dissatisfied with the adequacy of the brainstorming (gathering) table to accommodate group discussion, while they were satisfied with the remaining two attributes as shown in (table 4.4.1).

8. **Support service**: four attributes were examined in this category. The result shows that respondents were very satisfied with two of the attributes namely; ability to control access for non-members of the studio and overall perception of the quality of the studio space. However, the respondents were very dissatisfied with the adequacy of printers and plotters in the studio, but satisfied with adequacy of help provided in cases of technical problems with IT equipment.

The assessment of the overall performance appraisal of the design studio facilities reveals that out of the thirty three (33) attributes measured, the respondents were very satisfied with nineteen (19), satisfied with six (6), dissatisfied with seven (7) and very dissatisfied with three (3). In addition, respondents were generally satisfied with the visual comfort, thermal comfort, studio quality and layout, interior finishes, brainstorming space and support service, but were generally dissatisfied with the acoustic comfort and fire safety measures put in place in their design studio.

Table 4: Performance Appraisal of Design Studio Facilities

S/N	Design Studio Facilities	VS	S	D	VD	Decision
1	**Visual comfort**	%	%	%	%	
A	Adequacy of lighting at your studio	51.6	47.6	0.9	-	Very Satisfied
B	Adequacy of lighting at the brainstorming (group-gathering) space	25.8	63.7	10.5	-	
C	Overall perception of the quality of lighting in the studio	53.2	44.4	0.16	0.8	
2	**Thermal comfort**					
A	Space temperature during morning times	17.7	57.3	14.5	10.5	Satisfied
B	Space temperature during evening times	26.6	35.5	36.3	0.16	Satisfied
C	Overall perception of the thermal environment in the studio	16.9	66.9	15.3	0.8	Very Satisfied
3	**Acoustical comfort**					
A	The level of noise generated in the studio space	0.8	23.4	28.2	47.6	Dissatisfied
B	The level of noise generated from outside the studio	0.8	3.2	46.0	50.0	Very Dissatisfied
C	Overall perception of the acoustical environment in the studio	-	25.8	25.0	49.2	Dissatisfied
4	**Fire safety**					
A	Ease to identify emergency exits for occupants and visitors	21.0	2.4	34.7	41.9	Dissatisfied
B	Ease of evacuating the building in case of fire emergencies	23.4	1.6	37.1	37.9	Dissatisfied
C	Ease to identify and reach the fire alarm system	2.4	21.8	37.9	37.9	Dissatisfied
D	Quality and perception of fire safety systems in the building	3.2	8.1	47.6	41.1	Very dissatisfied
5	**Studio quality and layout**					
A	The studio size and adequacy for all drafting and design activities	76.6	22.6	0.8	-	Very satisfied
B	Flexibility of the drawing board in terms of vertical adjustment	68.5	29.8	1.6	-	Very satisfied
C	Type of chair where you sit	37.9	57.3	4.8	-	Very satisfied
D	The table height in the studio	24.2	57.3	18.5	-	Very Satisfied
E	Sense of privacy while working at the studio	24.2	37.9	32.3	5.6	Satisfied
F	Adequacy of space within the studio to permit having discussions	36.3	54.8	8.9	-	Very satisfied
G	Adequacy of personal storage space in each studio	41.1	40.3	18.5	-	Very satisfied
H	Width of walkways between cubicles in the studio	29.0	58.1	11.3	1.6	Very satisfied
I	Overall perception of the quality of the cubicles	41.1	47.6	3.2	8.1	Very satisfied
6	**Interior finishes**					
A	Color of studio's interior partition.	33.9	65.3	0.8	-	
B	Quality of studio's interior partition finish	33.9	64.5	1.6	-	Very Satisfied
C	Quality of floor finish in the studio	46.0	45.2	6.5	2.4	
D	Quality and presentation of wall finishes	33.1	62.1	3.2	1.6	
7	**Brainstorming (group-gathering) space**					
A	Adequacy of the brainstorming (gathering) table to accommodate group discussion	1.6	34.7	50.8	12.9	Dissatisfied
B	Adequacy of the white board in the studio	29.8	47.6	16.1	6.5	Satisfied
C	Suitability of the slide projector and screen	9.7	61.3	21.8	7.2	Satisfied
8	**Support services**					
A	Adequacy of printers and plotters in the studio.	4.8	2.4	57.3	35.5	Very dissatisfied
B	Adequacy of help provided in cases of technical problems with IT equipment	-	62.1	17.7	20.1	Satisfied
C	Ability to control access for non-members of the studio	71.8	9.7	0.8	17.7	Very satisfied
D	Overall perception of the quality of the studio space	20.2	65.3	14.5	-	Very satisfied

Impact of Architectural Design Studio Facilities on Students Learning Outcome

Previous studies had shown that design studio facilities affect students learning outcome. According to (Obeidat et al, 2012), room temperature, air quality, glare, noise, lighting, seats comfort and possibilities of arrangement have a great effect on the standards of teaching and learning in design studio.

The regression analysis to examine the impact of architectural design studio facilities on students learning outcome is presented in table (4.5.1). In other to assess the statistical significance of the model, it is necessary to look in the ANOVA value. This tests the null hypothesis that the predictors (design studio facilities) are not statistically significant in predicting the dependent (learning outcome) variable. The model in this case reached statistical significance (F=4.490, p =.001<0.05). In other words, this model is statistically significant. To check for the predictor variables that are statistically significant, their associated p-value were examined. As shown in (table 4.5.1), only two predictor variables namely; acoustic (p=0.001<0.05) and studio quality (0.028<0.05) had their associated p-value to be less than the alpha threshold value and were found to have impact on the dependent variable. The co-efficient of multiple determinations (R^2) provides an explanatory power of the regression model. From our result, the co-efficient of multiple determination value (R^2=0.238) indicates that the predictor variables (design studio facilities) are accounting for approximately (24.0%) variation on the learning outcome.

Table 6: Regression Analysis of the Impact of Architectural Design Studio Facilities on Students Learning Outcome

Variables	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	-2.325	2.130	-	-1.091	.277
Visual comfort	-.060	.125	-.066	-.481	.631
Thermal comfort	.086	.088	.135	.972	.333
Acoustic comfort	.292	.065	.587	4.454	.001
Fire safety	.042	.038	.128	1.101	.273
Studio quality	.098	.044	.269	2.223	.028
Interior finish	.051	.097	.050	.522	.603
Brainstorming space	-.131	.104	-.150	-1.266	.208
Support service	.009	.092	.015	.103	.918
ANOVA (F=4.490, p=0.001) R^2=0.238					

Independent variable: Learning outcome

Relationship between Studio Environment and Studio Attendance among Architectural Students

The relationship between studio environment and attendance among architectural students was examined by assessing the number of hours spent at the design studio during the day time and at night and their perception on the effects of the studio environment on their learning outcome. The survey data reveals that (51.6%) of the total respondents strongly agreed that the studio environment affects their learning outcome. Out of this proportion, (36.3%) spent between 4-6 hours in their design studio during the day, compared to (15.3%) that spent between 1-3 hours during day time. Furthermore, (20.2%) agreed that the studio environment affects their learning outcome, with (12.1%) of this proportion spending between 1-3 hours per day in their design studio. The chi square test reveals that duration of stay in the studio during the day was statistically significantly related with their perception on the effect of studio environment on learning outcome (p<0.05) (table 6). Similar trend was also observed during the night (p<0.05) (table 4.6.2).

Table 7: Relationship Between Learning Environment and Duration of Stay in Studio

How Long Do You Spend in Your Design Studio During the Day?		Studio Environment Generally Affects My Learning Outcome					Total
		No Response	Strongly Agree	Agree	Disagree	Strongly Disagree	
1-3 hours	Freq	4	19	15	8	3	49
	%	3.2	15.3	12.1	6.5	2.4	39.5
4-6 hours	Freq	10	45	10	0	10	75
	%	8.1	36.3	8.1	0.0	8.1	60.5
Total	Freq	14	64	25	8	13	124
	%	11.3	51.6	20.2	6.5	10.5	100.0
X^2 =29.392 df=4 p=0.001							

Table 8: Relationship between Learning Environment and Duration of Stay in Studio

How Long Do You Spend Working in Your Studio at Night?		Studio Environment Generally Affects My Learning Outcome					Total
		No Response	Strongly Agree	Agree	Disagree	Strongly Disagree	
No response	Freq	1	0	0	0	0	1
	%	0.8	0.0	0.0	0.0	0.0	0.8
1-3 hours	Freq	4	0	10	0	0	14
	%	3.2	0.0	8.1	0.0	0.0	11.3
4-6 hours	Freq	7	14	0	0	10	31
	%	5.6	11.3	0.0	0.0	8.1	25.0
Above 6 hours	Freq	0	34	0	0	3	37
	%	0.0	27.4	0.0	0.0	2.4	29.8
Not applicable	Freq	2	16	15	8	0	41
	%	1.6	12.9	12.1	6.5	0.0	33.1
Total	Freq	14	64	25	8	13	124
	%	11.3	51.6	20.2	6.5	10.5	100.0
X^2 =114.658 df=16 p=0.001							

Effect of Design Studio Facilities on Studio Attendance

The effect of studio facilities on studio attendance was done in other to ascertain the relationship between studio facilities and studio attendance during the day and at night. This was necessary so as to validate the claim of the students on their general perception and appraisal of the design studio facilities.

In other to assess the statistical significance of the model, it is necessary to look in the ANOVA value. This tests the null hypothesis that the predictor variables (design studio facilities) does not necessarily affects studio attendance at night among architectural students. The model in this case reached statistical significance (F=16.853, p =.001<0.05). In other words, this model is statistically significant. To check for the predictor variables that are statistically significant, their associated p-value were examined. As shown in (table 4.7.1), studio quality, brainstorming space and support service were the only three predictor variables that had their associated p-values to be less than the alpha threshold value (p<0.05) and are therefore the only predicator variables that affect architectural students studio attendance at night. The coefficient of multiple determinations reveals that design studio facilities accounts for (54.0%) variation in studio attendance at night among architectural students.

Furthermore, in assessing the second model which seeks to examine the impact of design studio facilities on studio attendance during the day, the ANOVA value was also found to reach statistical significance (F=22.723,

p=0.001<0.05). To check for the significant variables, their associated p-values were examined. As shown in (table 4.7.2), thermal comfort, acoustic comfort, studio quality and support service were the four predictor variables (design studio facilities) that had their associated p-values to be less than the alpha threshold value (p<0.05) and were therefore the design studio facilities that affects architectural students studio attendance during the day. The co-efficient of multiple determinations reveals that design studio facilities accounts for approximately (61.0%) variation in studio attendance during the day among architectural students.

Table 9: Relationship Between Studio Facilities And Studio Attendance (Night)

Variables	Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Model Summary
	B	Std. Error	Beta			
(Constant)	1.695	.670		2.530	.013	
Visual comfort	-.051	.039	-.138	-1.290	.200	R^2=0.540
Thermal comfort	.041	.028	.159	1.473	.143	
Acoustic comfort	.003	.021	.014	.133	.895	R=0.735
Fire safety	-.005	.012	-.039	-.429	.669	
Studio quality	-.087	.014	-.587	-6.254	.000	ANOVA
Interior finish	.021	.031	.051	.676	.501	F=16.853 p=0.001
Brainstorming space	-.067	.033	-.189	-2.049	.043	
Support service	.160	.029	.618	5.554	.000	
a. Dependent Variable: Do you work in your design studio at night?						

Table 10: Relationship between Studio Facilities and Studio Attendance (Day)

Variables	Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Model Summary
	B	Std. Error	Beta			
(Constant)	2.001	.632		3.168	.002	
Visual comfort	.033	.037	.087	.886	.377	
Thermal comfort	-.112	.026	-.422	-4.277	.000	R^2=0.613
Acoustic comfort	.042	.011	.310	3.729	.000	
Fire safety	-.018	.019	-.089	-.945	.347	R=0.783
Studio quality	.069	.013	.456	5.287	.000	
Interior finish	-.043	.029	-.102	-1.484	.140	ANOVA F=22.723 p=0.001
Brainstorming	.024	.031	.065	.770	.443	
Support service	-.136	.027	-.509	-4.986	.000	
a. Dependent Variable: How long do you spend in your design studio during the day						

CONCLUSIONS AND RECOMMENDATIONS

This study examines the effect of design studio facilities of Nigeria universities on students learning outcome. The findings from this study shows that students learn design skills in the studio space, therefore the use of the studio for architecture education is crucial and the design studio can be considered a specialized form of learning space. This study therefore plays a significant role in contributing to design knowledge and provides blue print both for improving the condition of existing studio facilities as well as for provision of new ones.

The assessment of the overall performance appraisal of the design studio facilities reveals that out of the thirty three (33) attributes measured, the respondents were very satisfied with nineteen (19), satisfied with six (6), dissatisfied with seven (7) and very dissatisfied with three (3). In addition, respondents were generally satisfied with the visual comfort, thermal comfort, studio quality and layout, interior finishes, brainstorming space and support service, but were generally dissatisfied with the acoustic comfort and fire safety measures put in place in their design studio.

Although the generality of the students perceived the majority of the existing design studio facilities as satisfactory and that it does not affect their learning outcome, this situation somehow is only good to the learning environment for the short term, but in the long run might give negative health effect to the students.

Furthermore, the chi square test reveals that duration of stay in the studio during the day was statistically significantly related with their perception on the effect of studio environment on learning outcome ($p<0.05$) (table 4.6.1). Similar trend was also observed during the night ($p<0.05$) (table 4.6.2).

As shown in (table 4.7.2), thermal comfort, acoustic comfort, studio quality and support service were the four predictor variables (design studio facilities) that had their associated p-values to be less than the alpha threshold value ($p<0.05$) and were therefore the design studio facilities that affects architectural students studio attendance during the day, while studio quality, brainstorming space and support service were the three predictor variables that had their associated p-values to be less than the alpha threshold value ($p<0.05$) and are therefore the only predicator variables that affect architectural students studio attendance at night.

This finding can be used by lecturers or administrators to take appropriate measures to streamline the efforts towards providing conducive learning environment for architecture studio taking into consideration the acoustic comfort which is has often been the barrier to effective learning outcome in design studios.

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