Challenges Affecting the Adoption of Digital Technology in Nigerian Architectural Education: A Case Study of the Federal Polytechnic Ado Ekiti

Afolabi Adedeji[1], Oluwatosin Babalola[1], Adenike Olugbesan[1], Tayewo Olanrewauju.[2]

[1]Department of Architecture, Lead City University, Ibadan, Oyo State, Nigeria
[2]Department of Architectural Technology, Federal Polytechnic Ado Ekiti, Ekiti State, Nigeria

(adedeji.idowu@lcu.edu.ng;babalola.oluwatosin@lcu.edu.ng; olugbesan.adenike@lcu.edu.ng; diamondarctoa@gmail.com)

Corresponding email: adedeji.idowu@lcu.edu.ng

Abstract. The integration of digital technology in architectural education has significantly transformed the process of training architects by providing new possibilities for design innovation, creativity and collaboration. Technologies such as Computer-Aided Design (CAD), Building Information Modelling (BIM) and immersive Technologies like virtual reality are replacing manual and traditional tools in many schools of architecture across the globe. However, Nigeria lags in embracing these innovations. This study investigates the challenges affecting the adoption of digital technology in Nigerian architectural education, using the Department of Architectural Technology, Federal Polytechnic Ado Ekiti as a case study. Data was collected from 112 students in the department across three academic levels (ND II, HND I, and HND II) through a mixed-methods approach, The study established that while students favored digital tools over traditional ones, the presence of several adoption barriers such as insufficient power supply, high costs of hardware, and limited access to software hindered effective digital technology integration in the school. The study further highlights the need for curriculum review to accommodate emerging technologies such as digital fabrication, which are currently unavailable in the Nigerian architectural education curriculum. The results of the study underscore the need for well-equipped centralized computer laboratories with reliable power supply in schools of architecture in Nigeria and improved training for faculty and students. The findings contribute to understanding the digital technology gap in architectural education in developing countries and offer actionable insights for enhancing architectural education in Nigeria's digital landscape.

Keywords: Digital Technology, Architectural Education, Nigeria, Challenges, Curriculum Integration

1. Introduction

Digital Technology encompasses the use of hardware utilizing computational power (computers and mobile devices), multimedia and communication technologies, inclusive of software to acquire and process data (Egodawele et al., 2022; Gong & Ribiere, 2021; Wang et al., 2021). It was introduced into architectural practice in the 1960s through Ivan Sutherland's Sketchpad(Ramilo & Embi, 2014) and has evolved from early Computer-Aided Design (CAD) to specialized systems covering parametric modelling, Building Information Modelling (BIM), scripting, and more (Abro et al., 2021; Akah et al., 2021; Ramilo & Embi, 2014). It enhances both design processes and student learning and becomes an indispensable component of the profession(Soulikias et al., 2021).

Specifically in architectural education, digital technology is broadly categorized into pedagogical tools (e.g interactive whiteboards, computers, televisions, radios, projectors, and mobile devices) and creative design tools(Abdulrahaman et al., 2020; Hettithanthri & Hansen, 2022; Ordu, 2021). Pedagogical tools which primarily support teaching and academic collaboration are not the focus of this study. Digital creative design tools peculiar to the Architecture, Engineering and Construction industry such as BIM (Revit, ArchiCAD), computation/parametric design (Grasshopper, Dynamo), immersive realities (VR/AR/MR) and digital fabrication (3D printing, CNC) used in design optimization (Abdulghany et al., 2022; Asghar, 2023; Hajirasouli et al., 2023; Kumar & Janardhan, 2023) constitute the reference to digital technology in this research. Traditional CAD tools such as AutoCAD, modelling tools such as Rhino and graphics presentation tools such as Adobe Illustrator and Photoshop (Ramilo & Embi, 2014) continue to be quite relevant despite the advancements in the field.

The benefits of digital tools in architecture are well-documented. They include significantly improved architectural visualisation, collaboration among stakeholders, sustainability and employability. (Abro et al., 2021; Maina, 2018). The introduction of digital tools and technology has equally had a significant impact on architectural education through software innovation and digital design processes, such as BIM and computational design methodologies (Abro et al., 2021; Akah et al., 2021; Ramadan, 2021; Soydaş Çakir & Uzun, 2020). Advances like these have enhanced the creativity of students, their collaboration potential and as well as presentation capabilities. Additionally, it has also positively impacted the teaching and learning process in architecture (Xiang et al., 2020).

Despite these acknowledged benefits, there is no widespread acceptance of its role and integration into architectural education. In the adoption of innovations, factors that impede integration have been classified as barriers (Babalola et al., 2022) Several barriers and challenges exist in this regard, both locally and globally. Firstly, there are concerns about the role of digital technology in training, including the opinion among some of the stakeholders that digital tools may inhibit early-stage creativity, which has led to the advocacy of a hybrid approach of combining digital technology with traditional design methods during training (Fakhry et al., 2021; Kara, 2015).

Additionally, financial constraints, resistance to change, and inadequate infrastructure have also been identified as barriers to digital technology integration (Peter, 2022). In Nigeria specifically, these challenges are exacerbated by an unreliable power supply system, relatively high costs of digital infrastructure, and a limited pool of digitally proficient professionals (Abdullah & Hassanpour, 2021; Hamma-adama et al., 2020). These issues reflect a broader pattern in developing countries, as identified by (Brozovsky et al., 2024; Rodriguez et al., 2017).

Also concerning is the fact that many of the current crop of students are Generation Z, who are considered digital natives, as most grew up more exposed to digital tools than the generations before them (Akah et al., 2021; Doyle & Senske, 2016) They are therefore expected to naturally be more inclined towards digital tools than manual ones. This is important considering that a study by (Yoo et al., 2021) asserts that user resistance is a contributory hindering factor in technology adoption, and further research by Cho et al., (2021); Shirish & Batuekueno, (2021) supports the more general evidence that resistance is a recurrent barrier in several contexts (smartphones, IT systems, healthcare, IS adoption).

It is important to note that while these challenges exist across the spectrum of architectural training in Nigeria, there is a difference between polytechnic architectural education, which is

largely practical and technical in orientation and universities, which are designed to be theory-based (Omokaro & Akpojaro, 2022). This study focuses on the polytechnic setting to understand student-facing challenges, which are crucial for developing effective integration strategies.

Despite existing literature on the subject of digital technology integration challenges, current empirical studies are scarce, particularly from the student perspective in Nigerian polytechnics. This study aims to investigate challenges in digital technology adoption from the viewpoint of architectural technology students at the Federal Polytechnic Ado Ekiti. It will assess preferences, curriculum adequacy, specific usage challenges and compare polytechnic and university curricula. The study will, thereafter, offer actionable insights for enhancing architectural education in Nigeria digitally.

2. Methodology

This study adopted a convergent parallel mixed-methods approach to investigate the challenges affecting the adoption of digital technology in Nigerian architectural education from the perspective of the students. The methodology facilitates the simultaneous collection and analysis of both quantitative and qualitative data. This allows the study to acquire a comprehensive understanding of the stated research problem.

The study was conducted as a cross-sectional study at the Department of Architectural Technology, Federal Polytechnic, Ado Ekiti, Nigeria. A total population sample technique was adopted, comprising all eligible students across the three core academic levels in the department (NDII, HND I and HND II) in the 2022/2023 academic session. This was an overall target population of 157 students.

Primary data was collected through an online questionnaire distributed via class Telegram groups of the three classes in December 2023. Data solicited covered socio-demographic information, Likert-scale perceptions and qualitative insights on the subject. From 157 total potential survey participants, 112 valid responses were received, constituting a response rate of 71.3%. Secondary data was collected documentary analysis of the National Board for Technical Education (NBTE) and the National Universities Commission curricula for comparative purposes.

The quantitative data obtained were analysed using descriptive statistics such as frequencies, percentages with IBM SPSS Statistics. Thematic analysis was utilised for the qualitative responses. The study followed relevant ethical guidelines, including obtaining informed consent and ensuring participant anonymity. This research acknowledges some limitations based on its case study design. There is limited generalizability due to the one-institution survey. There is also a possibility of self-reporting bias.

3. Results and Discussion

The study yielded insightful findings on students' perceptions and experiences concerning digital technology adoption in their training. Table 1. Shows that the respondent profile was predominantly male (85.71%), with most of the overall respondents situated within the Generation Z age bracket (over 90% aged 18-26). This is a cohort characterised as digital natives (Akah et al., 2021; Doyle & Senske, 2016). This demographic context is considered crucial because it places the majority of the respondents within a user base receptive to technology adoption

Table 1: Socio-demographic Data

Gender	Frequency	Percentage
Male	96	85.71
Female	16	14.29
Total	112	100
Age		
18 - 22	50	44.64
23-26	53	47.32
Above 26	8	7.14
Blank	1	0.89
Total	112	100
Year of Study		
200 Level (ND II)	49	43.75
300 Level (HND I)	29	25.89
400 Level (HND II)	32	28.57
Non response	2	1.79
Total	112	100

The study established that students have a clear preference for digital tools over traditional manual methods, as shown in Figure 1. In contrast to research that identifies user resistance as the main obstacle to adoption in other situations (Cho et al., 2021; Shirish & Batuekueno, 2021; Yoo et al., 2021). This conclusion is consistent with the description of Generation Z as digital natives who show little inherent resistance to technology (Doyle & Senske, 2016). This preference notwithstanding, the data demonstrate that impediments to digital technology adoption in schools are more systemic than personal.

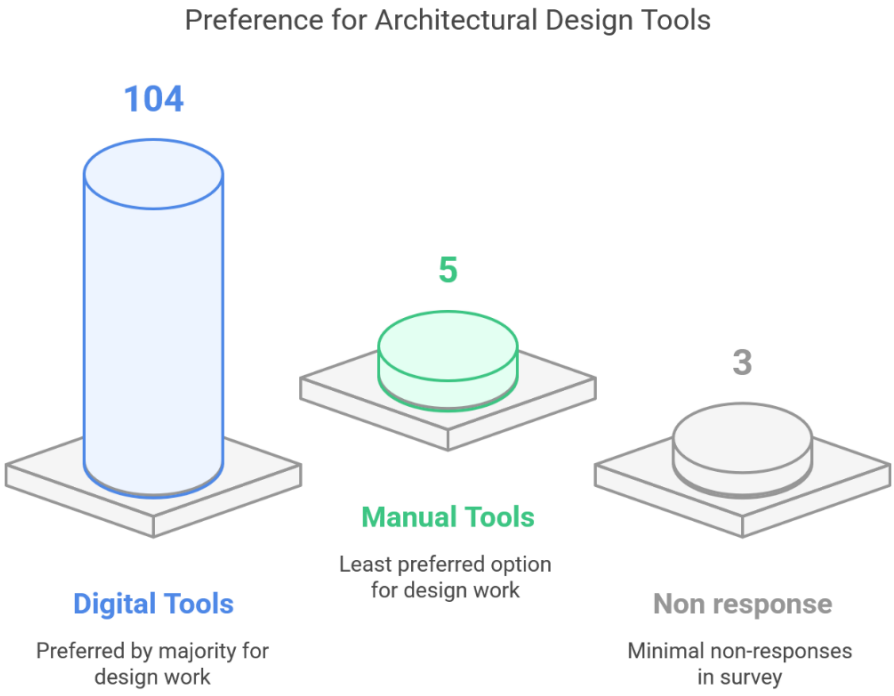

Figure 1: Tools Preference for Architectural Design (Source: Researchers' fieldwork)

Figure 2 identifies insufficient electrical power supply (42.6%) and technical hardware issues (38.9%) as the most frequent challenges, while Figure 3 highlights the cost of computer hardware as the single greatest obstacle.

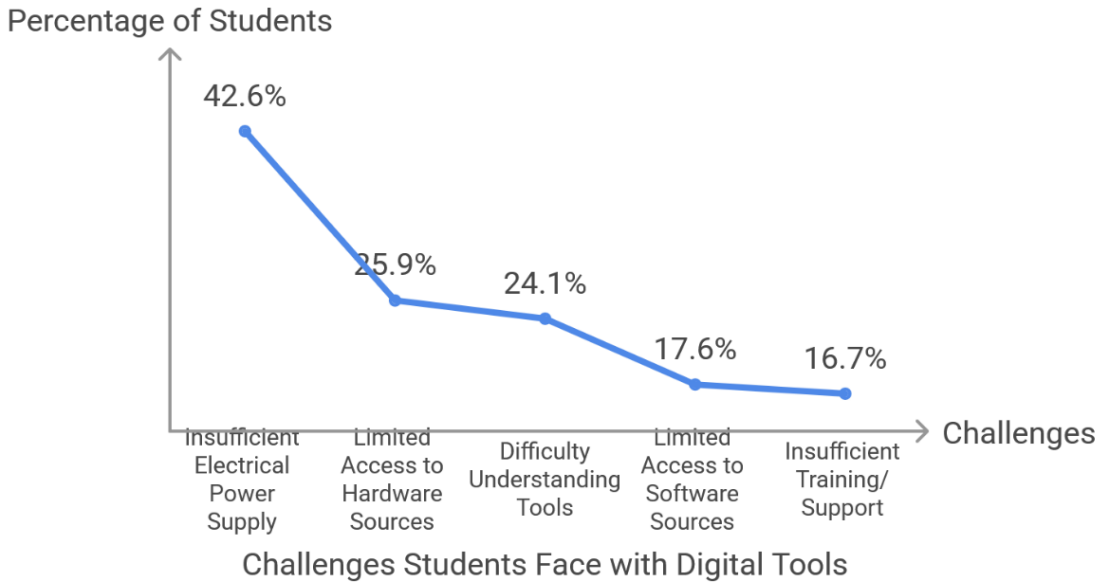

Figure 2: *Areas where Students Experience Challenges with using Digital Tools (Source: Researchers' fieldwork)*

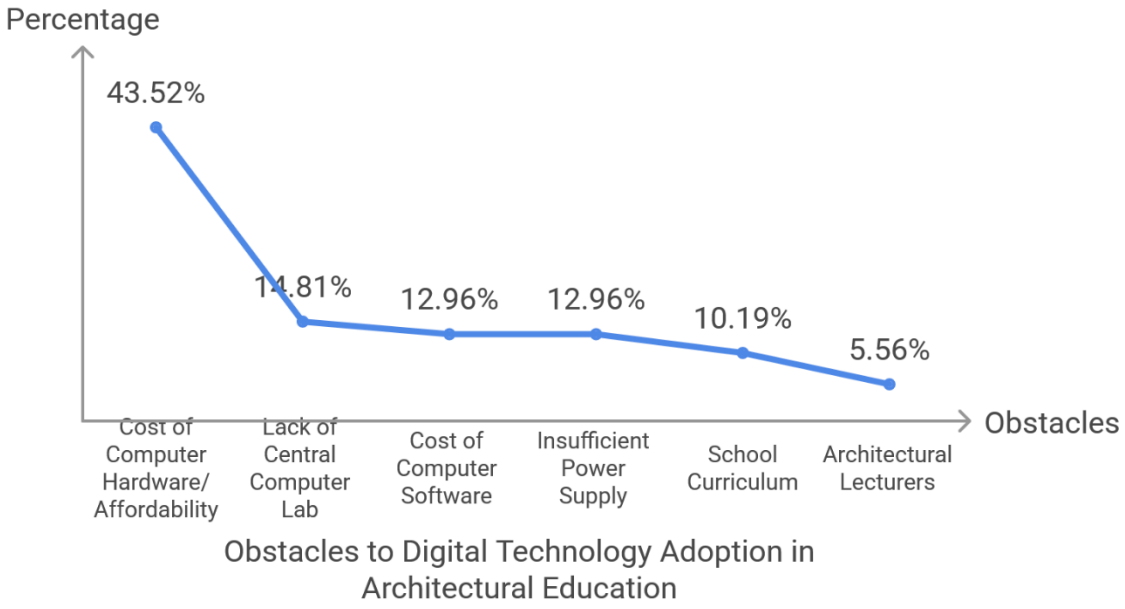

Figure 3: The Greatest Obstacle to the Adoption of Digital Technology in Architectural Design Education (Source: Researchers' fieldwork)

These results strongly converge with prior research in Nigeria and similar developing contexts, which consistently identifies affordability and unreliable infrastructure as the foundational barriers to digital integration (Hamma-adama et al., 2020; Maina, 2018a). Interestingly,

students reported a relatively high level of satisfaction with the digital tool training provided in their curriculum (Figure 4) and institutional support (Figure 5).

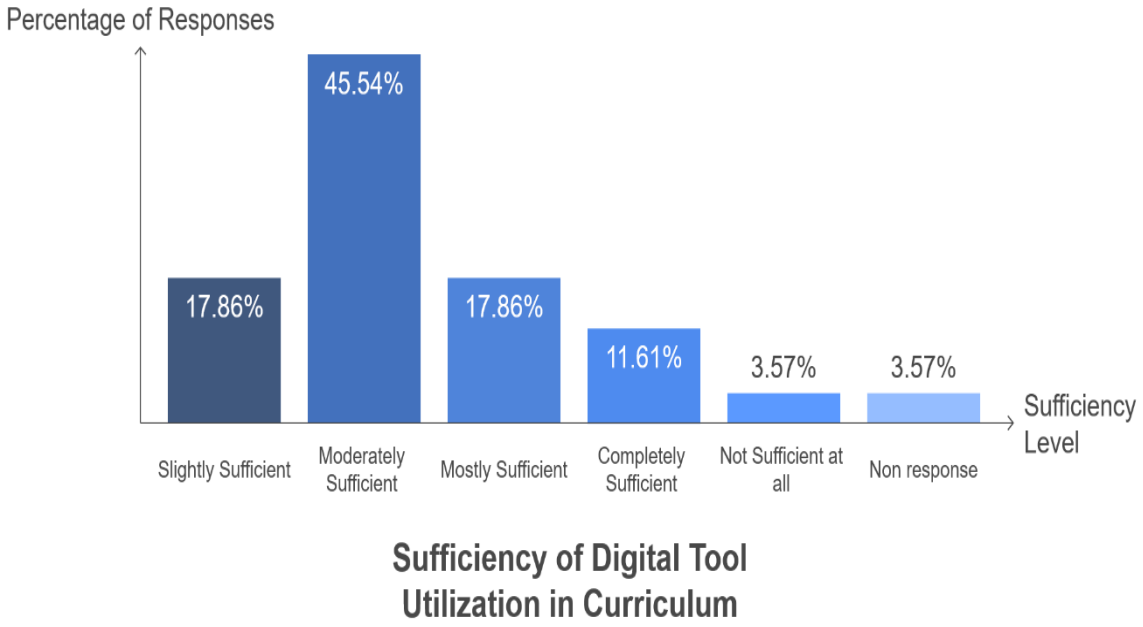

Figure 4: Level of sufficient digital tool utilization in the curriculum (Source: Researchers' fieldwork)

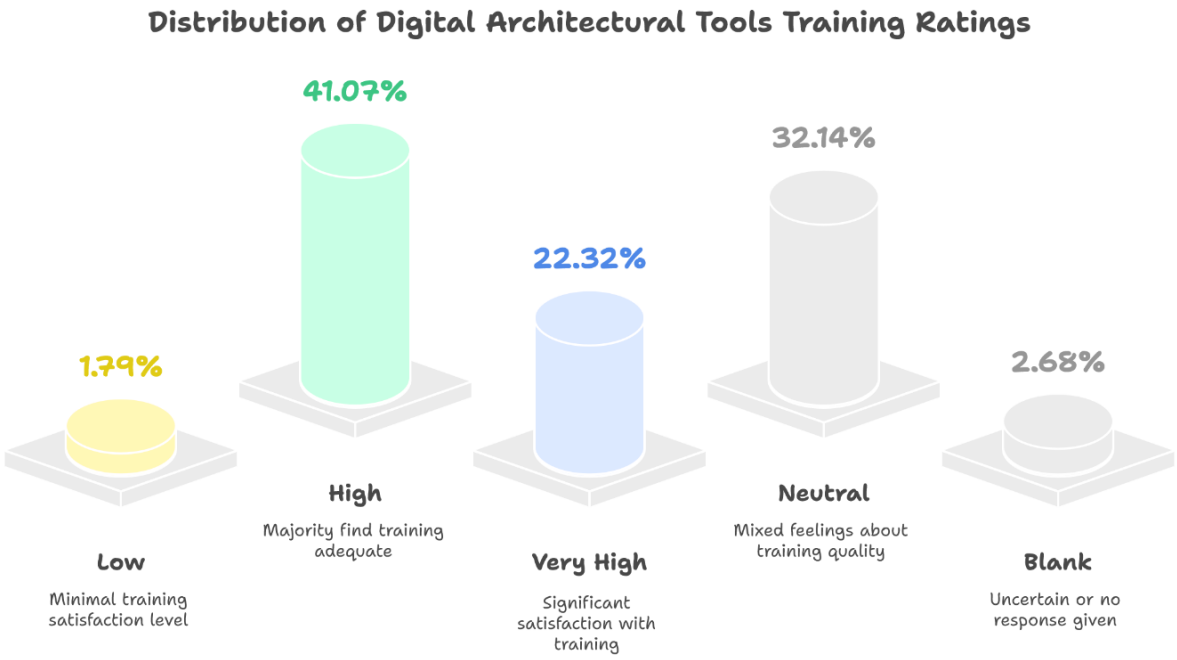

Figure 5: Rating of the level of Digital Architectural Tools Training in the Department (Source: Researchers' fieldwork)

This perceived sufficiency, discussed above (Figure 4) needs to be placed into the right context. The comparative analysis of the NBTE (polytechnic) and NUC (university) curricula (Table 2) establishes that polytechnics offer significantly more digital-application courses (8 courses, ~14.8% of units) than universities (2 courses, ~3.9% of units). This implies that student satisfaction is likely relative to the Nigerian educational landscape, essentially and may differ

when treated as an absolute measure against global standards. This finding supports observations by Okonta & Ayinla, (2024) regarding curricular distinctions between Nigerian institution types. However, despite this relative advantage, the lack of cutting-edge technologies like digital printing and immersive VR/AR in both curricula suggests a gap that still exists, supporting criticisms by Abdullah & Hassanpour, (2021); Marcel-Okafor & Okafor, (2021)

Table 2: *Comparison of 2020 NBTE Curriculum and 2023 CCMAs for Architectural Technology and Architecture*

	2020 NBTE Curriculum	**units**	**Units per session**	**2023 NUC CCMAS**	**Units**	**Units per session**
ND I/100 level	i. ICT 101 Computer Application I ii. ARC 126 Introduction to Computer-Aided Design	4 3	56	i. FAA 121 Introduction to Basic Computer Applications	2	20
ND II/200 level	i. ARC 216 Computer-Aided Design: 2-Dimensional Drawing ii. ARC 226 Computer-Aided Design: 3-Dimensional Drawing	3 3	53	-		30
HND I	i. ARC 312 Computer-Aided Design: Rendering in 3 Dimensions ii. ARC 322 Advanced Computer Aided Design I	3 3	58	i. ARC 309 Building Information Modelling	2	28
HND II	i. ARC 412 Advanced Computer Aided Design II ii. ARC 427 Building Information Modelling (BIM)	3 3	51			24
Total	8 Digital Application-based courses	25	168	2 Digital Application-based courses	4	102
Percentage			14.8%		C	3.9%

4. Conclusion

This study concludes that, rather than student resistance or an inadequate core curriculum, the adoption of digital technology in Nigerian architectural education, as experienced by students at a leading polytechnic, is mainly limited by economic and infrastructural barriers, particularly the high cost of hardware and unstable power supply. These systemic external issues produce a considerable implementation gap, even if the students who are primarily digital natives strongly favor digital tools and are generally satisfied with their institution's targeted training.

The study contributes to knowledge by providing empirical, student-centred evidence that prioritizes the hierarchy of challenges within the Nigerian context. It shows that factors such as electricity, cost, and maintenance remain the crucial bottleneck even with a willing user population and a relatively strong technical curriculum. This strengthens the argument for a fundamental, infrastructure-first approach to intervention in the discussion of technology adoption in emerging economies. More resources should be dedicated by institutions, particularly Polytechnics, towards the acquisition of dedicated computer laboratories with enough capacity and power support for students to develop their skills and carry out their assignments

Ultimately, addressing the identified challenges is more of a developmental imperative than an educational intervention. SDG 9 (Industry, Innovation, and Infrastructure) and SDG 4 (Quality Education) are directly impacted by improving digital literacy and technical proficiency in architecture education. Nigeria can develop a more innovative, sustainable, and competitive building sector by giving aspiring architects the necessary digital skills. This would help the country better manage and design its built environment in the digital era.

REFERENCES

Abdulghany, R., Youssry, M., & ElKhateeb, S. (2022). Digital fabrication as an approach for innovative architecture education. *MSA Engineering Journal*, *1*(4), 79–97. https://doi.org/10.21608/msaeng.2022.280424

Abdullah, H. K., & Hassanpour, B. (2021). Digital design implications: A comparative study of architecture education curriculum and practices in leading architecture firms. *International Journal of Technology and Design Education*, *31*(2), 401–420. https://doi.org/10.1007/s10798-019-09560-2

Abdulrahaman, M. D., Faruk, N., Oloyede, A. A., Surajudeen-Bakinde, N. T., Olawoyin, L. A., Mejabi, O. V., Imam-Fulani, Y. O., Fahm, A. O., & Azeez, A. L. (2020). Multimedia tools in the teaching and learning processes: A systematic review. *Heliyon*, *6*(11), e05312–e05312. PubMed. https://doi.org/10.1016/j.heliyon.2020.e05312

Abro, A. S., Shar, D. B. K., Memon, A. M., Hussain, A. R., & Memon, A. A. (2021). Utilization of Digital Tools in Architectural Education and Practice. *International Research Journal of Innovations in Engineering and Technology (IRJIET)*, *5*(3), 41–44. https://doi.org/10.47001/IRJIET/2021.503008

Akah, U., Luna, E. B., & Edidiong, E. U. (2021). Empirical investigation into the effect of Computer- Aided Design (CAD) on the manual Drafting Skills of Undergraduate Empirical Investigation into the Effect of Computer. *Department of Architecture, Faculty of Environmental Studies, University of Uyo*, *1*(April), 159–172.

Asghar, Q. (2023). *TECHNOLOGY AND TOOLS INTEGRATION IN ARCHITECTURE EDUCATION: REFLECTION ON STRATEGIES AND TECHNIQUES*. *6*(4).

Babalola, O., Ibem, E. O., Ezema, I. C., & Agboola, S. (2022). *Barriers to the Adoption of Lean Practices (LPs) in the Nigerian Building Industry*. *3*(2).

Brozovsky, J., Labonnote, N., & Vigren, O. (2024). Digital technologies in architecture, engineering, and construction. *Automation in Construction*, *158*, 105212. https://doi.org/10.1016/j.autcon.2023.105212

Cho, Y., Kim, M., & Choi, M. (2021). Factors associated with nurses' user resistance to change of electronic health record systems. *BMC Medical Informatics and Decision Making*, *21*(1), 218. https://doi.org/10.1186/s12911-021-01581-z

Doyle, S., & Senske, N. (2016). *Between design and digital: Bridging the gaps in architectural education*.

Egodawele, M., Sedera, D., & Bui, V. (2022). *A Systematic Review of Digital Transformation Literature (2013 – 2021) and the development of an overarching a- priori model to guide future research*.

Ewharieme Blessing Omokaro & Ogheneochuko Owens Akpojaro. (2022). An empirical evaluation on the comparison between students' preference and choice of polytechnic education over university in Nigeria. *World Journal of Advanced Research and Reviews*, *16*(3), 168–177. https://doi.org/10.30574/wjarr.2022.16.3.1163

Fakhry, M., Kamel, I., & Abdelaal, A. (2021). CAD using preference compared to hand drafting in architectural working drawings coursework. *Ain Shams Engineering Journal*. https://doi.org/10.1016/J.ASEJ.2021.01.016

Gong, C., & Ribiere, V. (2021). Developing a unified definition of digital transformation. *Technovation*, *102*, 102217. https://doi.org/10.1016/j.technovation.2020.102217

Hajirasouli, A., Getuli, V., Bruttini, A., Sorbi, T., & Capone, P. (2023). TOWARDS A DIGITAL ERA IN AEC HIGHER EDUCATION: COMBINING THEORY AND TECHNOLOGY TO DEVELOP AND DELIVER ARCHITECTURAL MASTER CLASSES. In *Research and teaching in a digital era* (pp. 377–388). Firenze University Press. https://library.oapen.org/bitstream/handle/20.500.12657/89107/9791221502893_25.pdf?sequence=1

Hamma-adama, M. H., Kouider, T., & Salman, H. (2020). Analysis of Barriers and Drivers for BIM Adoption. *International Journal of BIM and Engineering Science*, *3*(1), 18–41. https://doi.org/10.54216/ijbes.030102

Hettithanthri, U., & Hansen, P. (2022). Design studio practice in the context of architectural education: A narrative literature review. *International Journal of Technology and Design Education*, *32*(4), 2343–2364. https://doi.org/10.1007/s10798-021-09694-2

Kara, L. (2015). A Critical Look at the Digital Technologies in Architectural Education: When, where, and how? *Procedia - Social and Behavioral Sciences*. https://doi.org/10.1016/J.SBSPRO.2015.01.506

Kumar, N. S., & Janardhan, J. (2023). The Role of Technology in Shaping the Future of Architectural Education. *INTERANTIONAL JOURNAL OF SCIENTIFIC RESEARCH IN ENGINEERING AND MANAGEMENT*, *07*(12), 1–11. https://doi.org/10.55041/IJSREM27584

Maina, J. J. (2018). Cad and Bim in Architecture Education: Awareness, Proficiency and Advantages From the Student Perspective. *Part B*, *6*(4), 167–178.

Marcel-Okafor, U., & Okafor, M. (2021). Enhancing building information modelling (BIM) training in Nigerian polytechnics: Towards sustainable development in Southeast Nigeria. *E3S Web of Conferences*, *295*, 05020. https://doi.org/10.1051/e3sconf/202129505020

Okonta, E. D., & Ayinla, O. A. (2024). Promoting global alliances for sustainable architectural education, training, and practice in Nigeria. *Discover Cities*, *1*(1), 12. https://doi.org/10.1007/s44327-024-00014-6

Ordu, U. B.-A. (2021). The Role of Teaching and Learning Aids/Methods in a Changing World. In *New Challenges to Education: Lessons from Around the World* (BCES Conference Books, Vol. 19, pp. 210–216). https://files.eric.ed.gov/fulltext/ED613989.pdf

Peter, S. (2022). CHALLENGES OF THE APPLICATION OF INFORMATION TECHNOLOGY FACED BY STAFF IN THE TRAINING OF ARCHITECTURAL STUDENTS IN POLYTECHNICS IN NIGERIA. *International Journal of Environmental Research*, *24*(4).

Ramadan, N. M. (2021, February 26). *(An Approach to Introduce BIM into schools of architecture curriculum in Greater Khartoum)*. 2020 International Conference on Computer, Control, Electrical, and Electronics Engineering (ICCCEEE). https://doi.org/10.1109/iccceee49695.2021.9429564

Ramilo, R., & Embi, M. R. B. (2014). Critical analysis of key determinants and barriers to digital innovation adoption among architectural organizations. *Frontiers of Architectural Research*, *3*(4), 431–451. https://doi.org/10.1016/j.foar.2014.06.005

Rodriguez, A. K. S., Suresh, S., Heesom, D., & Suresh, R. (2017). BIM Education Framework for Clients and Professionals of the Construction Industry: *International Journal of 3-D Information Modeling*, *6*(2), 57–79. https://doi.org/10.4018/IJ3DIM.2017040104

Shirish, A., & Batuekueno, L. (2021). Technology renewal, user resistance, user adoption: Status quo bias theory revisited. *Journal of Organizational Change Management*, *34*(5), 874–893. https://doi.org/10.1108/JOCM-10-2020-0332

Soulikias, A., Cucuzzella, C., Nizar, F., Hazbei, M., & Goubran, S. (2021). We gain a lot…but what are we losing? A critical reflection on the implications of digital design technologies. *Open House International*, *46*(3), 444–458. https://doi.org/10.1108/OHI-02-2021-0041

Soydaş Çakir, H., & Uzun, T. (2020). BUILDING INFORMATION MODELLING IN ARCHITECTURAL EDUCATION: CONTRIBUTION OF BIM IN DESIGN PROCESS. *TURKISH ONLINE JOURNAL OF DESIGN ART AND COMMUNICATION*, *10*(4), 452–467. https://doi.org/10.7456/11004100/009

Wang, K., Guo, F., Zhang, C., & Hao, J. (2021). *Digital Technology in Architecture , Engineering , and Construction (AEC) Industry: Research Trends and Practical Status toward Construction 4. 0. September*. https://doi.org/10.1061/9780784483978.100

Xiang, X., Yang, X., Chen, J., Tang, R., & Hu, L. (2020). A Comprehensive Model of Teaching Digital Design in Architecture that Incorporates Sustainability. *Sustainability*, *12*(20), 8368. https://doi.org/10.3390/su12208368

Yoo, J., Choi, S., Hwang, Y., & Yi, M. Y. (2021). The Role of User Resistance and Social Influences on the Adoption of Smartphone: Moderating Effect of Age. *Journal of Organizational and End User Computing*, *33*(2), 36–58. https://doi.org/10.4018/JOEUC.20210301.oa3