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COMPUTER AIDED DESIGN (CAD) IN ARCHITECTURAL EDUCATION: A COMPARATIVE STUDY OF PRIVATE AND PUBLIC UNIVERSITIES IN SOUTHWEST NIGERIA

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ABSTRACT

Purpose*: The rise of computer-aided design (CAD) has revolutionised architectural education, driving a shift from traditional drafting techniques to digital design processes. This technological advancement has made CAD an integral part of architectural training, reshaping how students conceptualise and develop design solutions. This study aims to explore CAD proficiency and deployment levels among postgraduate architecture students of public and private Universities.*

Design/methodology/approach*: This study employs quantitative approaches through the survey method to explore the proficiency and deployment levels of computer-aided design (CAD) tools in architectural studio design education across four ARCON (Architects Registration Council of Nigeria)- accredited public and private universities in Southwest Nigeria. A total of 407 postgraduate architecture students participated, with Caleb University contributing the largest share (38.3%), followed by University of Lagos (26.0%), Bell University (23.8%), and Obafemi Awolowo University (11.8%).*

Findings: *The findings reveal that AutoCAD is the most widely known CAD tool, with high familiarity among students at the University of Lagos (81.9%), Obafemi Awolowo University (97.9%), and Bell University (94.2%). However, proficiency levels differ significantly, with only 54.7% of Lagos students and 75% of Obafemi Awolowo students reporting a strong command. Revit is also well-known, particularly at Caleb University (92.9%), though mastery remains uneven.*

Research limitations/Implications*: This study is limited to randomly selecting ARCON-accredited, Private and Public Universities within the southwestern states out of six geopolitical zones of Nigeria. The contribution to knowledge is that this study established the influence of CAD proficiency level and the early deployment of studio design.*

Practical implications*: The study underscores the urgent need for enhanced investment in CAD infrastructure and training to ensure all students, regardless of institution, acquire the necessary digital design skills for modern architectural practice.*

Keywords: Architectural design Studio, Architectural education, Computer-aided design (CAD), Schools of Architecture.

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1.0 INTRODUCTION

Architectural education must remain responsive to the evolving skill requirements of the labour market, ensuring that graduates are adequately prepared for professional practice. As architects are central actors in urban growth and infrastructure development, their training should be aligned with the competencies demanded by contemporary society. (Zhou, Liang, Guo , & Li, 2025) The primary objective of architectural education is therefore to cultivate graduates who possess both the theoretical knowledge and practical skills necessary to engage effectively in the architectural profession. Among these competencies, architectural design stands as the core skill that students must master. This foundational element of the discipline is developed through the design of buildings, expressed and refined via drawings, models, and other forms of visual representation, which together constitute the principal medium of architectural learning and practice.

Architecture studios have traditionally been the main method students learn about design and practice. In these design studios, ideas develop through discussions between students and their instructors. However, exploring different design options is often limited because hand-drawing takes a lot of time and makes quick changes difficult.

The strong dependency on digital tools for representation and communication in architectural design is becoming an integral element of studio design education methods in architecture schools, especially after the pandemic. (Gu & Behbahani, 2021)

Before the advent of Computer-aided design (CAD), the practice in the conventional design studio entailed that the design process was carried out using sketching, physical modelling and orthographic drawings. This architectural design process relied heavily on paper, pencil and the architect's creative and imaginative intuition. As such, development was typically tedious and time-consuming, often heavily loaded with costly trial and error (Pekta & Erkip, 2006). But in recent years, the developments in information technology have resulted in the emergence of CAD, now being used across different design domains. CAD is regarded not just as a technical drawing tool but also as a conceptual tool capable of developing new ways of conceiving and perceiving design (Brandon & McLain-Kark, 2008). The emergence of CAD has been changing the practice of both the architectural profession and its education, such that practising architects now value competence in the production of digital presentations, efficiency in the production of construction drawings and the ability to collaborate through digital media (Hannah & Barber, 2006).

With this emerging digitalisation trend in architectural practice, schools of architecture must train young professionals with knowledge that will enable them to manage the multifaceted relationships required to practice in cyberspace. Dare-Abel et al (2014) opined that the education of the architect ultimately affects the quality of practice and services provided in the real world, hence the suggestion for a wholesome integration of Computer Aided Architectural Design (CAAD) into the curriculum of schools of architecture in Nigeria instead of the current piecemeal approach. (Uwakonye, Alagbe, Oluwatayo, Alagbe, & Alalade, 2015).

The question then arises, whether CAD has been fully deployed in schools of Architecture in Nigeria to ensure that graduates produced are fit properly to the changing reality of digitalisation in the architecture profession. This paper, therefore, intends to explore the level of deployment and use of CAD in Architectural education across selected public and private Universities in Southwest Nigeria.

2.0 LITERATURE REVIEW

2.1 Architectural Design Education

Architecture represents one of the most multifaceted domains of human endeavour, dealing with the organisation of space and the resolution of spatial, aesthetic, and social challenges. It is both an art and a science concerned with the design and construction of buildings, structures, and complexes essential to human existence. Through diverse approaches to spatial organisation, architecture addresses practical needs while simultaneously engaging with cultural, social, and aesthetic dimensions of human activity**.** (Maksymova, 2022)**.** Kalay (2008), as cited in Hassanpour & Şahin (2022), Portraits Architecture, as a technology-intensive discipline, utilises technology in both the design process and its products.

The architectural design process, according to Cross (2008) and Lawson (2005), as cited in Bertol-Gros, Lopez, & Bardí-Milà (2025), is understood not only as a creative activity but also as a structured problem-solving method. Its development through five main stages: (1) identifying and defining the problem, (2) gathering detailed information about the current situation, (3) analysing the collected data, (4) evaluating and interpreting the results, and (5) presenting the design as a coherent synthesis Berttol-Gros et al, 2025).

Architectural design education has been implicitly ruled, regulated or even controlled by its educational objectives, teaching strategies, methods, and priorities. Despite the ever-changing nature of architectural education and profession, the core element of architectural design education remains the design process. Design, as a concept, usually refers to a creative process (Vegnelli & Vegnelli, 2006), and it has been in existence since the beginning of life, as humans have always manipulated their natural environments.

According to Berlian, Mujtahid, Vebrianto, and Thahir (2020), the 21st century presents unprecedented levels of competition and complexity across all areas of life, compelling individuals to acquire a broad spectrum of knowledge and skills. This transformation places significant pressure on educational institutions to elevate the quality and relevance of their programs, ensuring learners are adequately prepared for real-world problem-solving. In alignment with this imperative, the Architect Registration Council of Nigeria (ARCON) emphasises in its 2012 benchmark that architectural education in Nigeria must cultivate competent, skilled, and versatile professionals capable of designing solutions that respond effectively to environmental, cultural, and socio-economic contexts. Consequently, Schools of Architecture are entrusted not only with technical instruction but also with shaping a professional ethos and shared worldview that underpin the architectural community.

Architects receive their education and training in hundreds of schools of architecture around the world. Practice is typically locally regulated, but sometimes licensed. The practice of architectural design education appears to be remarkably similar in many parts of the world due to the overriding preeminence given to the studio as the main forum for exploration, interaction, and assimilation. While the use of CAD in schools of Architecture in the developed countries might be seamless, in schools of architecture in Nigeria, where it has been the policy in design studio practice for the manual drafting method to be taught and used at the early undergraduate levels, and thereafter, CAD can be deployed up to the postgraduate levels. This CAD deployment in Nigeria has been met with challenges such as difficulty for design studio tutors to grade originality, the inability of most students to afford software and hardware equipment, as well as poor electricity supply to power digital equipment.

2.2 Changes in Architectural Design Studio Pedagogy

The design courses usually take place in an environment called the design studio. The design studio is an environment that is different from a traditional classroom, both in pedagogical, social and educational points of view. (See Fig. 1) Digital Design Studio differs from the conventional

Figure 1Obafemi Awolowo University, Architectural Year III Conventional Design Studio, where students still use traditional methods. Source Authors

design studio in terms of available communication modes and styles, learning experiences, studio focus, studio environment, time, information resources, and representation of design information. It offers numerous opportunities that are not fully or easily available in a conventional design studio setting.

Design studio still takes a central role in architectural education. According to the Architect Registration Council of Nigeria (ARCON), the curricula of schools of architecture include 60% of design studio activities, ARCON benchmark (2012). This applies to undergraduate as well as graduate education. According to Botchway et al (2015), CAD technological development in three-dimensional drawings, three-dimensional digital models, and computer simulation can provide a new approach for designers to find more solutions in the schematic design process. However, at the beginning, adding CAD to the architectural studio curriculum faced a strong rejection by the studio's professors, thinking that CAD skills would affect the students' willingness to acquire traditional drafting and design skills (Bille, 2002). The Extant Literature stated that the use of computer technologies has overtaken the use of hand-rendered graphics. One cogent argument is coercion, since building owners found more use for CAD drawings than architects have, and many clients now require CAD-generated drawings. Thus forcing the firm into purchases they would not otherwise have made. And yet there have been strong divisions amongst architects and scholars over the use of CAD in architectural education. (Battal, 2025)

There is increasing concern that CAD is affecting designers' identities and the expression of their creative work. Many experts also emphasise the importance of hand drawings and identify distinct stages of the design process wherein they cannot be replaced by computer graphics. Additionally, Amoroso posits that using traditional and digital tools together "has enabled a greater connection between fine art and architecture" (Amoroso, 2012). (Chaudhuri & Dhar, 2024) Found that digital platforms facilitate iterative evaluation and feedback, potentially enhancing creative processes. However, Kamel & Khalil (2023) reported that the use of CAD tools during early design phases neither significantly enhances nor restricts creativity, implying that the influence of CAD depends heavily on how and when it is employed.

The fast development of CAD technology today has created a lot of software that can be used for drawing two-dimensional and three-dimensional models, which creates a bridge between the architect and the client by giving the clients the power to participate in the design process, thus clients do not need a lot of architectural knowledge to fully understand the CAD-rendered models. The digital model can be used easily for a simulation activity. The development of CAD

Figure 2*: Typical Architectural digital studio setting with Year III architecture students of the University of Lagos. Source: Authors*

technology today has opened new opportunities to assist the development of architectural education, especially in learning the design process. Research conducted showed that the integration of CAD technology in the design process helped students with the synthesis and simulation activities (Ismail, Mahmud, & Hassan, 2012). However, the use of CAD in architectural drawing is robbing the traditional method of hand drafting and craft modelling of its very significance in the development of rationalisation of design ethics. Mohd et al (2012) also opined that the influx of CAD into architectural education has overridden the traditional methods of drafting by emasculating the advantages of the relationships that should exist between student to student and student to instructor, which is a canonical interaction in

Figure 3*: Visual representations of spaces*
Author's portfolio

architectural education. (Salman, Laing, & Conniff, 2014) claimed that CAD does not improve designing to anywhere near the extent of the exaggerated publicity of CAD vendors that claim CAD improves designing, or how we were meant to believe. As regards the negative impacts of the use of the CAD software, Lawson (2005) claimed that we are in danger of creating a generation of young architects who are highly skilled with computer software and yet have little visual sensibility.`

Effectively communicating ideas to clients is essential for ensuring they fully understand the project. Designers and architects confirm that they typically rely on two main methods to present their concepts: 2-D and 3-D presentations. Clients, in turn, interpret and experience these presentations through various elements that shape their perception and understanding. (Nigam & Kapoor, 2022) Architects create visual representations of spaces (as seen in FIG 3) and structures using drawings, which convey aesthetic and technical aspects of their ideas. Three-dimensional models, now primarily created digitally, have become a more efficient way to visualise architectural designs (Dunn, 2014), cited in (Çelik, 2025)

3.0. STUDY AREA

The general study in focus is Architectural education in Nigeria, but for proper investigation, this research is centred more on Federal and Private Universities randomly selected within the southwestern states in Nigeria. The federal universities are Obafemi Awolowo University and University of Lagos, Akoka, while private universities consist of Bell University of Technology, Ota and Caleb University, Imota, both in Ogun state.

The general study in focus is Architectural education in Nigeria, but for proper investigation, this research is centred more on Federal and Private Universities randomly selected within the southwestern states in Nigeria.

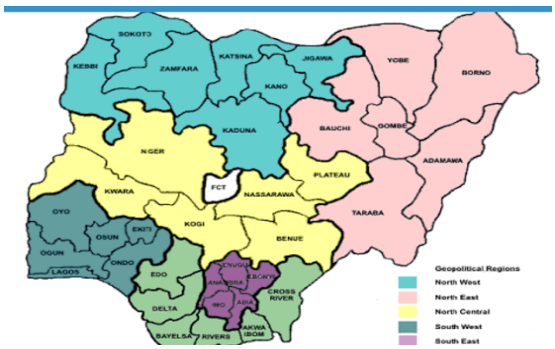


Figure 5: Geopolitical zones and their states in Nigeria

Figure 4: Map showing the southwestern states

University of Lagos

University of Lagos: This is a federal tertiary institution of higher learning in Nigeria, West Africa, founded in 1962. This University campus is located within the Lagos Metropolis. With location extent of Latitude: 6° 31' 4.1"(6.5178°) north and Longitude: 3° 23' 43.7"(3.3955°) east.

The Department of Architecture is one of the five departments in the Faculty of Environmental.

The sciences are located in the main campus of the University of Lagos. It was established in the year 1973 as one of the three departments in the Faculty of Environmental Design, which was originally referred to. Currently, the department has an approximate population of about four hundred and twenty (420) students (the population at the period of research).

Figure 6 University of Lagos Location Map

There are six different architectural design studio spaces allocated to the individual year of study, from first year to fourth year undergraduate students, and first to second year of the postgraduate students.

Obafemi Awolowo University, *Ile-Ife*

Obafemi Awolowo University, IIe-Ife is one of the three Universities established in Nigeria between 1961 and 1962 as a result of the report submitted to the Federal Government in September, 1960, by a commission it appointed in April 1959 under the Chairmanship of Sir Eric Ashby, Master of Clare College., Cambridge, to survey the needs of post-secondary and higher education in Nigeria over the next twenty years. The planning of the Obafemi Awolowo University was entrusted to two Committees. The first being a University Planning Committee comprising persons qualified to advise on the planning of a new University, and who, in effect, undertook the preparatory work connected with the establishment of the University pending the setting up of the Provisional Council of the University. The second committee was the University Parliamentary Committee, which was advisory to the Minister of Education. On 8th June, 1961, the Law providing for the establishment of the Provisional Council of the university was formally inaugurated under the Chairmanship of Chief Rotimi Williams.

On 11th June, 1970, an Edict known as the University of Life Edict, 1970 was promulgated by the Government of the Western State to replace the Provisional Council Law of 8th June, 1961. This Edict has since been amended by the Obafemi Awolowo University, Ile-Ife (Amended) Edict No. 11 of 1975 (Transitional Provisions) Decree No. 23 of 1975. This new Decree effected a takeover of the Obafemi Awolowo University by the Federal Military Government and established a Provisional Council as an interim governing body of the University, which shall be subject to the general direction of the Head of the Federal Government, control the policies and finances of the University and manage its affairs. The Governing Council has since replaced this Provisional Council.

The site selected for the University was at Ile-Ife, a town about 80 kilometres northeast of Ibadan in the Oyo State. Ife is famous as the centre of an ancient civilisation and home of the Museum, which contains the renowned Ife heads. It was intended that temporary buildings should be put up on the site to enable teaching to commence in October 1962 while the permanent buildings were being planned and erected. But when the Federal Government transferred the Ibadan Branch of the Nigerian College of Arts, Science and Technology to the University, it was decided that it would be unnecessary to put up temporary buildings at Ife and the University was temporarily located on the site of the Ibadan Branch of the Nigerian College.

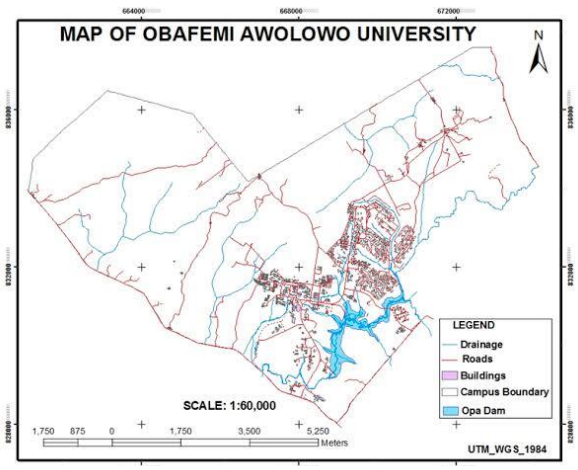


Figure 7*:* Obafemi Awolowo University Location Map

Teaching began in October 1962 with an initial enrolment of 244 students. The teaching, administrative and technical staff, either transferred from the Nigerian College or newly recruited from abroad, numbered about eighty.

The University started with five Faculties - Agriculture, Arts, Economics and Social Studies (now Social Sciences), Law and Science.

The Bell University of Technology

Bells University of Technology (BUT), also known as Bellstech, owned by Olusegun Obasanjo, former-President of Nigeria, is the first private university of technology established in Nigeria in the year 2004, and began admitting students from the 2005/2006 academic session. It is located in Ogun State, Nigeria. (Ayedun, Utom, Oluwunmi, Omonijo, & Akinjare, 2021)

Table 1*:* Population of Architecture students

	EXPECTED POPULATION		OBSERVED POPULATION		SAMPLE SIZE(75% OF OBSERVED)	
UNIVERSITY	**M.Sc 1**	**M.Sc. 2**	**M.Sc 1**	**M.Sc. 2**	**M.Sc 1**	**M.Sc. 2**
University of Lagos	83	68	78	63	59	**47**
Obafemi Awolowo University	32	35	29	34	22	**26**
Caleb University	124	108	106	101	80	**76**
The Bell University	70	64	66	62	50	**47**
TOTAL					**211**	**196**

The strong response rates across most universities suggest that the findings can be generalised with confidence to the wider student population. The slight shortfall in Caleb University's M.Sc. 1 responses highlights a potential area where engagement strategies could be improved. The higher participation among M.Sc. 2 students may indicate stronger motivation or interest in contributing to research at that level. Since the sample size was calculated as 75% of observed responses, the final dataset remains proportionally representative of each institution. Overall, the consistency of responses across universities reduces the likelihood of bias and strengthens the credibility of the research outcomes.

4.0 METHODOLOGY

The data for this study were gathered from postgraduate students of two private and two public universities, within the South-Western states in Nigeria. This sampling method was adopted to capture diverse perspectives across institutional types to ensure a balanced representation of participants, thus strengthening the relevance and reliability of the results. The questionnaire was pre-tested on 90 students of the University of Lagos, 5th-year architecture students of the 2023/24 session with their undergraduate degrees from different universities, both home and abroad (As shown in Table 3 below). The questionnaire was administered at the end of their second semester through Google Form as a free online platform to Master Class 1 and 2 architecture students of Obafemi Awolowo University and University of Lagos, representing the public-owned institutions, while The Bell University of Technology and Caleb University represent the private-owned institutions. The questionnaire received 78 responses from 5th-year students, 63 from 6th-year students, of an expected population of 83, 5th-year and 68, 6th-year architecture students of the University of Lagos, while 29 responses from 5th-year students, 34

responses from 6th-year students, of an expected population of 32, 5th-year and 36, 6th-year students of the Obafemi Awolowo University. For that of private-owned universities, 60 responses from 5th-year students, 62 from 6th-year students, of an expected population of 70, 5th-year and 64, 6th-year architecture students of the Bell University of Technology, ota and 106 responses from 5th-year students, 101 from 6th-year students, of an expected population of 124, 5th-year and 108, 6th-year architecture students of Caleb University Imota. Responses were analysed using SPSS and Nvivo for each set of questions, and statistical data analysis was conducted. Also, for the investigation of differences across the student groups, an ANOVA analysis was done.

5.0 PRESENTATION AND DISCUSSION OF RESULTS

Demographic Characteristics of Respondents

The demographic characteristics of the respondents in this study, as shown in **Table 2**, highlight a predominantly young sample, with the largest group (54.1%) falling within the 21 to 25 years age range. This age group is indicative of the typical age for students in master's programs in architectural design in Nigerian universities, which underscores the relevance of their insights into CAD deployment in this context. Other notable age groups include 26 to 30 years (18.2%) and 31 to 35 years (10.8%), suggesting a relatively mature student body, though the focus remains clearly on younger participants. The age distribution affirms that the study captures the perspectives of those who are actively engaged in advanced education in architecture, providing valuable input on modern tools like CAD.

Gender representation in the study reveals a significant skew toward male respondents, with 75.9% of participants identifying as male. This disproportionate representation mirrors the longstanding gender gap in fields like architecture, where male students typically outnumber females. This imbalance is critical in interpreting the data, as it suggests that the perspectives on CAD deployment might be more reflective of the male experience in these programs. The lower female representation (24.1%) points to potential barriers or differences in the engagement with CAD tools that should be addressed to ensure more inclusive participation in architectural education.

The study's representation of students from various universities, including Caleb University (38.3%), University of Lagos (26.0%), Obafemi Awolowo University (11.8%), and Bell University (23.8%), enhances the generalizability of the findings. This wide institutional representation suggests that the perceptions of CAD deployment are not limited to a single educational environment but reflect a broader range of experiences across Nigerian universities. Such diversity in institutional backgrounds strengthens the relevance of the results for understanding how CAD is perceived in different academic settings within the country.

In terms of academic levels, the study shows a near-even split between Master Class I (51.8%) and Master Class II (48.2%) students. This balance is particularly significant as it ensures that both early and later-stage master's students provide input, offering insights from individuals at different stages of their education. Additionally, class sizes vary, with 25.8% of respondents indicating smaller classes of fewer than 60 students. These variations in class size are important, as they could influence how CAD tools are deployed and the extent to which students engage with such technologies, particularly in smaller, more intimate learning environments where personalised instruction is possible.

Finally, the educational backgrounds of the respondents further contextualise the findings. A significant proportion of students (38.6%) completed their undergraduate education at private

universities, with 45.9% of respondents attending unspecified institutions. This suggests that the perceptions captured may be influenced by the specific educational practices and resources available at these institutions. The relatively small number of respondents from federal and state universities highlights that the study is less likely to capture the views of students from public universities, which could have different institutional approaches to CAD deployment in their curricula. Understanding these demographic factors is crucial for interpreting the findings and assessing the broader implications for CAD in architectural design education across Nigerian universities.

Table 2: Demographic Characteristics of Respondents

Demographic Variables	Categories	Frequency	Percentage (%)
Age	16 - 20 Years	5	1.2
	21 - 25 Years	220	54.1
	26 - 30 Years	74	18.2
	31 - 35 Years	44	10.8
	36 - 40 Years	26	6.4
	41 Years and above	38	9.3
Gender	Male	309	75.9
	Female	98	24.1
University	University of Lagos	106	26.0
	Obafemi Awolowo University	48	11.8
	Caleb University	156	38.3
	Bell university	97	23.8
What level are you?	Postgraduate Diploma	0	0.0
	Master Class I	211	51.8
	Master Class II	196	48.2
What's the total number of students in your class?	Below 60	105	25.8
	60 – 69	69	17.0
	70 – 79	69	17.0
	80 – 99	24	5.9
	100 – 120	83	20.4
	Above 120	57	14.0
Where did you complete your undergraduate degree?	Foreign Institution	2	0.5
	Private University	157	38.6
	State University	17	4.2
	Federal University	44	10.8
	Unspecified	187	45.9

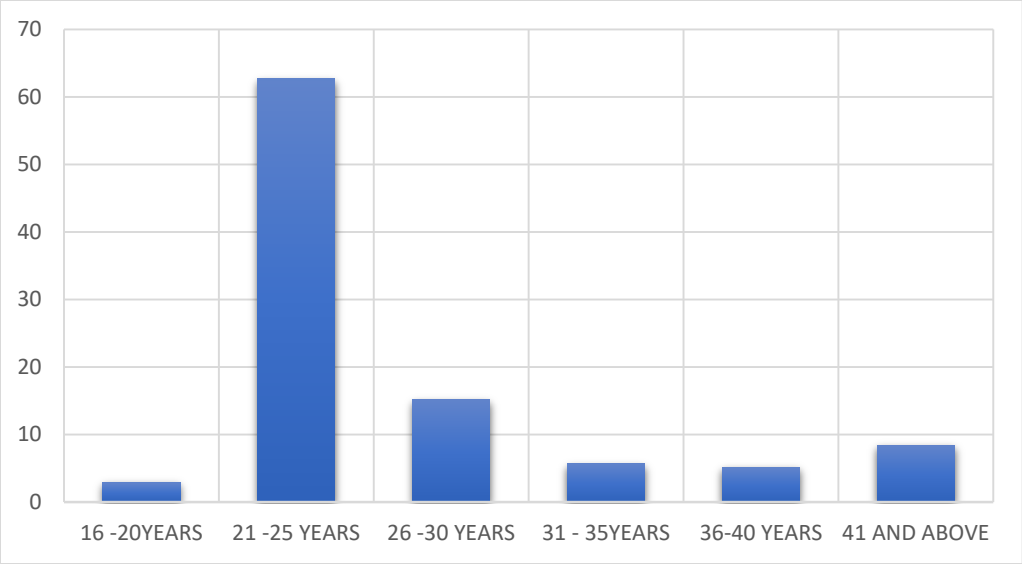
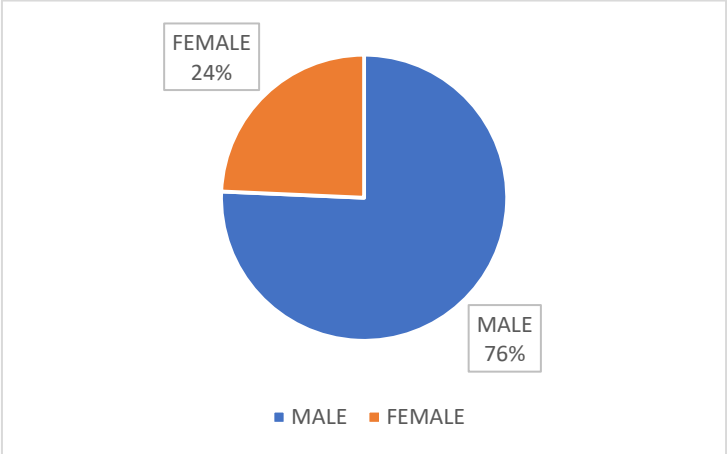


Figure 8.1 *Age Group*

The age distribution of the respondents (Figure 4.1) showed a youthful population, with the majority falling between the ages of 21 and 25 years. Out of the 407 individuals surveyed, 255 respondents, representing 62.7 per cent, were in this age category. This finding indicated that nearly two-thirds of the sampled population was concentrated within early adulthood. The next represented group was those aged 26 to 30 years, accounting for 62 respondents or 15.2 per cent. When combined with the 21 to 25 years category, individuals under the age of 30 constituted more than three-quarters (77.9 per cent) of the total sample, emphasising the observation that the study population was largely dominated by young adults.

Figure



4.2: Gender

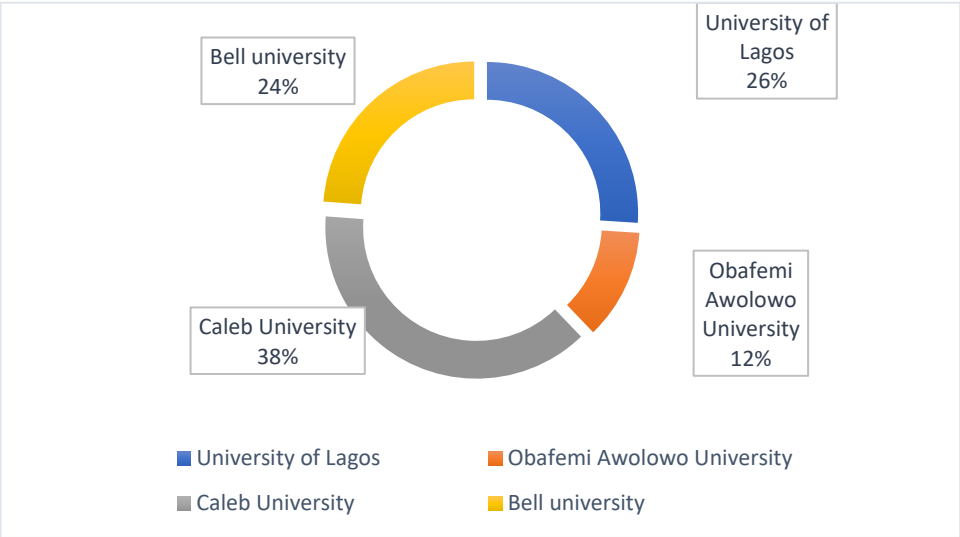
The younger bracket of 16 to 20 years recorded the lowest frequency, with only 12 respondents or 2.9 per cent of the total, which showed that very few individuals in their late teenage years participated in the survey. In contrast, the older cohorts were more modestly represented. Respondents between 31 and 35 years formed 5.7 per cent of the sample, while those aged 36 to 40 years made up 5.2 per cent. Individuals aged 41 years and above contributed 8.4 per cent, suggesting that perspectives from mature and older adults, though present, were relatively limited in comparison to the younger age groups.

The overall representation that emerged from the data was that the survey population was distinctly youthful, with early and late young adulthood being the most dominant life stages represented. This demographic structure implied that the findings of the study were more reflective of the experiences, aspirations, and attitudes of young adults.

The gender distribution of the respondents in Figure 4.2 revealed that males were the predominant group in the study population. 308 were male, representing 75.7 per cent of the total, while 99 respondents, accounting for 24.3 per cent, were female. This showed that more than two-thirds of the participants were males, with females forming less than one-quarter of the sample.

The data suggested that the study involved a significantly higher proportion of male respondents. The overall picture that emerged was that the research sample was male-dominated, which was influenced by the dominant numbers of males in the field of architecture, as reflected in the various tertiary institutions in the study, the accessibility of respondents, or prevailing social dynamics that positioned males as more visible or available participants.

Figure 4.3: *University Names*



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The distribution of respondents in Figure 4.3 showed that participation was spread across four institutions. Caleb University accounted for the largest share, with 156 respondents, representing 38.3 per cent of the total. The University of Lagos followed with 106 respondents, constituting 26.0 per cent, while Bell University contributed 97 respondents, making up 23.8 per cent of the sample. Obafemi Awolowo University had the smallest representation, with 48 respondents, or 11.8 per cent of the total. The data indicated that Caleb University formed the dominant cluster within the study, accounting for more than one-third of all participants. When combined with the University of Lagos, these two institutions alone contributed over 64 per cent of the total respondents, showing that the study population was strongly concentrated around these universities. In contrast, Obafemi Awolowo University, though significant, was comparatively underrepresented, suggesting a smaller level of participation from that institution. The dataset provided insights into student populations across multiple universities.

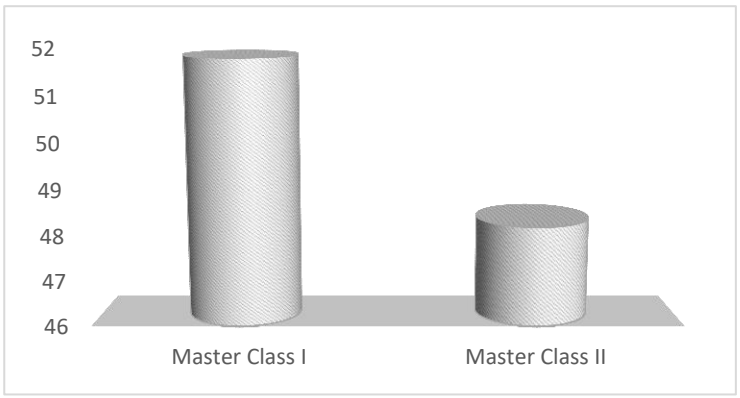

Figure 4.4: University Names

The academic level of respondents was almost evenly distributed between the two categories, though a slight dominance was observed. 211 respondents, representing 51.8 per cent, were in Master Class I, while 196 respondents, accounting for 48.2 per cent, were in Master Class II. The findings suggested that both groups were well represented, with neither category significantly outweighing the other. The narrow margin of difference indicated that the study population was fairly balanced in terms of academic level, thereby ensuring that the perspectives of respondents from both Master Class I and II were adequately reflected in the dataset.

The overall representation that emerged was that the study captured insights from participants at two closely related stages of academic progression. This balance strengthened the reliability of the data, as it reduced the risk of dominance by one group and allowed for more comprehensive deductions across the levels. Figure 4.4 above revealed the names of various universities engaged in the study.

The Current Level of CAD Deployment in Architectural Design Studio Education of Selected Universities

Table 3*:* The Current Level of CAD Deployment in Architectural Design Studio Education in Selected Universities

	University							
	University of Lagos		**Obafemi Awolowo University**		**Caleb University**		**Bell university**	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Level of CAD Deployment in Architectural Design Studio Education								
My department has a dedicated computer lab for students	71	78.0%	46	95.8%	155	99.4%	22	**26.5%**
Do students have access to the computer facilities in your department?	51	56.0%	10	20.8%	149	95.5%	26	**31.3%**
CAD was first introduced to	67	73.6%	11	22.9%	83	53.2%	73	**88.0%**

students in the department in the year								
At what level are students allowed to present their studio design Assignment with CAD in your department?								
100 Level	5	4.7%	0	0.0%	24	15.4%	5	**5.2%**
200 Level	56	52.8%	4	8.3%	34	21.8%	15	**15.5%**
300 Level	9	8.5%	39	81.3%	41	26.3%	9	**9.3%**
400 Level	12	11.3%	3	6.3%	9	5.8%	5	**5.2%**
Master Class 1	24	22.6%	2	4.2%	48	30.8%	63	**64.9%**
Master Class 2	0	0.0%	0	0.0%	0	0.0%	0	**0.0%**

Table 3 presents data on the current level of CAD deployment in architectural design studio education across four selected Nigerian universities. The findings reveal significant variation in the availability and usage of CAD tools. At the University of Lagos, 78% of respondents reported having a dedicated computer lab for CAD use, whereas Bell University had only 26.5% of respondents indicating the same. This highlights a notable disparity in infrastructure availability, which may impact the effectiveness of CAD deployment across different universities. Access to computer facilities also varies, with 56% of University of Lagos students reporting access, compared to a remarkable 95.5% at Caleb University. This disparity indicates that while some universities are providing substantial access to CAD tools, others may face limitations in offering sufficient resources to students. Additionally, the introduction of CAD tools in curricula differs significantly, with 73.6% of University of Lagos respondents reporting the first introduction of CAD tools in their department, whereas Bell University reported a high 88% for CAD's introduction, suggesting a more recent or proactive integration of technology in that institution.

Regarding when students are allowed to present their studio design assignments using CAD, there is a clear variation in the levels at which CAD is introduced. For example, at the University of Lagos, 52.8% of students are permitted to present CAD-based designs in their second year (200 level), whereas at Obafemi Awolowo University, 81.3% of students can do so at the 300 level. This suggests that some universities may have more advanced CAD integration into their curricula, while others may introduce it later in the program. Notably, at Bell University, a substantial proportion of students (64.9%) in the Master Class I level are allowed to use CAD for assignments, underscoring the importance placed on CAD proficiency at advanced levels of study. The data also shows that none of the universities have introduced CAD to students in the Master Class II level, suggesting a gap in continuity and progression of CAD skills as students advance through their studies.

Table 4: Details of the architectural CAD tools that students across the selected universities have knowledge of and a good command of

	University							
	University of Lagos		**Obafemi Awolowo University**		**Caleb University**		**Bell university**	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Architectural CAD tools you know of								

ArchiCAD	60	57.1%	20	41.7%	30	19.2%	61	70.9%
Artlantis	0	0.0%	1	2.1%	0	0.0%	0	0.0%
AutoCAD	86	81.9%	47	97.9%	95	60.9%	81	94.2%
Autodesk 3ds Max	47	44.8%	32	66.7%	25	16.0%	36	41.9%
Blender	10	9.5%	5	10.4%	8	5.1%	10	11.6%
BricsCAD	2	1.9%	0	0.0%	2	1.3%	9	10.5%
Chief Architect	1	1.0%	0	0.0%	1	0.6%	0	0.0%
Coohom	3	2.9%	1	2.1%	1	0.6%	0	0.0%
Corona Renderer	1	1.0%	0	0.0%	0	0.0%	0	0.0%
D4 CAD	0	0.0%	0	0.0%	0	0.0%	5	5.8%
D5 Render	20	19.0%	0	0.0%	1	0.6%	9	10.5%
Dynamo	0	0.0%	3	6.3%	0	0.0%	0	0.0%
Enscape	5	4.8%	0	0.0%	2	1.3%	5	5.8%
Fusion 360	0	0.0%	2	4.2%	0	0.0%	0	0.0%
Grasshopper	7	6.7%	4	8.3%	0	0.0%	0	0.0%
Illustrator	1	1.0%	0	0.0%	0	0.0%	5	5.8%
Lumion	36	34.3%	6	12.5%	43	27.6%	43	50.0%
Maya	4	3.8%	0	0.0%	1	0.6%	0	0.0%
Microstation	2	1.9%	1	2.1%	5	3.2%	0	0.0%
Morpholio	1	1.0%	0	0.0%	0	0.0%	0	0.0%
Photoshop	0	0.0%	0	0.0%	0	0.0%	5	5.8%
PowerPoint	0	0.0%	0	0.0%	0	0.0%	5	5.8%
Revit	102	97.1%	47	97.9%	145	92.9%	68	79.1%
Rhino (Rhinoceros 3D)	28	26.7%	9	18.8%	3	1.9%	20	23.3%
SketchUp	54	51.4%	33	68.8%	46	29.5%	62	72.1%
SolidWorks	5	4.8%	0	0.0%	0	0.0%	0	0.0%
Trace	1	1.0%	0	0.0%	0	0.0%	0	0.0%
TurboCAD	0	0.0%	0	0.0%	1	0.6%	0	0.0%
Twinmotion	5	4.8%	1	2.1%	1	0.6%	10	11.6%
Unreal Engine	0	0.0%	2	4.2%	0	0.0%	0	0.0%
Vectorworks Architect	6	5.7%	0	0.0%	1	0.6%	0	0.0%
V-Ray	22	21.0%	3	6.3%	2	1.3%	24	27.9%
Architectural CAD tools you have a good command of								
ArchiCAD	15	14.2%	2	4.2%	2	1.3%	4	4.7%
Artlantis	0	0.0%	0	0.0%	0	0.0%	0	0.0%
AutoCAD	58	54.7%	36	75.0%	40	26.0%	61	70.9%
Autodesk 3ds Max	20	18.9%	3	6.3%	17	11.0%	1	1.2%
Blender	6	5.7%	0	0.0%	0	0.0%	0	0.0%
BricsCAD	0	0.0%	1	2.1%	1	0.6%	0	0.0%
Chief Architect	0	0.0%	0	0.0%	1	0.6%	0	0.0%

Coohom	3	2.8%	0	0.0%	0	0.0%	0	0.0%
Corona Renderer	0	0.0%	0	0.0%	0	0.0%	0	0.0%
D4 CAD	0	0.0%	0	0.0%	0	0.0%	0	0.0%
D5 Render	10	9.4%	0	0.0%	0	0.0%	0	0.0%
Dynamo	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Enscape	3	2.8%	0	0.0%	1	0.6%	5	5.8%
Fusion 360	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Grasshopper	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Illustrator	3	2.8%	0	0.0%	0	0.0%	0	0.0%
Lumion	23	21.7%	4	8.3%	12	7.8%	25	29.1%
Maya	2	1.9%	0	0.0%	1	0.6%	0	0.0%
Microstation	1	0.9%	1	2.1%	2	1.3%	0	0.0%
Morpholio	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Photoshop	0	0.0%	0	0.0%	0	0.0%	0	0.0%
PowerPoint	0	0.0%	0	0.0%	0	0.0%	5	5.8%
Revit	101	95.3%	45	93.8%	144	93.5%	50	58.1%
Rhino (Rhinoceros 3D)	0	0.0%	0	0.0%	0	0.0%	0	0.0%
SketchUp	31	29.2%	5	10.4%	16	10.4%	39	45.3%
SolidWorks	2	1.9%	0	0.0%	0	0.0%	0	0.0%
Trace	0	0.0%	0	0.0%	0	0.0%	0	0.0%
TurboCAD	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Twinmotion	2	1.9%	0	0.0%	0	0.0%	0	0.0%
Unreal Engine	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Vectorworks Architect	5	4.7%	0	0.0%	0	0.0%	0	0.0%
V-Ray	10	9.4%	0	0.0%	0	0.0%	5	5.8%

Table 4 provides a detailed breakdown of the architectural CAD tools that students across the selected universities have knowledge of and have a good command of. AutoCAD is the most widely known CAD tool across all universities, with 81.9% of University of Lagos students, 97.9% of Obafemi Awolowo University students, and 94.2% of Bell University students reporting knowledge of it. However, the command over these tools varies significantly. At the University of Lagos, 54.7% of respondents report having a good command of AutoCAD, while at Obafemi Awolowo University, 75% report the same, indicating that while many students are familiar with AutoCAD, fewer have mastered it. Similarly, Revit is a well-known tool, especially at Caleb University, where 92.9% of respondents report familiarity with it, although the level of mastery is lower, with only 93.5% of University of Lagos students reporting good command. The data also reveals less widespread knowledge of other tools such as Rhino and Blender, with only a small proportion of students reporting familiarity and even fewer demonstrating a high level of command over these tools. This indicates that while certain CAD tools are widely adopted, there is a discrepancy in proficiency levels, which could affect how effectively students can use these tools in architectural design education.

6.0 CONCLUSION AND RECOMMENDATIONS

The variation in the deployment and mastery of CAD tools, as shown in Tables 3 and 4, underscores significant disparities in access to resources and the depth of technological integration across universities. These differences suggest that while some universities have made substantial progress in integrating CAD into their educational programs, others still face challenges in providing students with the necessary tools and training to develop proficiency in CAD. These disparities in CAD deployment may result in unequal learning opportunities for students, potentially influencing their preparedness for professional practice in the field of architecture. Therefore, the findings point to the need for increased investment in CAD infrastructure and training to ensure that all students, regardless of their institution, are equipped with the skills required to excel in modern architectural design practices.

Further study is required to present a new approach to architectural design studio teaching/learning by exploring different shapes in architecture with the use of CAD. Teaching creativity through these methods will make the students grounded in designing with creative ideas, and therefore, we can have professionals who design and build with satisfaction, safety and confidence. It means we can have real buildings and places that satisfy our clients, society and are in harmony with the environment. The future architects will be able to feel the new possibilities given by the computer and try exploiting them from the very beginning of the design process. In view of these findings, the researchers recommended the introduction of Architectural detailing aesthetics and criticism as a course at the Department of Architecture.

7.0 LIMITATION OF THE STUDY

This study is limited to randomly selected -ARCON-accredited,- Private and Public Universities within the southwestern states out of six geopolitical zones of Nigeria. Therefore, the result could be improved by further studies in other universities within other geopolitical zones, not covered in this study. Despite these limitations, the result could provide reasonable insight into the extent to which the use of CAD by students has influenced design studio education.

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