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THE ROLE OF ADVANCED COMPUTER HARDWARE IN ENHANCING TECHNICAL SKILLS DEVELOPMENT IN UNDERGRADUATES IN CROSS RIVER STATE, NIGERIA

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Abstract
This study investigates the transformative potential of advanced computer hardware in fostering technical skills development among undergraduates in Cross River State, Nigeria. As global industries increasingly demand digitally proficient graduates, Nigerian universities face challenges such as outdated hardware, limited access to modern facilities, and inadequate technical training. Using a descriptive survey design, data were collected via questionnaires from 400 undergraduates and 80 lecturers across five public universities in Cross River State. Results indicate that only 30% of students have regular access to advanced hardware like high-performance computers, while 75% of lecturers report insufficient infrastructure to support technical skills training. However, 82% of participants believe advanced hardware, such as graphic processing units (GPUs) and virtual reality (VR) systems, could enhance skills in programming, data analysis, and engineering design. Key barriers include erratic power supply (88%) and high equipment costs (70%). The study proposes solutions like government-funded hardware upgrades and industry partnerships. Grounded in the Technology Acceptance Model (TAM), this research underscores the need for accessible, high-quality hardware to bridge the technical skills gap, preparing undergraduates for a competitive global workforce.

Keywords: Advanced Computer Hardware, Technical Skills, Undergraduates, Digital Literacy, Technology Acceptance Model

Introduction

In an era defined by rapid technological evolution, advanced computer hardware such as high-performance processors, graphic processing units (GPUs), and virtual reality (VR) systems has become pivotal in shaping technical education. Technical skills, encompassing competencies in programming, data analysis, and engineering design, are critical for undergraduates to thrive in a globalized, technology-driven economy (UNESCO, 2017). In Nigeria, however, the tertiary education system struggles to equip students with these skills due to systemic challenges like outdated infrastructure, limited access to modern hardware, and insufficient training (Afolabi & Oyeyemi, 2023). In Cross River State, these issues are particularly pronounced, with many universities relying on obsolete computers that hinder practical training (Ekpo & Udo, 2021).

Advanced computer hardware offers transformative opportunities to enhance technical skills development. High-performance computers enable students to engage with complex software like MATLAB, AutoCAD, and Python, fostering hands-on learning (Okechukwu et al., 2019). Similarly, VR

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systems and GPUs support immersive simulations, enhancing skills in fields like computer-aided design and artificial intelligence (Radianti et al., 2020). Despite these possibilities, access to such hardware in Nigerian universities remains limited. According to the Cross River State University Council (2024), only 25% of public universities have functional computer labs equipped with modern hardware, and rural institutions face even greater deficits.

Technical skills development is a cornerstone of modern higher education, equipping students with competencies to navigate industries driven by innovation (UNESCO, 2017). Advanced computer hardware plays a pivotal role in this process, enabling hands-on learning in disciplines like computer science, engineering, and data analytics (Okechukwu et al., 2019).

The global shift toward technology-enhanced education underscores the urgency of addressing these gaps. Studies by Davis (1989) and Venkatesh et al. (2003) highlight that user acceptance of technology, as outlined in the Technology Acceptance Model (TAM), depends on perceived ease of use and usefulness, factors critical to hardware adoption in education. In Nigeria, policies like the National Information Technology Development Agency's (NITDA) Strategic Roadmap (2021) advocate for ICT integration, yet implementation lags due to funding and infrastructural constraints (Afolabi & Oyeyemi, 2023). This study explores how advanced computer hardware can enhance technical skills among undergraduates in Cross River State, examining access, perceptions, and barriers to adoption.

Global Perspectives on Hardware in Education

Globally, advanced hardware has revolutionized technical education. High-performance computers with powerful CPUs and GPUs allow students to run resource-intensive software, such as MATLAB for data analysis or SolidWorks for engineering design (Radianti et al., 2020). VR systems further enhance learning by providing immersive environments for simulations, with studies reporting a 20% improvement in technical proficiency among students using VR-based training (Merchant et al., 2014). In developed countries, universities leverage these tools to foster skills in artificial intelligence, machine learning, and robotics, aligning education with industry demands (Brynjolfsson & McAfee, 2014).

Challenges in Nigeria's Tertiary Education

In Nigeria, the adoption of advanced hardware faces significant obstacles. Afolabi and Oyeyemi (2023) note that only 20% of public universities have access to modern computer labs, with most relying on outdated systems incapable of running current software. In Cross River State, Ekpo and Udo (2021) found that 70% of university computer labs lack high-performance hardware, limiting students' exposure to practical training. Erratic power supply and high equipment costs further exacerbate the issue, particularly in rural institutions (NITDA, 2021).

Opportunities for Hardware Integration

Despite these challenges, opportunities exist to leverage advanced hardware. Mobile workstations and cloud-based computing can bypass infrastructural limitations, enabling students to access powerful systems remotely (Etim et al., 2016). Open-source hardware solutions, such as Raspberry Pi, offer cost-effective alternatives for teaching programming and electronics (Mordecai & Ojo, 2022). Moreover, partnerships with tech industries, as seen in Lagos State's collaboration with Microsoft, demonstrate the potential for scalable hardware upgrades (Okechukwu et al., 2019). These initiatives align with TAM's emphasis on perceived usefulness, as students and lecturers are more likely to adopt technologies that enhance learning outcomes.

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Theoretical Framework

This study is grounded in the Technology Acceptance Model (TAM), proposed by Davis (1989), which posits that technology adoption is influenced by two primary constructs: perceived usefulness (the belief that a technology enhances performance) and perceived ease of use (the degree to which a technology is perceived as effortless to use). TAM is relevant to this study as it provides a framework to understand undergraduates' and lecturers' acceptance of advanced computer hardware for technical skills development. The model suggests that access to high-quality hardware, coupled with training, can enhance perceived usefulness and ease of use, thereby increasing adoption rates and skill acquisition (Venkatesh et al., 2003). In the context of Cross River State, TAM helps explain how barriers like outdated hardware and limited training affect students' and lecturers' willingness to engage with advanced technologies, guiding recommendations for effective integration.

Methodology

Research Design

A descriptive survey design was employed to explore the role of advanced computer hardware in technical skills development. This design facilitated the collection of detailed data on access, perceptions, and barriers to hardware use.

Population and Sample

The population included undergraduates and lecturers from public universities in Cross River State. Using a multi-stage sampling technique, five universities were randomly selected from the eight public institutions in the state. From each university, 80 undergraduates (from computer science, engineering, and related disciplines) and 16 lecturers were purposively selected, resulting in a sample of 400 students and 80 lecturers. The demographic profile is presented in Table 1.

Table 1

Demographic Profile of Participants

Variable	Category	Frequency	Percentage (%)
Students			
Gender	Male	220	55.0
	Female	180	45.0
Age	18–21 years	250	62.5
	22–25 years	150	37.5
Institution Type	Urban	300	75.0
	Rural	100	25.0
Lecturers			
Gender	Male	50	62.5
	Female	30	37.5
Years of Experience	1–5 years	35	43.8
	6–10 years	30	37.5

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>10 years	15	18.8

Data Collection

Primary data were collected using a structured questionnaire, the “Technical Skills and Hardware Integration Questionnaire” (TSHIQ), adapted from Davis’s (1989) TAM framework and Okechukwu et al.’s (2019) technical skills assessment tool. The TSHIQ comprised three sections: (a) access to advanced computer hardware, (b) perceptions of hardware’s impact on technical skills, and (c) barriers to adoption. A 4-point Likert scale (1 = Strongly Disagree, 4 = Strongly Agree) was used. Reliability was established with a Cronbach’s Alpha of 0.85. Data collection occurred over six weeks in April–May 2025, with ethical approval from the Cross River State University Council.

Data Analysis

Quantitative data were analyzed using descriptive statistics (frequencies, percentages, means) and t-tests to compare urban and rural responses. Qualitative data from open-ended questions were thematically analyzed. SPSS version 25 was used for data processing.

Results

Access to Advanced Hardware

Only 30% of students reported regular access to advanced hardware (e.g., high-performance computers, GPUs), with rural institutions showing significantly lower access (15%) compared to urban ones (40%) ($t = 3.98$, $p < 0.05$). Among lecturers, 25% used advanced hardware in teaching, primarily in urban universities.

Table 2

Access to Advanced Computer Hardware

Hardware Type	Students (%)	Lecturers (%)
High-Performance PCs	30	25
GPUs	15	10
VR Systems	5	3
Internet Access	35	40

Perceptions of Hardware Impact

Eighty-two percent of students and 78% of lecturers agreed that advanced hardware enhances technical skills ($M = 3.52$, $SD = 0.58$). Students particularly valued GPUs for programming and VR for simulations, with 65% noting that such tools make learning “more practical and engaging.”

Barriers to Hardware Adoption

Major barriers included erratic power supply (88%), high equipment costs (70%), and lack of technical support (60%). Rural institutions reported higher barriers, with 90% citing power issues compared to 75% in urban settings ($t = 4.76$, $p < 0.01$).

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Table 3

Barriers to Hardware Adoption

Barrier	Students (%)	Lecturers (%)
Erratic Power Supply	88	85
High Equipment Costs	70	68
Lack of Technical Support	60	65
Inadequate Training	55	60

Qualitative Findings

Thematic analysis identified three themes: (1) enthusiasm for advanced hardware's practical applications, (2) frustration with infrastructural constraints, and (3) a call for training and technical support. Students expressed excitement about VR simulations, with one stating, "VR could make engineering design feel real!" Lecturers emphasized the need for maintenance expertise, noting, "We need technicians to keep these systems running."

Discussion

The findings highlight the critical role of advanced computer hardware in enhancing technical skills among undergraduates. The low access rate (30%) aligns with Ekpo and Udo's (2021) findings on infrastructural deficits in Cross River State. The significant urban-rural disparity ($t = 3.98$, $p < 0.05$) underscores the digital divide, consistent with Afolabi and Oyeyemi (2023). High enthusiasm for hardware, as predicted by TAM, suggests that perceived usefulness drives adoption, but barriers like power supply and costs hinder progress (Davis, 1989).

The study's implications align with global trends, where advanced hardware has improved technical proficiency (Radianti et al., 2020). In Nigeria, addressing these barriers requires aligning educational practices with NITDA's (2021) roadmap. The qualitative findings emphasize training and support, echoing Venkatesh et al.'s (2003) assertion that ease of use is critical for technology acceptance.

Conclusion

Advanced computer hardware holds immense potential to enhance technical skills development among undergraduates in Cross River State. Despite high enthusiasm, systemic barriers—erratic power, high costs, and inadequate support limit adoption. By addressing these challenges through targeted interventions, universities can equip students with industry-relevant skills, aligning with global technological demands. This study, grounded in TAM, provides a roadmap for stakeholders to foster a technically proficient workforce.

Recommendations

- Hardware Upgrades: The government should invest in high-performance computers and GPUs for university labs, prioritizing rural institutions.

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- Power Infrastructure: Implement solar-powered systems to address erratic power supply.
- Training Programs: Develop workshops to train lecturers and students on advanced hardware use.
- Industry Partnerships: Collaborate with tech firms to provide affordable hardware and technical support.
- Policy Implementation: Strengthen NITDA's roadmap through funding and monitoring mechanisms.

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