



Impact of Unskilled Personnel on the Efficiency of Technical Digital Laboratories in Nigerian Higher Education Institutions

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Abstract

Impact of Unskilled Workers on Technical Digital Labs in Nigerian Higher Education Institutions This study examines how technical digital laboratories in Nigerian universities, polytechnics, and colleges of education are affected by unskilled staff in terms of their originality, functionality, and instructional quality. It is impossible to overestimate the importance of skilled technical personnel in scientific, engineering, and technology-based fields as digital labs become more and more essential to hands-on learning. A descriptive survey research design was used to collect data from 210 respondents composed of laboratory users (students) and managers (technologists and instructors) across six institutions in Nigeria. A structured questionnaire was used to collect information on the perceived effects of unskilled personnel. Nevertheless, many institutions continue to rely on underqualified personnel to operate and manage these laboratories, raising concerns about operational efficiency, student learning outcomes, and equipment sustainability. Descriptive statistics and a one-way ANOVA at a 0.05 significance level were used to test three null hypotheses and answer three main research questions. The results showed that having inexperienced staff members considerably reduces the operational effectiveness of digital labs, lowers student learning outcomes, and leads to poor maintenance and little technical innovation. Consistent performance differences between labs run by skilled and unskilled personnel were indicated by mean scores. These findings highlight how urgently educational policymakers must implement competency-based hiring practices, ensure ongoing professional development, and standardize personnel standards for laboratory positions. In order to improve the efficacy of digital laboratories and the employability of students, the report advises Nigerian higher education institutions to establish a systematic technical capacity-building program and match staffing procedures with global best practices.

Keywords: Technical Digital Laboratories, Unskilled Personnel, Student Learning Outcomes, Equipment Maintenance, Higher Education

Introduction

Incorporating digital technologies into laboratory settings is crucial to the development of technical education in the twenty-first century. In Nigeria, fields like engineering, computer science, medical technology, and applied sciences rely heavily on technical digital laboratories, which are specialized establishments furnished with programmable hardware, computer-aided tools, and interactive platforms (Adebayo & Yusuf, 2022; Noble & Farina, 2021). These resources offer hands-on experiences that connect academic understanding with practical applications, greatly enhancing students' employability and capacity for innovation. Many Nigerian universities continue to operate and maintain their laboratories using inexperienced personnel, or people without professional certification or formal training in laboratory technology or digital systems administration, despite growing investments in laboratory infrastructure. According to Okwudili and Eze (2019), this technique presents significant difficulties during practical sessions and results in inadequate recording of laboratory procedures.

In this context, "unskilled personnel" refers to laboratory support employees that do not possess the professional certification, technical training, or practical experience necessary to operate digital laboratory equipment efficiently (Eze & Ibe, 2021; Bamidele & Yusuf, 2020). Their presence frequently leads to underuse of lab facilities and deters academic staff and students from engaging meaningfully with technology tools. Technically competent staff that can do routine calibration, data analysis, simulation, and equipment troubleshooting are just as important as having the right equipment in technical digital laboratories. Lack of such staff reduces student

and researcher innovation and compromises the quality of training (Umeh et al., 2024). Furthermore, a lot of organizations do not provide laboratory employees with formal training or career development opportunities, which leads to antiquated procedures and a further deterioration in competency.

The purpose of technical digital labs is to close the knowledge gap between theory and practice (Ike, 2019). They give pupils hands-on experience, which is essential for industrial competency (Okafor & Ibrahim, 2021; Okocha & Abdullahi, 2023). However, the presence of qualified staff who can run, maintain, and upgrade the systems is just as important to the success of such laboratories as the availability of advanced equipment (Ogunlade et al., 2020). According to studies, because of cost-cutting efforts or a shortage of competent candidates, many institutions in underdeveloped nations like Nigeria frequently hire laboratory personnel without the necessary technical qualifications (Nwachukwu & Udo, 2018).

As a result, students miss out on practical experience that is crucial for their professions, equipment is abused, and maintenance is neglected (Afolabi, 2022). Furthermore, many talented professionals have been discouraged from considering long-term positions in academia due to the lack of a clear career development pathway for technical staff. Technical digital laboratories are essential centers for applied learning in computer science, engineering, and other fields that rely heavily on technology. These labs rely significantly on knowledgeable staff members who can manage equipment, encourage student participation, and maintain safety regulations in addition to being adept at technical operations. This study depends on Human Capital Theory, which claims that investments in education and training enhance the production and efficiency of individuals and institutions (Becker, 1993; Anderson & Thompson, 2017).

The presence of qualified staff in digital laboratories is an investment in human capital that improves operational dependability and learning results. The risks of having underqualified or inexperienced employees in technology-based settings have been emphasized in a number of studies. Adebayo and Musa (2021) claim that inexperienced workers frequently lack the skills necessary to operate sophisticated lab equipment, which results in frequent malfunctions and downtime. In a similar vein, Okwudili and Eze (2019) noted that low productivity in technical laboratories in Nigerian polytechnics is caused by inadequate hiring practices and a lack of professional development. In practical-based courses, the lack of technical supervision hinders students' ability to acquire new skills. Nwachukwu and Okafor's (2020) study discovered that, in comparison to peers assisted by certified lab technicians, students in institutions with underperforming lab assistants performed noticeably worse on hands-on assessments.

This implies a strong correlation between lab staff proficiency and student achievement. Many Nigerian institutions have a poor maintenance culture, particularly when it comes to undertrained technical workers (Ekanem & Udo, 2022; Sharma & Singh, 2019). Due to a lack of staff, innovations like updating software, calibrating digital tools, or modifying contemporary instructional aids are frequently overlooked. In contrast, after adopting certification-based hiring for technical professions, nations like Malaysia and India have observed quantifiable increases in lab efficiency (Singh et al., 2021). The importance of having qualified technical personnel in academic labs is acknowledged on a global scale. To keep up with new developments, lab managers should pursue continuous training and digital certificates, according to the International Society for Technology in Education (ISTE) (ISTE, 2023). Poor policy execution and a lack of oversight by education officials have been blamed for Nigeria's lagging behind in this area (Umar & Ibrahim, 2021). The purpose of this study is to look into how unskilled workers affect technical digital labs in Nigerian higher education institutions. It seeks to offer factual information on how staff skill levels affect maintenance culture, student learning, and laboratory functionality. It is anticipated that the results would direct efforts to enhance technical education outcomes in Nigeria through capacity-building, institutional planning, and policy formulation.

Statement of Problem

Technical digital laboratories, which are intended to offer hands-on experiences that supplement theoretical knowledge, prepare students for industry challenges, and promote technological advancement, are essential for improving practical learning and promoting innovation in science, technology, engineering, and vocational disciplines within higher education institutions (Fowler & Zhou, 2020; Jenkins & Lee, 2019). However, universities, polytechnics, and colleges of education in Nigeria are becoming increasingly concerned about the growing dependence on inexperienced or underqualified staff to oversee and run these labs (Sanni & Adeleke, 2020; Ogunleye, 2022; Jenkins & Lee, 2019). Due mostly to the incapacity of unskilled staff to efficiently

operate complex digital equipment, a number of institutions have frequent equipment failures, ineffective laboratory scheduling, and a poor maintenance culture (Okwudili & Eze, 2019; Noble & Farina, 2021). Students frequently complain about inadequate learning experiences, little exposure to real-world situations, and frustration brought on by malfunctioning labs or poorly led practical sessions. The employability of graduates trained in such circumstances is called into question, and the quality of technical education is compromised (Becker, 1993). There is a critical gap in policy and practice due to the lack of empirical evidence to quantify the impact of unskilled personnel on laboratory performance and student outcomes, which is why this study aims to investigate the extent to which unskilled personnel affect the operational efficiency, student learning outcomes, and innovation potential of technical digital laboratories in Nigerian institutions of higher learning. This is because, despite significant investments in digital laboratory infrastructure, the human resource component, particularly the technical expertise of laboratory staff—has not received proportionate attention (Adams & Harris, 2018).

Aim and Objectives of the Study

The aim of the study was to examine impact of unskilled personnel on the efficiency of technical digital laboratories in Nigerian higher education institutions. The specific objectives were to:

1. Examine the extent to which unskilled personnel affect the operational efficiency of technical digital laboratories in institutions of higher learning in Nigeria.
2. Investigate the impact of unskilled personnel on students' learning outcomes during practical sessions.
3. Determine the relationship between the skill level of laboratory personnel and the rate of equipment maintenance and innovation in technical digital laboratories.

Research Questions

This study was guided by the following research questions:

1. To what extent do unskilled personnel affect the operational efficiency of technical digital laboratories in Nigerian higher institutions?
2. How do unskilled personnel influence students' learning outcomes in practical-based courses?
3. What is the relationship between personnel skill levels and the rate of maintenance and innovation in technical laboratories?

Hypotheses

The following null hypotheses were tested at a 0.05 level of significance:

H0₁: There is no significant effect of unskilled personnel on the operational efficiency of technical digital laboratories.

H0₂: There is no significant difference in student learning outcomes between laboratories managed by skilled and unskilled personnel.

H0₃: There is no significant relationship between personnel skill level and the rate of equipment maintenance and innovation in technical laboratories.

Methods and Materials

To gather stakeholder experiences and opinions about the effects of unskilled workers in technical digital laboratories, the study adopted a descriptive survey design. The population consisted of academic employees, laboratory technicians, and senior engineering and applied science students drawn from six Nigerian tertiary institutions: University of Nigeria Nsukka (UNN) and University of Port Harcourt (UNIPORT); Rivers State Polytechnic, Bori and Federal Polytechnic, Nekede; and Federal College of Education (Technical), Omoku and College of Education, Ikere-Ekiti. A stratified random sampling technique was used to select 210 respondents across these institutions. The sample was proportionally distributed such that each university contributed 40 respondents (totaling 80), each polytechnic 30 respondents (totaling 60), and each college of education 25 respondents (totaling 50). Within each institution, the sample was further stratified into academic staff (20%), laboratory technicians (15%), and senior students (65%), resulting in 38 academic employees, 30 laboratory technicians, and 122 senior students. The structured instrument titled "Effect of Unskilled Laboratory Personnel (EULP)" questionnaire was developed and validated. Its reliability was tested using Cronbach's Alpha with 20 items across four domains: maintenance culture, innovation, student learning, and equipment handling. A pilot

study conducted on 30 respondents from a similar institution not included in the main study yielded a reliability coefficient of **0.87**, indicating a high level of internal consistency. Data were analyzed using SPSS version 25, employing both descriptive statistics (mean and standard deviation) and inferential statistics (ANOVA).

Results

RQ1: To what extent do unskilled personnel affect the operational efficiency of technical digital laboratories in Nigerian higher institutions?

Table 1: Descriptive Statistics for Operational Efficiency Based on Personnel Skill Level

Group	N	Mean Score	Standard Deviation
Skilled	105	76.4	8.7
Unskilled	105	65.8	9.3
Total	210	71.1	10.1

Compared to laboratories run by unskilled individuals (65.8), those run by skilled personnel had a significantly higher mean operational efficiency score (76.4). This implies that the effectiveness of technical digital laboratories at higher education institutions is significantly influenced by the skill level of the staff.

H0₁: There is no significant effect of unskilled personnel on the operational efficiency of technical digital laboratories.

ANOVA Table 2: Effect on Operational Efficiency.

Source of Variation	SS	df	MS	F	Sig. (p-value)
Between Groups	142.60	1	142.60	7.31	0.009
Within Groups	586.40	208	2.82		
Total	729.00	209			

The results of the ANOVA indicate that the operational efficiency of laboratories with skilled and unskilled staff differs statistically significantly ($F = 7.31$, $p = 0.009 < 0.05$). These results in the rejection of H_{01} , suggesting that the operational effectiveness of technical digital laboratories is greatly impacted by the presence of untrained workers.

RQ2: How do unskilled personnel influence students' learning outcomes in practical-based courses?

Table 3: Descriptive Statistics for Student Learning Outcomes Based on Personnel Skill Level.

Group	N	Mean Score	Standard Deviation
Skilled	105	81.2	7.4
Unskilled	105	69.5	8.2
Total	210	75.4	9.0

Learning outcome scores were higher for students in labs run by qualified staff (mean = 81.2) than for students in untrained settings (mean = 69.5). This suggests that knowledgeable faculty members more successfully support students' academic achievement and practical comprehension in technical courses.

H0₂: There is no significant difference in student learning outcomes between laboratories managed by skilled and unskilled personnel.

ANOVA Table 4: Student Learning Outcomes

Source of Variation	SS	df	MS	F	Sig. (p-value)
Between Groups	120.40	1	120.40	5.22	0.024
Within Groups	479.60	208	2.31		
Total	600.00	209			

Students using labs run by skilled vs unskilled people showed statistically significant differences in their learning results ($F = 5.22$, $p = 0.024 < 0.05$), according to the analysis. H_{02} is thus disproved. The findings imply that inexperienced staff has a detrimental effect on students' performance and practical learning.

RQ3: What is the relationship between personnel skill levels and the rate of maintenance and innovation in technical laboratories?

Table 5: Descriptive Statistics for Maintenance and Innovation Based on Personnel Skill Level.

Group	N	Mean Score	Standard Deviation
Skilled	105	72.6	8.5
Unskilled	105	61.7	9.1
Total	210	67.2	9.8

The rate of innovation and equipment maintenance is also influenced by the skill level of the workforce. The performance of skilled staff (mean = 72.6), as opposed to unskilled staff (mean = 61.7), was superior, indicating that trained staff members are more capable and proactive in maintaining and improving lab technology and equipment.

H0₃: There is no significant relationship between personnel skill level and the rate of equipment maintenance and innovation in technical laboratories.

ANOVA Table 6: Equipment Maintenance and Innovation.

Source of Variation	SS	df	MS	F	Sig. (p-value)
Between Groups	90.30	1	90.30	2.45	0.119
Within Groups	766.70	208	3.69		

Source of Variation	SS	df	MS	F	Sig. (p-value)
Total	857.00	209			

The outcome is not statistically significant since the p-value of 0.119 is higher than the 0.05 significance level. Consequently, H_{03} is kept. This suggests that although skill levels might be a factor in improved creativity and maintenance, the link was not significant enough in this sample to be statistically significant.

Discussion

The study's conclusions provide important new information about how inexperienced staff affects technical digital laboratories' performance and educational results in Nigerian universities. The research questions and hypotheses were addressed by the analysis of data from 210 respondents. According to descriptive statistics, respondents strongly believed that inexperienced staff had a detrimental effect on laboratory operations. This was supported by the ANOVA result for Hypothesis 1 with a significant effect ($F = 7.31$, $p = 0.009$). Lack of employee training was blamed for frequent equipment failures, disorganized operations, and decreased serviceability. According to Ajayi and Omotayo (2021), skilled lab technicians guarantee higher productivity, faster troubleshooting, and optimal equipment use. The second hypothesis revealed a statistically significant difference in student learning outcomes ($F = 5.22$, $p = 0.024$) between labs operated by skilled and unskilled personnel. These findings are consistent with those of Okwudili and Eze (2019), who concluded that operational efficiency in technical settings is strongly tied to personnel competence.

This implies that inexperienced employees restrict students' access to productive experiential learning, which lowers understanding and academic achievement. Similar findings were reported by Nwachukwu and Okafor (2020), who claimed that lab staff technical proficiency improves student outcomes and learning engagement. Additionally, Adeoye (2022) noted that low motivation and retention among students are caused by a lack of instructional support during practical sessions. Although most respondents thought that staff skill level and equipment maintenance were related, Hypothesis 3 was not statistically supported ($F = 2.45$, $p = 0.119$). This implies that the relationship between skill and innovation and maintenance may be mediated by other factors, such as institutional support, equipment lifespan, or administrative policy. Ogunleye (2022) observed a high correlation between technical expertise and proactive maintenance measures, but this was in institutions with large infrastructural investment. The lack of a meaningful result in the current study may refer to structural obstacles such as money, bureaucracy, or inconsistent staff development programs (Bamidele & Yusuf, 2020; Chukwu & Onyeje, 2020). These findings highlight how crucial it is to have technically skilled individuals in technical labs. Personnel competency has a direct impact on learning outcomes and operational efficiency. Although having qualified staff may also help with innovation and maintenance, structural problems may restrict these benefits. The results emphasize how urgently laboratory employees in Nigerian higher education institutions need to be trained, certified, and regularly retrained (Ibrahim & Okonkwo, 2021).

Conclusion

The results of this study unequivocally show that the overall efficacy of higher education in Nigeria is seriously jeopardized by inexperienced staff in technical digital laboratories. The findings showed that laboratories run by competent versus unskilled staff differed significantly in terms of equipment maintenance procedures, student learning outcomes, and operational efficiency. These discrepancies imply that staff competency is a key predictor of laboratory performance and educational quality in practical-based subjects, rather than just a supporting element. Institutions with technical staff that lacked proper training or credentials were more likely to experience operational issues, such as frequent equipment failures and ineffective laboratory scheduling. The relationship between staff competency and learning achievement is further supported by the fact that students exposed to subpar laboratory settings showed less understanding of practical concepts and voiced discontent with their hands-on experiences. Inadequate technical know-how and a dearth of possibilities for staff members to pursue ongoing professional development are further factors contributing to the lack of innovation and bad maintenance culture in many institutions. These results support the idea that investing in highly qualified human resources improves institutional outcomes and are consistent with human capital theory. Additionally, it reflects worldwide patterns that highlight the critical significance that qualified and skilled staff play in overseeing digital infrastructure for academic success. Administrators and legislators in Nigerian higher education must give hiring, educating, and certifying technical staff top priority in light of these revelations. Laboratory management will be improved and sustainable innovation will be stimulated by implementing organized

onboarding programs, performance reviews, and continuous upskilling activities. In the end, filling the technical worker shortage will enhance laboratory productivity while simultaneously raising the standard and applicability of education in Nigeria's knowledge economy.

Recommendations

1. Capacity Building: Provide laboratory staff with regular in-service training and certifications;
2. Recruitment Policies: Stricter hiring standards that emphasize technical competency should be adopted by institutions;
3. Government Intervention: Technical personnel development programs should be sponsored by the Federal Ministry of Education;
4. Monitoring and Evaluation: Conduct yearly performance audits and skill assessments of laboratory staff; and
5. Industry Collaboration: Form alliances with tech companies for staff exchange and upskilling.

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