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EDITORIAL COMMENTS

The *East African Journal of Educational Research and Policy (EAJERP)* Vol. 19 comprises sixteen scholarly contributions that interrogate the changing landscape of education, workforce development, technological advancement, and sustainability in Africa within the context of the Fourth Industrial Revolution (4IR). The collection of articles reflects the journal's commitment to promoting evidence-based research that addresses contemporary educational and developmental challenges and offers practical solutions for policymakers, educational leaders, and practitioners.

A major theme that cuts across this volume is the urgent need for re-skilling and capacity building in educational institutions and workplaces. The articles on Institutional Strategies for Re-skilling Administrative Personnel towards Effective Service Delivery in the Fourth Industrial Revolution Era*,* The Role of Public-Private Partnerships in Re-skilling the Workforce for Industry*, and* Re-skilling Human Resources for Contribution to the Fourth Industrial Revolution in Nigerian Universitie*s* collectively emphasize that the future of African education and industry depends significantly on the continuous acquisition of new competencies. These studies demonstrate that traditional skills are increasingly becoming inadequate in a digital and knowledge-driven economy and advocate collaborative efforts among governments, industries, and educational institutions to bridge existing skill gaps.

Similarly, the papers on Nigerian University Education and Fourth Industrial Revolution: Prospects and Challenges, Higher Education, Employability and the Fourth Industrial Revolution in a Globalised World: The African Experience*,* and Developing Employability Skills for the Fourth Industrial Revolution through Technical Vocational Education Training in Selected Technical Colleges in Ogun State highlight the growing demand for graduates who possess digital, entrepreneurial, and problem-solving competencies. These studies provide valuable insights into how higher education institutions can reposition their curricula and pedagogical approaches to prepare learners for emerging labour market realities.

Another significant contribution of this issue is its emphasis on digital transformation and technological innovation in education. The articles titled Influence of Digital Transformation on Teaching

Effectiveness and Management of University Education in South-West, Nigeria*,* Multimedia-Enhanced Blended Learning Strategy and the Moderating Effect of Digital Self-Efficacy on Economics Students' Cognitive Engagement*,* Undergraduate Perceptions of Digital Literacy Skills and Graduate Employability*,* Influence of Digital Innovations on Lecturer Effectiveness in Colleges of Education in Southwestern Nigeria*, and* From Typewriter to AI: A Century of Technological Shifts in Nigerian University Education collectively document the transformative power of digital technologies in teaching, learning, and educational administration. The studies underscore the importance of digital literacy, self-efficacy, and technology integration in enhancing educational outcomes and institutional efficiency. Particularly noteworthy is the historical perspective on technological evolution in Nigerian universities, which demonstrates how educational systems have transitioned from analogue practices to artificial intelligence-driven innovations.

The issue also pays considerable attention to leadership, governance, and sustainability. The studies on Relationship between Leadership Styles of Catholic Female Religious and Administrative Effectiveness of Secondary Schools in South-West, Nigeria and Environmental Sustainability and University Governance in Nigeria: Implications for Educational Effectiveness and Institutional Development offer important insights into leadership practices and institutional governance mechanisms that can promote organizational effectiveness and sustainable development. Equally significant is the article on Green Awareness and Green Practices by Library Personnel in Public Universities in Southwestern Nigeria, which contributes to the growing discourse on environmental sustainability and the role of educational institutions in promoting environmentally responsible behaviours.

Furthermore, the interdisciplinary nature of this issue is enriched by contributions that extend beyond traditional educational concerns. *The article on* Integrating Social Media, French Club Activities and Cultural Immersion as Determinants of French Language Proficiency among University of Ibadan Students in the 4IR demonstrates the relevance of innovative learning approaches and digital tools in language education. Likewise, The Impact of Public Debt on Industrialization in West African Countries broadens the scope of the volume by examining macroeconomic issues that have significant implications for educational financing,

employment generation, and sustainable development across the region.

Collectively, the sixteen articles in this issue offer a compelling narrative on the future of education and workforce development in Africa. They reinforce the idea that educational institutions must embrace innovation, strengthen partnerships, invest in human capital development, and adopt sustainable practices if they are to remain relevant in the rapidly evolving global environment. The studies also provide practical recommendations that can inform policy formulation and institutional reforms aimed at improving educational quality, employability, and socio-economic development.

It is our expectation that the insights presented in this volume will stimulate further research, inspire innovative educational practices, and contribute meaningfully to policy discussions on the future of education, technology, sustainability, and human capital development in Africa and beyond.

Editors
East African Journal of Educational Research and Policy (EAJERP)

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INSTITUTIONAL STRATEGIES FOR RE-SKILLING ADMINISTRATIVE PERSONNEL TOWARDS EFFECTIVE SERVICE DELIVERY IN THE FOURTH INDUSTRIAL REVOLUTION ERA

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Abstract
The Fourth Industrial Revolution (4IR) has redefined administrative functions in higher education institutions, demanding a workforce proficient in digital systems, data management, and technology-driven service delivery. This study examined institutional strategies for re-skilling administrative personnel towards effective service delivery in the 4IR era. Re-skilling in higher education entails equipping administrative staff with competencies in e-governance, data analytics, cybersecurity, and automation to enhance institutional performance and responsiveness. The paper identified that digital transformation has shifted administrative work from routine clerical duties to knowledge-intensive tasks requiring analytical and technological expertise. Effective institutional strategies include: formal digital literacy programmes, continuous professional development (CPD) integrated into human resource policy, partnerships with digital training providers, and incentive systems that reward technological proficiency. The benefits of re-

skilling are reflected in improved operational efficiency, data-driven decision-making, enhanced innovation, and higher staff motivation. However, challenges such as limited funding, weak ICT infrastructure, inconsistent CPD implementation, and resistance to change impede progress. The study concluded that re-skilling administrative personnel is a strategic necessity for achieving effective and sustainable service delivery in the digital era. It recommended that institutions institutionalize CPD, provide dedicated funding for ICT infrastructure, strengthen leadership commitment, and establish industry partnerships to ensure continuous learning and adaptability. These measures will enhance institutional competitiveness, accountability, and service quality in a rapidly evolving educational landscape.

Keywords: Institutional strategies, Re-skilling, Administrative personnel, Effective service delivery, Fourth industrial revolution era

Introduction

The Fourth Industrial Revolution (4IR) has ushered in a new era of digital transformation that continues to redefine every aspect of human activity, including higher education administration. The Fourth Industrial Revolution (4IR) represents a technological paradigm shift characterized by the convergence of artificial intelligence (AI), robotics, big data analytics, cloud computing, and the Internet of Things (IoT). Unlike earlier revolutions that primarily mechanized or digitized production, the 4IR integrates physical, digital, and biological systems to redefine how work is organized and executed across all sectors, including education. According to UNESCO (2023), the 4IR has accelerated the digital transformation of higher education, prompting universities to adopt smart technologies for teaching, research, and administration. As these technologies evolve, administrative processes such as admissions, human resource management, finance, record keeping, and communication are increasingly mediated by digital platforms, cloud-based systems, and automated decision-support tools.

Essential of administrative personnel in Nigerian higher institutions seem crucial for the efficient management of resources, the promotion of a positive learning environment, and the overall success of the institution. Key personnel are responsible for a wide range of functions, including managing human and financial

resources, ensuring regulatory compliance, planning and executing programmes and providing support for both students and faculty. As their roles become significant to effective

In this context, universities are increasingly compelled to redefine the competencies required of their administrative workforce to align with the rapid digital transformation brought about by the Fourth Industrial Revolution (4IR). The emergence of e-governance, online service delivery systems, and data-driven institutional management has fundamentally altered the expectations placed on administrative personnel. Staff are now required to possess advanced digital skills, including proficiency in managing cloud-based platforms, utilizing Enterprise Resource Planning (ERP) systems, safeguarding digital records, and interpreting analytics for evidence-based decision-making. This transition moves administrative work beyond routine clerical functions to knowledge-based, technology-mediated roles that demand adaptability, innovation, and digital literacy.

According to the World Bank (2021), the success of digital transformation in higher education depends heavily on a parallel investment in workforce re-skilling and continuous professional development. Without such investment, universities risk entrenching digital inequities within their organizational structures. Institutions that neglect to re-skill their administrative staff are likely to experience declining efficiency, reduced responsiveness to stakeholders, and weakened accountability frameworks. Outdated administrative practices such as paper-based workflows, manual record-keeping, and fragmented communication systems cannot sustain the speed, accuracy, and transparency required in a 4IR-driven educational ecosystem. Thus, building digital capacity among administrative personnel is not merely an operational adjustment but a strategic necessity for ensuring institutional sustainability, competitiveness, and service excellence in the evolving higher education landscape (Adebayo & Oladipo, 2021; World Bank, 2021; UNESCO, 2023).

Furthermore, Barrett (2024) note that the integration of automation and artificial intelligence in university administration is transforming roles from purely clerical to analytical and strategic. Administrative personnel are now expected to interpret data, manage digital workflows, and provide evidence-based insights that support institutional planning. Similarly, Li (2022) argues that re-skilling is not only about technical training but also about

fostering a culture of digital adaptability and lifelong learning among university staff. This broader orientation enables higher education institutions to remain competitive and responsive to global technological trends.

Therefore, the 4IR presents both a challenge and an opportunity for higher education. It challenges traditional administrative systems built around manual processes and hierarchical structures, while simultaneously offering opportunities for innovation, transparency, and improved service delivery. To harness these opportunities, universities must develop institutional strategies for re-skilling administrative personnel, ensuring they possess the digital competencies necessary to thrive in the evolving educational landscape. As World Bank (2021) consistently stress, sustainable digital transformation depends not only on technology acquisition but also on human capacity development making re-skilling the cornerstone of effective institutional adaptation in the 4IR. Unlike the previous industrial revolutions, the 4IR is driven by advanced technologies such as artificial intelligence (AI), robotics, the Internet of Things (IoT), big data analytics, and automation, which have altered the skills and competencies required for effective institutional operations.

Administrative tasks that require the use of management information systems (MIS), enterprise resource planning (ERP), and online documentation often take longer to complete due to staff's limited ability to navigate digital tools (Oduwaiye et al., 2022). This inefficiency leads to delays in student processing, payroll management, and correspondence handling. Consequently, institutional workflows become slow, error-prone, and dependent on manual processes. In recent time the context of the digital transformation of higher education, the lack of digital proficiency among administrative personnel presents a major constraint to institutional efficiency, accountability, and service quality. As universities adopt digital platforms for record management, communication, and data-driven decision-making, administrators who lack essential technological skills often face several observable challenges that affect overall performance and organizational outcomes. In some times, administrators do struggle to maintain accurate databases, retrieve records promptly, or ensure data security which often results in data duplication, information loss, and breaches of confidentiality. Furthermore, limited knowledge of cloud storage, cybersecurity, and backup

systems exposes institutional records to risks of loss and manipulation. In this context, administrative personnel once valued primarily for routine clerical duties are now expected to manage digital platforms, interpret data, and engage in technologically mediated service delivery processes.

Re-skilling has therefore become a strategic necessity rather than a discretionary option. Institutions that fail to prepare their administrative workforce for the realities of digital change risk inefficiency, redundancy, and reduced service quality. The need to re-skill administrative staff stems from the growing complexity of tasks in higher education, ranging from digital communication, online record management, and automated admissions to financial data processing and e-learning support. Consequently, this research takes the position that re-skilling administrative personnel is central to achieving effective service delivery in the 4IR era.

The Fourth Industrial Revolution and the Changing Demands of Higher Education Administration

The Fourth Industrial Revolution has introduced unprecedented shifts in higher education management. Administrative tasks once performed manually are now executed using digital technologies, requiring new technical and analytical skills. The rise of e-governance systems, virtual documentation, and data analytics means that administrative personnel must possess a deep understanding of digital systems to function effectively.

Moreover, the 4IR has blurred the boundaries between administrative and technological functions. For instance, university registries and bursaries now depend on cloud-based management systems, while communication with students and faculty is facilitated through AI-driven chat systems and automated platforms. These transformations demand a workforce that is not only literate in ICT but capable of adapting to new systems as technology evolves.

Therefore, higher education institutions must rethink of administrative work in the digital era. The emphasis must shift from routine operations to knowledge-driven and innovation-oriented practices. Administrative personnel must now function as facilitators of institutional efficiency and data-driven decision-making, contributing meaningfully to the overall quality of service delivery.

Table 1: Fourth Industrial Revolution (4IR) Technologies and Their Usefulness for Institutional Administrators

4IR Technology	Description	Usefulness for Administrators in Educational Institutions
Artificial Intelligence (AI)	Simulation of human intelligence through systems capable of reasoning, learning, and decision-making.	- Enables automation of repetitive tasks such as admissions, student record management, and report generation. - Supports predictive analytics for enrolment trends and resource allocation. - Enhances efficiency in administrative decision-making and student support services.
Big Data Analytics	The use of large-scale data sets and statistical tools to extract meaningful insights for decision-making.	- Helps administrators analyze institutional data for policy planning and quality assurance. - Supports evidence-based budgeting, staffing, and performance evaluation. - Promotes transparency and accountability through data-driven governance.
Automation and Robotics	Use of software robots or physical machines to perform repetitive or manual administrative tasks.	- Reduces paperwork and human error in record management and payroll processing. - Frees administrators' time for strategic and student-focused activities. - Improves workflow efficiency and turnaround time for services.
Cloud Computing	Internet-based computing services that enable storage, management, and access to data and applications remotely.	- Facilitates seamless document sharing and collaboration across departments. - Ensures data security, backup, and accessibility anytime and anywhere. - Reduces cost of maintaining physical servers and enhances remote work efficiency.
Internet of Things (IoT)	Network of interconnected devices that collect and share data in real-time.	- Enables smart campus systems for facilities management (lighting, security, attendance tracking). - Enhances monitoring of institutional resources and utilities. - Improves safety and environmental sustainability on campus.

Blockchain Technology	A decentralized digital ledger that records transactions securely and transparently.	- Ensures tamper-proof record keeping for student credentials and certifications. - Reduces fraud and improves trust in administrative data handling. - Facilitates secure document verification for admissions and staff records.

Source: Researcher's conceptualization

Institutional Strategies for Re-Skilling Administrative Personnel

In the era of the Fourth Industrial Revolution (4IR), administrative personnel in higher education institutions face increasing pressure to adapt to technological changes, data-driven systems, and evolving service expectations. Re-skilling, that is, the process of updating or acquiring new competencies to meet changing job demands has become a strategic priority for universities aiming to remain competitive and operationally efficient (UNESCO, 2023; World Bank, 2021). Effective institutional strategies for re-skilling administrative staff could involve a deliberate blend of policy reform, digital transformation, human capital investment, and organizational learning initiatives as address below;

1. Institutional Policy Frameworks for Continuous Learning: One of the foundational strategies for re-skilling administrative personnel is the establishment of robust institutional policy frameworks that prioritize continuous learning. Universities must integrate lifelong learning policies into their human resource management systems, ensuring that staff development is tied to institutional performance indicators (Akinola and Olayinka, 2022). Policies should mandate regular training audits, skill gap analyses, and development plans that align individual competencies with evolving job roles (Okafor, 2023).

Moreover, continuous professional development (CPD) should be institutionalized through partnerships with professional bodies, digital learning platforms, and accreditation agencies. This ensures administrative personnel are equipped with current knowledge in areas such as digital record management, e-governance, cybersecurity, and cloud-based collaboration tools (Oduwaiye et al., 2022).

2. Digital Competency Development through Technology-Enabled Learning: A central strategy for re-skilling administrative

staff involves technology-enabled learning platforms that provide flexible, accessible, and scalable training options. Digital learning environments, including Massive Open Online Courses (MOOCs), webinars, and virtual simulations, have transformed how institutions can build capacity among non-academic personnel (Adebayo & Oladipo, 2021).

Administrative staff now need competencies in digital literacy, data analytics, cybersecurity awareness, and workflow automation using tools like Microsoft 365, Google Workspace, and institutional enterprise resource planning (ERP) systems (Olumide and Adetunji, 2023). Institutions can achieve this by adopting Learning Management Systems (LMS) that integrate digital badges, certification tracking, and self-paced modules tailored to specific administrative functions (Okon & Ekong, 2024).

3. Leadership-Driven Talent Development Initiatives: Effective re-skilling initiatives are leadership-driven. University management plays a critical role in fostering an organizational culture that values learning, experimentation, and innovation (Eze & Onuoha, 2021). Through visionary leadership, institutions can establish learning academies or staff development units dedicated to talent management and re-skilling.

Such leadership strategies should include mentoring and coaching programs that pair senior administrators with younger staff to facilitate knowledge transfer. As noted by Amah and Udeh (2023), leadership commitment to staff training not only increases administrative efficiency but also enhances institutional loyalty and morale. Leadership should also allocate adequate funding and incentives for training participation, ensuring equitable access across all departments.

4. Collaboration and Partnership for Capacity Building: Collaboration with external partners—including international development organizations, technology firms, and other universities—has emerged as a strategic approach to re-skilling administrative staff. Through strategic alliances, institutions can access specialized training resources, funding opportunities, and expertise that may not be available internally (World Bank, 2021; UNESCO, 2023).

For instance, partnerships with Microsoft Education, Google for Education, and Coursera for Campus enable

administrative workers to gain globally recognized certifications in data management, cybersecurity, and digital administration. Additionally, inter-university staff exchange programs foster peer learning and exposure to best practices in administrative modernization (Ogundele and Afolabi, 2024).

5. Data-Driven Performance Management Systems: Re-skilling strategies are most effective when tied to data-driven performance management systems. Institutions should use digital dashboards and analytics tools to track employee competencies, performance trends, and training impact (Ogunyemi, 2023). This approach allows for personalized re-skilling plans that address identified weaknesses and align with institutional strategic goals.

Data analytics can further inform decisions on promotions, redeployments, and role redesigns, ensuring staff remain agile and productive in evolving administrative contexts (Eze & Nwachukwu, 2022). Performance metrics should therefore include indicators of digital readiness, problem-solving capacity, and adaptability to technological change.

6. Embedding Soft Skills and Change Management Training: Beyond technical abilities, soft skills and change management training are crucial to successful re-skilling. Administrative staff require enhanced communication, critical thinking, teamwork, and adaptability skills to function effectively in dynamic digital workplaces (Ibrahim & Adewale, 2022). Institutions must therefore embed emotional intelligence, customer service orientation, and organizational change readiness in their re-skilling programmes

This approach helps mitigate resistance to new technologies and procedures, fostering a culture of openness and flexibility. As noted by Olanrewaju and Musa (2024), administrative modernization efforts often fail not due to technological barriers but because of inadequate human adaptability.

7. Incentive-Based and Career-Progressive Re-Skilling Programmes: A sustainable re-skilling strategy must include incentive-based participation mechanisms. Administrative personnel are more likely to engage in re-skilling if linked to tangible career progression opportunities such as promotions, certifications, or financial rewards (Okorie & Nwachukwu, 2023). Institutions can design competency-based promotion frameworks

where career advancement is contingent upon demonstrated mastery of new digital and managerial competencies.
Incentives could also include recognition awards, training allowances, or international exposure opportunities. Such systems reinforce a performance-based culture while motivating lifelong learning among staff (Eze & Onuoha, 2021).

8. Institutionalizing Knowledge Management Systems: Finally, universities can sustain re-skilling efforts by creating knowledge management systems (KMS) that facilitate knowledge sharing, documentation, and collaboration. Digital repositories, communities of practice, and online knowledge hubs can ensure that newly acquired skills are institutionalized rather than individualized (Okafor, 2023).

These systems enhance institutional memory, enable continuous improvement, and prevent redundancy in training. Knowledge-sharing sessions, staff retreats, and interdepartmental workshops further embed learning within the institution's culture (Adebayo & Oladipo, 2021).

Benefits of Re-Skilling Administrative Personnel for Service Delivery

Re-skilling administrative personnel offers profound benefits for institutional service delivery in the digital era. One major advantage is enhanced operational efficiency, as digitally competent staff can perform administrative tasks more quickly, accurately, and with minimal resource waste (Adebayo & Oladipo, 2021). Through the acquisition of digital literacy and process automation skills, administrative workflows such as student record management, financial reporting, and communication are streamlined, reducing bureaucratic delays and improving service responsiveness.

Re-skilled personnel are also empowered to utilize data analytics for evidence-based decision-making, which fosters transparency and accountability in institutional management (Eze & Nwachukwu, 2022). With improved data handling and interpretation capabilities, administrative staff can generate actionable insights that guide planning, budgeting, and performance monitoring.

Another significant benefit is increased innovation and adaptability. Staff with technological proficiency can propose creative solutions to institutional challenges, identify process

improvements, and swiftly adapt to emerging digital tools, system upgrades, or policy reforms (Olanrewaju & Musa, 2024). This agility enables institutions to remain competitive amid global changes in higher education operations.

Furthermore, re-skilling promotes collaborative learning and teamwork, as administrative personnel gain confidence to operate within interdisciplinary teams that integrate administrative, academic, and technical expertise (Ogundele & Afolabi, 2024). Such collaboration enhances cross-departmental communication and coordination, leading to holistic institutional effectiveness.

Equally important, re-skilling enhances employee motivation and job satisfaction, as personnel who acquire new competencies experience renewed confidence, relevance, and career growth within the organization (Okorie & Nwachukwu, 2023). This sense of professional empowerment fosters commitment, reduces turnover, and strengthens institutional stability.

Ultimately, these collective outcomes translate into higher service quality, improved communication flow, and enhanced institutional competitiveness in a globalized educational landscape (UNESCO, 2023; World Bank, 2021). Institutions that prioritize continuous re-skilling not only build a capable administrative workforce but also ensure sustainable service excellence and stakeholder satisfaction.

Challenges to Effective Re-skilling in Higher Education Institutions

Despite its benefits, implementing re-skilling initiatives in higher education is fraught with challenges. A major barrier could be inadequate funding, which may limit institutions' ability to organize regular training programmes and procure modern ICT tools. Insufficient infrastructure, such as outdated computer systems or unreliable internet connectivity, further hinders digital learning.

Additionally, resistance to change remains may be a significant issue. Many administrative personnel are accustomed to traditional office routines and may view re-skilling as unnecessary or intimidating. Institutional policy gaps and the absence of structured re-skilling frameworks could also contribute to inconsistency in implementation across departments.

Moreover, the lack of strategic leadership and weak collaboration with industry experts prevent universities from

aligning training programs with current technological realities. Addressing these challenges requires policy reform, increased investment in human capital development, and a cultural shift towards embracing innovation and continuous learning.

Policy and Institutional Implications

The findings and arguments of this paper underscored the urgent need for national and institutional re-skilling policies in higher education. Governments should create enabling policies that promote digital transformation and allocate funding for continuous workforce development. Institutions, on their part, must integrate re-skilling into their human resource management frameworks, making it a mandatory aspect of staff evaluation and promotion.

University leaders must also develop institutional blueprints for digital transformation, which clearly outline training needs, performance metrics, and sustainability plans. There is also a need to strengthen partnerships between higher education institutions and technology providers to enhance knowledge transfer and access to cutting-edge training resources.

In the long term, these policies and institutional reforms will contribute to a more agile, competent, and innovative administrative workforce capable of sustaining effective service delivery in the 4IR era.

Conclusion

In conclusion, based on the assumptions and submissions from different scholars the study concluded that re-skilling administrative personnel is a strategic necessary for higher education institutions seeking to achieve effective service delivery in the Fourth Industrial Revolution era. The 4IR has redefined administrative roles, demanding a shift from manual, routine processes to technology-driven, analytical, and knowledge-based operations. Re-skilling provides the pathway through which administrative staff can acquire the digital competencies required to navigate emerging technologies and contribute meaningfully to institutional goals. However, achieving this requires deliberate institutional strategies such as digital training programmes continuous professional development, and leadership commitment to overcome challenges of funding, resistance, and policy gaps.

Recommendations

i. Higher education institutions should embed re-skilling programmes into their HRD policies.
This ensures continuous staff learning and adaptability to digital transformation.
A structured policy will align workforce competencies with institutional goals.
It promotes sustainability and responsiveness in administrative operations.

ii. Institutions should organize periodic ICT-based training to enhance staff digital skills.
Training should cover data management, e-administration, and cybersecurity awareness.
Regular development opportunities help staff remain competent and innovative.
They also build confidence and efficiency in handling technological tasks.

iii. Universities should collaborate with technological firms and training organizations.
Such partnerships provide access to specialized expertise and certification programmes
Collaboration strengthens institutional capacity for global digital practices.
It also ensures staff training aligns with evolving industry standards.

iv. University leaders should champion innovation and support technology adoption.
They must model digital competence and encourage creative administrative practices.
Adequate funding should be allocated to sustain re-skilling and ICT infrastructure.
Strong leadership commitment ensures successful digital transformation and service excellence

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THE ROLE OF PUBLIC-PRIVATE PARTNERSHIPS IN RE-SKILLING THE WORKFORCE FOR INDUSTRY

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Abstract
The rapid transformation of the global labour market, driven by digitalization, artificial intelligence (AI), and automation, has intensified the need for workforce reskilling. Reports by the World Economic Forum highlight significant disruption in skill requirements, contributing to persistent skill mismatches that hinder productivity and growth. This paper examines Public-Private Partnerships (PPPs) as a strategic approach to addressing these challenges through collaboration between governments, educational institutions, and industry. The study explores key drivers of skill change and analyses PPP models such as apprenticeships, micro-credentials, and digital learning partnerships. Evidence from global case studies underscores critical success factors, including industry alignment, strong governance, flexibility, and inclusivity. Despite challenges related to scalability, funding, and quality assurance, the paper concludes that well-designed PPPs can enhance workforce readiness, improve employability, and support inclusive and sustainable economic development, particularly in developing economies.

Key Words: Re-skilling, Public Private Partnerships, Upskilling, Workforce

Introduction

In recent years, the dynamics of the global labour market have undergone profound transformations, driven largely by digitalization, artificial intelligence (AI), automation, and other emerging technologies. A report by the World Economic Forum anticipates that by 2025, 50% of all employees will require reskilling due to technological advancements. While the 2020 report projected these figures for 2025, subsequent reports (such as the *Future of Jobs Report 2025* published in early 2025) continue to track high levels of skill disruption, often highlighting that over 40% of worker core skills are expected to change due to AI and technological advancements(World Economic Forum, 2025).These shifts impose urgent pressure on both workers and institutions to adapt, leading governments and industries to seek collaborative models that can respond effectively and at scale.

Skill mismatch—where the qualifications and competencies workers possess do not align with what employers require—has emerged as a persistent obstacle to economic growth and productivity. The events and logistics sectors are undergoing a major shift that is driven by digitalization, globalization, and shifting consumer behavior. The events industry, long valued for its multiplier effects across tourism, hospitality, and creative sectors, is increasingly professionalized. According to Allied Market Research (2024), the global events industry is projected to grow at a compound annual growth rate (CAGR) of 6.4%, reflecting rising global demand for specialized roles such as event coordinators, audiovisual (AV) technicians, digital marketers, crowd safety managers, and sustainability officers. Despite this, the sector faces significant seasonal volatility including informal employment, and skill mismatches particularly in the growing markets (Brunello & Wruuck, 2021).

Public-private partnerships (PPPs) are increasingly highlighted as a strategic vehicle to bridge this gap. Van Ham and Koppenjan (2001), cited in Khanom (2010) with the lens of organisational relationships, identify PPP as ‘cooperation of some sort of durability between public and private actors in which they jointly develop products and services, and share risks, costs, and resources which are connected with these products’. These arrangements—characterized by shared design, funding, implementation, and oversight between public entities (governments, public education/training institutions) and private

actors (businesses, industry associations, or private training providers)—offer the potential to combine the scale and regulatory legitimacy of the public sector with the innovation, technological capability, and market insights of the private sector. The rationale is that neither sector can efficiently nor sufficiently address reskilling demands alone at the pace or scope required.

In Nigeria, for example, recent government-private institution collaborations have been formalized to boost the healthcare workforce via signing of MoUs between the National Hospital, Abuja and private training institutions. It was emphasized expansion of capacity to address both quantity and quality gaps in skill supply. Such initiatives reflect broader national priorities to not only produce more trained professionals but to ensure that those professionals are equipped with the competencies demanded by modern healthcare delivery settings (FGN, 2025).

At the same time, global initiatives are reinforcing the importance of PPPs in reskilling efforts, particularly in sectors facing rapid technological disruption. In Indonesia, for instance, the International Labour Organization (ILO), in collaboration with industry partners, has implemented training programmes in the electronics industry under the Skills Development and Responsible Business Conduct project, aiming to align workforce skills with injury prevention, safety, and responsible business standards. (International Labour Organization, 2025) These examples illustrate how PPPs can be designed not just to teach technical skills but also softer, contextual, and sector-specific competencies that are increasingly critical.

Alongside these developments, academic research has highlighted what kinds of training and institutional conditions are most effective in building a future-ready workforce. A 2023 study on reskilling and upskilling for Industry 5.0 identified organizational culture, commitment, job design, and reward management as among the strongest predictors of successful professional development programs Leon (2023). Moreover, complementarity between human skills and AI-augmented tasks is becoming more recognized: research indicates that demand is rising most for skills that complement AI (digital literacy, adaptability, teamwork), rather than those purely replaced by automation.

Despite this momentum, there remain significant challenges: scalability, sustainability, equity, infrastructure, recognition of credentials, and alignment between academic or

public training institutions with private sector expectations. Investments in PPP structures must therefore be smartly designed, with strong governance, monitoring, and feedback loops to ensure effectiveness and to avoid duplication or inefficiency. The urgency of these challenges is magnified in regions with limited resources or where informal employment is large.

Thus, this paper examines the role of Public-Private Partnerships in re-skilling the workforce for industry: what are the models and mechanisms being used; what evidence exists of their effectiveness; what enabling conditions are required; and what lessons can be drawn for policy and practice. Understanding these issues is increasingly vital for countries seeking to navigate the future of work, maintain competitiveness, and ensure that workers are not left behind as industries transform.

Drivers of Skill Change in Industry

Several recent trends make re-skilling urgent:

Technological disruption: The advancement of disruptive technology accelerates the reskilling requirements. Disruptive technologies are opening up new possibilities for society, providing innovative technology applications, novel materials, and processes to create products and services that until recently were unimaginable. Regions in industrial transition are facing challenges in today's fast-moving environment of technological disruption, digitisation, automation and decarbonisation (OECD, 2019). As a result, those working in the manufacturing and service sectors will need new skills.

Labour market dynamics: Shifts in demand for certain occupations; decline of some routine/manual jobs; growth in digital, green, and service-oriented roles. Rapidly evolving technologies mean that labour markets in European and OECD regions will inevitably undergo major transformations in the coming years and decades. Firms and regions that do not keep up 24 | with the pace of innovation risk falling behind (OECD/ILO, 2017b). Understanding these changes through the lenses of digital capital, skill polarization, and labor market segmentation is imperative to foster equitable economic development (Li et al., 2025).

Global competition and innovation: Countries and firms are pushing to increase productivity, reduce cost, and innovate. Digital transformation has launched a global competitiveness pace which has initiated an instructional paradigm shift for learning and teaching. The US National Education Association (NEA), a founding member of the Partnership for the twenty-first century, is a viable advocator who encourages schools, districts, and states to infuse technology into education and provide tools and resources to facilitate that effort (Li, 2020). That requires not just classical technical skills but also digital literacy, soft skills, adaptability, lifelong learning.

Social imperatives: Inequality, youth unemployment, displacement from industries due to automation, or climate policies; governments require inclusive strategies to ensure workforce transitions.

Policy pressure and regulation: Governments increasingly integrate skills/training as part of industrial strategies, digital transformation policies, climate commitments etc.
These drivers imply that re-skilling must be faster, more flexible, more aligned with evolving demands, and more inclusive.

Re-skilling: Definitions and Scope
Re-skilling refers to training people in new skills so they can move into different types of work, especially when their existing jobs are being transformed or displaced. In another way round, reskilling means employees need the knowledge and skills to take on different or entirely new roles. For example, the switchboard operator position disappeared after the cell phone became a primary communication device (Li, 2020). Upskilling refers to upgrading the skills of people within their current roles or occupations. Upskilling means that employees gain new skills to help in their current job responsibility. For example, an accountant, who used to use an abacus for accounting and computing, learns digital spreadsheets to balance the company's balance sheet (Li, 2020). The Scope of Re-skilling includes: Technical / hard skills (digital, AI, automation, green technologies, industry-specific technical skills), Soft skills (communication, adaptability, problem-solving, teamwork), Certification / credentialing, Modes of

delivery: vocational training, apprenticeships, online/blended learning, micro-credentials etc.

Rationale of Public-Private Partnership

Public Private Partnerships in the re-skilling context are formal collaborations between public actors (government, public training institutions), private sector (firms, industry associations), education providers, sometimes NGOs or international bodies, in which cost, governance, responsibility, and risk are shared in designing and delivering training/re-skilling. Among the PPPs rationale: Private sector has direct knowledge of what skills are needed; can inform curricula and provide practical training, placements, public sector has scale, equity mandate, ability to invest in infrastructure, subsidize cost, regulate, ensure standards., PPPs leverage strengths of both: speed, relevance, legitimacy, and with limited public budgets and growing demand, PPPs can mobilize private investment and reduce burden.

Models of PPPs in Re-skilling

Below are several models, with their features, pros and cons.

Model	**Description**	**Advantages**	**Potential Limitations / Trade-offs**
Industry-led apprenticeship / internship programmes	Firms collaborate with public training institutions to deliver apprenticeships, often jointly designing curricula, providing workplace exposure.	Strong alignment with industry needs; smoother transition to employment; practical experience; immediate relevance.	Requires substantial coordination; cost to firms in supervising / mentoring; regulatory and certification challenges; may be difficult to scale, especially in small firms.
Micro-credentials / short modular training	Short, modular courses leading to certificates, often in specific digital, technical, or green	Flexibility; fast turn-around; lower cost; good for mid-career	Issues around recognition, credibility; risk of fragmentation; may not always

Model	Description	Advantages	Potential Limitations / Trade-offs
	skills; sometimes online or blended.	transitions; can be more accessible.	cover foundational knowledge; learners may struggle without prerequisites.
Centers of Excellence / Shared Training Infrastructure	Public and private sectors co-invest in labs, specialized training facilities or centres, innovation hubs.	Access to up-to-date technology; ability to train on modern equipment; economies of scale; can become focal points.	High fixed cost; ongoing maintenance; risk of under-utilizatio n; needs strong governance; may favor regions with more resources.
Government incentive models	Subsidies, tax incentives, grants or matching funds to firms who engage in re-skilling; policy frameworks that mandate or encourage PPPs.	Motivates private sector participation; can scale; encourages sustainable investment; can ensure alignment with national priorities.	Risk of misuse; firms may do minimum to qualify; oversight, quality assurance needed; public funds may be stretched.
Curriculum co-development & certification alignment	Private sector and public/educational institutions work together to design curricula, assessment, ensure certifications/credentia ls meet industry standards.	Ensures relevance; improves employabilit y; reduces mismatch; helps certifications carry weight.	Process can be slow; institutional inertia; regulatory or accreditation bodies may resist change; balancing academic

Model	Description	Advantages	Potential Limitations / Trade-offs
			standards with industry urgency.
Digital / Online Partnerships	Leverage technology, online platforms, MOOCs, virtual labs; private platforms partner with government or public institutions.	Scalability; accessibility (especially in remote areas); potential cost efficiencies; flexible scheduling.	Digital divide (connectivity, devices); may lose hands-on experience; quality control; learner motivation and support can suffer.

Source: European Training Foundation (2020)

Success Factors for Effective PPPs

Drawing from recent initiatives and literature, several factors appear essential:

Alignment with industry demand

Alignment with industry demand is a critical principle in effective Public-Private Partnerships (PPPs) for reskilling, as it ensures that training programmes remain relevant to labour market needs. This alignment is achieved through continuous collaboration between training institutions and employers, enabling the identification of current and emerging skill requirements. According to the World Bank (2019), strong engagement with industry stakeholders helps reduce skill mismatches by ensuring that training content reflects real workplace demands and technological trends.

Frequent consultation with employers—through advisory boards, sector skills councils, and industry forums—facilitates the timely identification of specific competencies required in the workforce. The International Labour Organization (2021) emphasizes that employer participation in curriculum design and delivery enhances the responsiveness of training systems and improves graduates' employability. This approach is particularly important in rapidly evolving sectors such as artificial intelligence,

digital technologies, and green industries, where skill requirements change quickly.

Strong governance and clear partnership arrangements

Strong governance and clearly defined partnership arrangements are fundamental to the success of Public-Private Partnerships (PPPs), particularly in reskilling initiatives. Effective governance ensures that all stakeholders—government agencies, private sector actors, and educational institutions—operate within a structured framework that clarifies roles, responsibilities, and expectations. According to the World Bank (2017), clearly articulated contractual and institutional arrangements help minimize ambiguity, reduce conflicts, and enhance the efficiency of PPP implementation. These arrangements typically include explicit provisions for funding contributions, risk-sharing mechanisms, and performance obligations among partners.

Flexibility and adaptability

Flexibility and adaptability are essential features of effective reskilling systems, particularly within Public-Private Partnerships (PPPs), as they enable training programmes to respond quickly to evolving labour market demands. One key approach to achieving flexibility is the use of modular and stackable credentials, which allow learners to acquire skills in smaller units that can be accumulated over time into full qualifications. The Organisation for Economic Co-operation and Development (2021) highlights that modular learning pathways enhance accessibility and lifelong learning by enabling individuals to upskill or reskill without committing to long-term programmes. These credentials are especially valuable in fast-changing sectors such as digital technology and green industries.

Scalability & sustainability

Sustainable funding sources (not only donor/grants or short-term). Institutional capacity (trainers, infrastructure). Scaling successful pilots across geographies.

1. **Inclusivity and equity**: Ensuring access for women, rural populations, lower-income groups. Removing barriers (costs, time, transport, digital infrastructure). Language, cultural context, flexible schedules.

2. **Certification, credential recognition, pathways into employment**: Credible credentials recognized by industry and public sector. Link training to actual job opportunities (internships, placement). Recognition in hiring / promotions.
3. **Monitoring, evaluation and feedback loops**: Collect data on outcomes: employment, retention, wages, productivity. Feedback from learners and firms to refine programs. Use learning outcomes to adjust policy.
4. **Policy support and incentives:** Regulatory environment that supports innovative partnerships. Incentives for private firms to invest in re-skilling. National strategies that embed PPPs in workforce development.

Challenges, Risks, and Barriers of PPPs in Reskilling

While PPPs have potential, there are several challenges:

1. **Misalignment of objectives**: public institutions, private firms might have different priorities (profit vs equity vs regulatory compliance).
2. **Funding constraints**: ongoing operational costs, trainer costs, infrastructure upgrades may be under-funded.
3. **Regulatory and accreditation inertia**: curricula updates may be slow; private credentials may lack recognition.
4. **Skill forecasting difficulties**: predicting future demand is inherently uncertain. Mistakes can lead to wasted investment or training people for jobs that do not materialize.
5. **Digital infrastructure and access barriers**: In developing countries, many learners lack internet access or devices.
6. **Quality assurance**: Ensuring that training is high quality, not just signaling, but actual competence.
7. **Scaling up**: Many PPPs are pilot scale; scaling introduces complexity in management, consistency, cost.
8. **Equity issues**: Vulnerable groups may be excluded if programs are not designed with them in mind.
9. **Sustainability and institutional capacity**: sometimes PPPs are driven by short-term incentives or donor cycles; may collapse once funding ends or leadership changes.

Recent Case Studies

Here are several recent examples illustrating how PPPs are being used in re-skilling and what lessons can be drawn which can serve as guide to third world countries:

Considering the – Electronics Sector especially Cevest Bekasi & Matsushita Gobel Foundation + ILO in Indonesia

The Centre for Vocational and Extension Service Training (Cevest) Bekasi in Indonesia, under the Ministry of Manpower, entered into a collaborative agreement with industry (electronics firms) as partners and the Matsushita Gobel Foundation, with ILO support. The aim is of this collaborative agreement is to upskill/reskill workers and instructors in the electronics industry, aligning training with industry needs. The government raised the target of people in skilling/upskilling/reskilling from 250,000 to 1 million under this initiative. MoUs between public training institutions and private firms. Strengthening instructor training to match technology and delivery. Incorporating responsible business conduct and soft skills. Demonstrates the importance of public-private dialogue, setting ambitious targets, and focusing on both technical and interpersonal skills. Inclusion of workers (including women) and awareness of workplace rights also part of the programme. The third world countries can learn from these examples by adopting this kind of strategies employed by these industries and the Ministry. It will boost the third world countries through partnership agreement.

Another case study was the Karnataka, India State formulated Skill Development Policy 2025-32

The Karnataka government formulated and approved a new skill development policy for the period of 2025-2032. In the Policy, part of the funding to transform the skilled talent hub will come via public-private partnerships. The main Aims of this policy include transforming the state into a skilled talent hub and reaching a $1 trillion economy ambition. This will involve the use of digital technologies and AI tools for training, assessment, career guidance; integrating vocational education into academic institutions; expanding industrial training institutes. Special attention to marginalized groups including women, persons with disabilities, informal workforce. However, the third world countries can benefit from this ideal by adopting and formulating such policy

in such a way that it will suit their own economy. The case study will serve as an eye opener for these countries that there is need to engage private partners in funding skilling and reskilling.

Global AI Reskilling Initiatives

The Global AI reskilling initiatives is very germane which made the World Economic Forum (WEF) and other actors who emphasised that PPPs are central to closing the AI opportunity gap. It is worth note that Public and private sectors, educational institutions are collaborating on micro-credentials (Google, Microsoft, IBM), AI literacy, personalized learning. **Examples of these are** Coursera programs, Amazon's internal training (Upskilling 2025), etc. Thailand & Microsoft launching "THAI Academy" to train over 1 million people in AI by end of 2025. Backed by many public and private organizations. The involvement of public and private organizations Global AI reskilling initiatives are indispensable. In the light of this, the World Economic Forum (WEF) other actors in the field of AI need to be involved as well as collaboration with PPPs in the third world countries. This will enhance the AI reskilling initiatives.

Skills for Industry Competitiveness and Innovation Program in Bangladesh

The government of Bangladesh initiated a program tagged "Skills for Industry Competitiveness and Innovation". This "Skills for Industry Competitiveness and Innovation Program" in Bangladesh aims to enhance quality, relevance, and accessibility of skills training, especially for youth, women, disadvantaged groups. It also seeks to strengthen capacity of training institutions. This program is fully supported by multilateral finance (ADB etc.) PPPs initiative. This program recorded massive success as a results of this support. In the light of this, PPPs involvement in program like this can as well be enhanced in the third world countries if venturing into.

Policy Implications & Strategic Recommendations

Based on the above, here are advised policy recommendations:

1. **Develop National Frameworks that embed PPPs in Skill Strategy**: Governments should define national skill priorities (e.g., digital, AI, green) and make PPPs central in achieving them. Create regulatory frameworks that facilitate

PPPs: simplifying accreditation, enabling mixed funding, etc.

2. **Enable Flexible, Modular, Industry-aligned Training**: Encourage short courses, micro-credentials, blended delivery to respond rapidly to industry change. Support continuous updating of curricula to align with technological advancement.

3. **Ensure Funding Sustainability and Incentives**: Use incentives (tax breaks, grants, matching funds) to encourage firms to invest in workforce training. Ensure that public funding is predictable and long-term for institutional stability.

4. **Strengthen Institutional Capacities**: Train instructors, update training facilities, ensure technological infrastructure exists, especially in under-served areas.

5. **Promote Equity & Inclusive Access**: Design programs specifically targeting women, rural populations, informal workers, persons with disabilities. Remove barriers: cost, transport, access to digital tools, language etc.

6. **Enhance Credential Recognition and Job Pathways**: Ensure that credentials produced under PPPs are recognized by public sector, by employers. Build apprenticeship, internship, work placement into the re-skilling pipeline.
7. **Monitoring, Evaluation, and Feedback Mechanisms**: Collect data on outcomes: employment, wages, productivity, learner satisfaction. Use feedback loops to improve programs.

8. **Encourage Innovation and Use of Technology**: Use online platforms, AI-powered personalized learning, virtual labs where possible. But also address the digital divide.

9. **Facilitate Multi-stakeholder Collaboration**: Bring together governments, firms, education providers, NGOs,

community / learners. Shared governance structures to align objectives and maintain trust.

10. **Scaling & Replication**: Pilot successful PPPs, document lessons, then replicate in other sectors or geographies. Encourage cross-learning within and between countries.

Conclusion

The evolving nature of work (driven by automation, AI, globalization, and climate imperatives) makes re-skilling a priority. The study conclude that Public-private partnerships have emerged as a potent mechanism to bridge the gap between supply and demand for skills as well reskilling and upskilling in a Global world. The study also concluded that when it is well structured, PPPs can deliver industry-relevant training, enhance access, improve employment outcomes, and do so with more agility than public sector alone that is these are better done through collaboration. The third world countries should build enabling policy environments, ensure inclusivity, invest in infrastructure and partnerships, and develop robust evaluation systems. Through strategic PPPs, societies can better ensure that their workforce is prepared for the industries of tomorrow — increasing competitiveness, reducing inequality, and ensuring sustainable growth.

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NIGERIAN UNIVERSITY EDUCATION AND FOURTH INDUSTRIAL REVOLUTION: PROSPECTS AND CHALLENGES

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Abstract
The study examined Nigerian university education and fourth Industrial Revolutions(4IR): prospect and challenges. 4IR is the current trend of automation and data exchange in labour, education sector and other sectors of the nation. All universities in Nigeria are struggling to access technology as a measure to ascertain academic excellence through teaching and learning. 4IR builds on the digital revolution which is characterized by mobile internet, artificial intelligence, robotics, autonomous vehicles, 3D printing, nanotechnology, biotechnology, materials science, energy storage and quantum computing among others. It included traditional technologies used in classrooms which are radio, television, tape recorder, projectors and also the software used for teaching and learning, which included graphic calculators, dynamic graphing tools, dynamic geometry tools, Microsoft spread-sheet, auto shape, mat lab, power points among others. The study highlighted the challenges of 4IR in Nigerian universities which are: funding, inadequate capacity building, inconsistent power supply, brain drain, maintenance, lack of skilled personnel, luxurious internet connectivity, among others. The study recommended that education stakeholders should train staff, and equip Nigerian

universities with technological skills needed in the fourth industrial revolution era by synergizing labor market, education curriculum and equipment.

Keyword: Fourth industrial revolution, University, Education

Introduction

The Fourth Industrial Revolution (4IR) is a term used to describe the current trend of automation and data exchange in labour, education sector and other sectors of the nation. While the 4IR presents many opportunities for innovation and growth, it also raises concerns about job displacement and the need for workers to adapt to new technologies (Dunmade, Ajani, Yusuf & Ahmed, 2023). A study by the World Economic Forum (2018) highlighted the need for education systems to adapt to the changing nature of work and prepare students for new types of jobs that will emerge in the 4IR. Altbach and de Wit's (2019) study focused on the challenges and opportunities for higher education institutions in the 4IR. They highlighted the importance of universities taking a proactive role in preparing students for the changes that the 4IR will bring and forging new partnerships and collaborations with the industry. The impact of the 4IR on academics will be substantial, requiring them to acquire fresh skills, adjust to novel ways of working, and cooperate with the industry to tackle complicated issues and foster inventive solutions. Some developing countries, including Nigeria, lagged behind in terms of preparedness for the 4IR (Bogdanovich et al., 2021).

Over the past century, there have been numerous key technologies introduced into education. For the most part, each of these technologies has been expected to revolutionize teaching and learning. However, it is generally accepted that dramatic reorientations or changes in education have not happened. Yet, while use of technology over the last 100 years has not resulted in a revolution, several key improvements and advancements in educational access and equity have resulted.

The skills required for the 4IR are evolving rapidly, and there is a need for continuous upskilling and reskilling to stay relevant (Kwiek, 2021; Shaikh et al., 2021). The Fourth Industrial Revolution (4IR) builds on the digital revolution and is characterized by ubiquitous and mobile Internet, along with more powerful sensors, artificial intelligence, robotics, autonomous

vehicles, 3D printing, nanotechnology, biotechnology, materials science, energy storage and quantum computing among others. However, there are various types of technologies currently used in traditional classrooms, these are: radio, television, audio tape, video tape, slide projector, overhead projector are of passive learning when interaction of the learner is less (Gaslow, 1997; Siu, 1997).

Also, software used for teaching and learning: are graphic calculators, dynamic graphing tools, dynamic geometry tools, microsoft spread-sheet, microsoft mathematics, auto shape, mat lab, power points among others. Artificial intelligence, systems that mimic the human brain to perform such tasks as problem-solving and learning, has enabled advances in robotics and the development of autonomous robots and vehicles. Other emerging technologies include blockchains, digital ledgers that store transactions across many computers so that records cannot be changed retroactively; big data, data sets so large and complex that traditional data-processing software is inadequate to deal with them. There are two types of computer-generated interactive displays, which are virtual reality (VR) and Augmented reality (AR). The transfer of data from analogue to digital is viewed as a crucial driver of innovation in teaching and learning (Gillpatrick, 2020). All universities in Nigeria are struggling to access the technology as a measure to ascertain academic excellent through teaching and learning. Very few of Public higher institutions in the country are capable of meeting the technological needs of their staff and students. (Ajegbelen, 2016). However, university is the highest level of education where the high-level manpower, intellectual and future leaders are developed (Olawoyin & Ala, 2019).

The Nigerian Universities Commission (NUC) prescribed that there should be one computer for every f our students; one computer for every two lecturers below the Lecturer 1 rank; one personal computer for each senior lecturer; and one notebook per Professor (Agyeman, 2007). However, there are still universities with as low as 1:30 (computer to student ratio) according to the 2017 NUC statistical digest of the Nigerian university system (NUC, 2017). Similarly, the 2018 national information communication technology in education policy prescribed certain ways to alleviate the epileptic growth of ICT in Nigerian educations sector (Federal Ministry of Education, 2019). However, Oyetimi & Adewakun (2020) explained that despite the ambitious policies and strategic

plans that have been put in place for the specific objective of integrating technology into education in Nigeria, the sector, particularly at the university level still suffers huge setbacks.

The Prospect of Technological Revolution in Education

Technology used in education can be traced back to the development of very primitive instruments, such as paintings on cave walls unlike the present-day presentation-based technology in education with different forms, such as streaming audio and video or PowerPoint presentations, and is based on the premise that individuals may learn through aural and visual reception. However, a revolution is an enormous shift in the method by which things are done. The entire ecosystem is currently experiencing its fourth revolution after having seen three preceding ones. The 18th century saw the first industrial revolution (1IR) occurring. Mechanical manufacturing and steam pressure were introduced (Philbeck & Nicholas, 2019). These shifts brought new opportunities, tasks, and skills. Several countries could advance, expand reinforce, and expand their economies due to the 1IR. Organization improvement remained the primary emphasis of the 1IR. Around the world, the 1IR has been attributed to multiple factors, including urbanization, new skills, and enhanced living standards. The IIR introduced a concept for an innovative curriculum in the educational field that focused on offering an array of degree options as well as fresh initiatives in general education that provided full comprehension of emerging fields.

Emanating is the Second Industrial Revolution (2IR) which began in the early 19th century and was the continuation of the preceding era. Extensive technical infrastructure, including power and new internal combustion-based open conveyance systems, additionally standardization, technical intricacy, and industrial flawlessness, experienced a significant transformation during the revolution (Kayembe & Nel 2019). The most significant innovation was the discovery of electricity, which allowed various businesses to function and grow. Mineral exploration was also made possible by this technical breakthrough. The 2IR was distinguished by the number of machines, most of which were electrically powered. Innovative educational institutions are proliferating in the education sector due to the introduction of powerful new technology. The goal of this era was to make industrial classes possible and to give everyone access to education (Uleanya 2022).

The third industrial revolution (3IR) commenced in the mid-1950s, resulting in the emergence of computers, the Internet, and notable technological advancements in the realms of manufacturing, distribution, and energy sectors, as delineated by Roberts (2015). This epoch is distinguished by computerized and web-based interconnectivity. The proliferation of education has been markedly amplified owing to the globalized dissemination of academic research, propelled by online technology. The proliferation of innovative educational institutions and curricula has fundamentally reshaped the first two industrial revolutions, affording the opportunity for bolstering workforce capabilities and driving the substantial economic and manufacturing expansion characteristic of the 20th century. The third industrial revolution has decisively restructured education by effecting instant and cost-free access to information, consequently shifting emphasis towards active learning pedagogies, and advocating collaboration among diverse teams and peer learning environments (Mazur, 2019).

The 4th Industrial Revolution (4IR) is indeed a significant and evolving era marked by disruptive technologies and transformative trends that are reshaping our daily lives and work environments. According to Mian et al. (2020), the past industrial revolutions have been largely fueled by advancements in technology, driving rapid growth in both the public and private sectors. Therefore, it is imperative for academic institutions to be proactive in responding to these changes, as they play a critical role in equipping students with the skills and knowledge needed in these rapidly emerging areas.

National Policy on University Education (Federal Republic of Nigeria, 2008)

University education shall make optimum contribution to national development by:

a) Intensifying and diversifying its programmes for the development of high-level manpower within the context of the needs of the nation
b) Making professional course contents reflect our national requirements
c) Making all students part of a general programme of all round improvement in university education
d) Not less than 60% of places in the universities created shall be allocated to science and science-oriented courses in the

conventional universities and not less than 80 % in the university of technology

Benefits of Fourth Industrial Revolution to Nigerian University System

Learning from computers is not the same as learning with computers. When students learn from computers, they essentially function as "tutors". On the other hand, when learning with computers, they are used as tools that can be applied to a variety of objectives in the learning process (Cueva, 2020). Fourth industrial revolution is vital to learners in the following ways:

a) It increases more access to research resources. There are several learning and research materials
b) Easier access to useful learning materials. Most students who are computer literate have quick access to useful information that will improve learning through the internet.
c) It encourages individual learning. Students can learn from their own without the assistance of parents and teachers. Through the use of the internet facilities, learners can access useful information that will enhance personal learning.
d) Convenience and broader contribution. The introduction of virtual classes increases the opportunities of learners to participate in physical classes especially to non-traditional students.
e) Prepares learners for the future. It gives learners the opportunities of being computer literate and help in preparation of the continuous revolution in technology.
f) Encourages improved process of instruct learners. This is achieved through the use of videos, images and other graphs and text found in computer by the learners. This makes learning more interesting through the use of gadget.
g) It opens learners to learn as a team. The internet facilities such as virtual classes, video learning and others simplifies group learning, inspires discussion, besides it makes classes more engaging.

The opportunities presented by the fourth industrial revolution for Nigerian academics are increased productivity, access to new research tools and data, and more personalized learning experiences (Bogdanovich et al., 2021). However, the ease and

speed of obtaining information on the internet definitely helps the instructor by empowering them (Newhouse, 2002: Jyoti, 2014). Fourth industrial revolution benefits lecturers in the following ways:

i. lecturers are able to assist and direct learners in obtaining useful learning material.
ii. It encourages competence, confidence and passion of lecturers through several teaching procedures.
iii. It assists lecturers in better preparation, lesson plan and teaching aids.
iv. Through graphics, pictures and PPT teachers can present the material in more interesting and attractive ways.
v. Technology simplifies input of resources, skill and information.
vi. Learners learn by interactive technologies and instructors' helps them on their usefulness.
vii. It guarantees wider litheness for lecturers in multi-tasking at different times.
viii. It assists lecturers in knowledge expansion and demonstrates professional teaching skills through the use of modern technological devices.

Challenges of Fourth Industrial Revolution

The introduction of technology innovation to university education allows for holistic, systemic and interdisciplinary work, contextualized to the learning processes that occur, which allows for diversifying the particular scenarios and actors with real and innovative interventions. However, this industrial revolution in the fourth era is threatened by various factors which include

a) Funding

Universities in Nigeria are owned by the federal and state governments and private individuals. The Federal and State governments' universities rely predominantly on the governments for funding, while the private universities obtain their incomes from the fees they charge the students. Other sources of revenue are endowments, investment income, grant and gifts. Over the years, governments' subventions to universities have never been adequate but at the same time governments maintain the policy that universities should not charge fees it deemed adequate to complement the financial effort of the Government (Uwaifo, 2010). One of the main hurdles to the fourth industrial revolution effective

implementation in Nigerian education continues to be the lack of funding. Among other things, this has led to lowered financing for research and higher educational. Establishing priorities and allocating funding to invest in new technological advances present challenges for educational organizations. Significant funding is necessary for new technology to be implemented successfully in educational settings. The largest costs of training are related to hiring certified instructors and building technology infrastructure (Brown-Martin, 2017).

b) Lack of Technically Skilled Personnel

Some lecturers and students are not trained to make use of some technological equipment. No combination of connectivity, equipment and software will achieve anything if people are not trained to use them (Daniel, 2009). This affects fourth industrial revolution in our universities.

c) Inadequate Educational Standard on technology

Proficiencies such as information curation, comprehensive research, digital scanning, data preservation, cloud data management, collaborative practices, educational expertise, analytical thinking, and creativity are imperative as a nod to the fourth industrial revolution. These competencies unequivocally elevate the graduate's employability. However, the government's lack of investment has resulted in inadequate educational standards and training in technology (Atiku & Boateng, 2019). Students are now being produced who lack the abilities necessary for the modern labour market. The government's ability to deploy new technologies is crucial for the successful adoption of these conditions, as failure to do so will cause the country's economy to regress and fail to achieve 21st-century norms. Graduates will need to have the necessary abilities to work in the fourth industrial revolution.

d) Maintenance

Some universities are faced not only with challenges and provision of adequate technological facilities but also maintenance. Some of the public universities (federal and state) only have the items or equipment that were provided when the institutions were established. Olawoyin and Ala (2019) explained that Nigerian universities are in a state of despair, as some do not have the

technological equipment such as computers, digital technology, and internet for proper utilization, even the few available systems are being infected with a virus which make them unfit for the use.

e) Brain drain

Akintunde (1989) identified five different components of brain drain in university education, which are: experts in academics who moved to the industry where they get better pay for their services, lecturers and students who leave the country to acquire more knowledge and skill but later refused to return, lecturers who move from one country for better conditions of service, skill professionals who abandon the practice of education in favour of other more lucrative economic activities and political appointments which are not related to their training, skilled professionals, although in their field of training, who do not devote their full attention to their job because of their efforts to supplement their earnings through other unrelated economic activities. In the 1970, Nigerian universities were able to attract experts from other countries such as India because the economic conditions then were favourable. But with down turn of the economy and consequences of the ineffective efforts of the government to resuscitate it, this resulted in the return of the foreigners to their countries and exodus of their Nigerian counterparts from the shores of Nigeria in order to earn a better living (Uwaifo, 2010).

f) Inconsistent Power Supply

Nigerian government has since inception of independence suffered a continuous inconsistent power supply, which has affected all the sectors of the economy. This has enhanced unrealizable computerization and digitization to be effective in an environment of epileptic power supply. The issue of epileptic power supply has become a national calamity. Thus, it has to be given priority by any library aspiring to attain global visibility. Hence, all the universities in Nigeria only depend mostly on generator for its power supply, and most often, there is no light due to lack of diesel or generator breakdown which often hinders their usefulness.

g) Luxurious Internet connectivity

Substantial inefficiencies have occurred from a lack of internet connectivity for wireless radio frequencies in emerging economies due to concerns with control, ownership, and sovereignty over

resources. the burden of licensing, data subscription charges, and inappropriate use of digital resources, amongst other factors affect access to fast internet.

Recommendations

i. Curriculum should be developed to measure up to fourth industrial revolution abilities and literacy.
ii. Education stakeholders such as federal ministry of education, National universities commission among others should equip Nigerian Universities with technological skills needed in the fourth industrial revolution era by synergizing labour market, clarify this education curriculum and equipment.
iii. Government should make investments in university education and training of staff to prepare students for the digital age and new technologies.
iv. Education stakeholders should equip universities with adequate and functional technological facilities to enhance improvement in education to foster economic development.
v. The current monitoring and evaluation process of the policy implementation in Nigeria must be improved upon, as this would be the best way to monitor the usage of the funds assigned to technology intervention in the Nigerian universities.
vi. The government must do better in making the resources needed to procure, install and maintain technical infrastructures available.

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GREEN AWARENESS AND GREEN PRACTICES BY LIBRARY PERSONNEL IN PUBLIC UNIVERSITIES IN SOUTHWESTERN NIGERIA

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Abstract
Green practices in university libraries are essential as these libraries face severe threat as a result of the depletion of the ozone layer. However, green awareness is crucial to undertaking green practices by library personnel. This study investigated the influence of green awareness on green practices by library personnel in public universities in Southwestern Nigeria. It adopted a descriptive survey design of a correlational type, 244 library personnel were enumerated from 25 public universities. The questionnaire titled Green Awareness and Green Practices by Librarians in Universities Questionnaire" (0.82) was used for data collection. The data collected was analysed using descriptive and inferential statistics. Findings revealed that library personnel exhibit a moderate level of green practices with weighted mean 2.89, while sustainable design and green services ranking highest, green procurement remained critically low. Green awareness among respondents was high (3.04). The frequency of green practices was predominantly occasional (3.01). Pearson correlation analysis confirmed a significant positive relationship between green awareness and green practices ($r = 0.422$; $p < 0.05$). The study concludes that broadening green awareness is essential to improving and institutionalising green practices in Nigerian public university libraries.

Keywords: green awareness, green practices, library personnel, university libraries, Southwestern Nigeria, sustainability

Introduction

Universities are regarded as the apex of all educational institutions where knowledge creation and sharing for economic, technological and political advancement take place. University education is meant to train the manpower required to facilitate national development in all ramifications, as confirmed in the National Policy on Education of the Federal Republic of Nigeria (FRN, 2014). The role of the library is very central to the realisation of university education. University libraries are established to support the aims and objectives of universities, which are to impart knowledge through teaching, learning and research. University libraries acquire relevant information materials to meet the needs of their respective users, who are mainly students, lecturers and other staff members. The university library is a centre for learning and information dissemination, which makes information resources and services available to support academic activities within the university community.

University libraries play fundamental roles in achieving the mandates of university education by providing access to a vast collection of resources, fostering information literacy and supporting research and academic excellence (Association of College and Research Libraries, 2016). As hubs of knowledge, university libraries offer a conducive environment for learning, collaboration and innovation, thereby enhancing the overall academic experience (Lynch, 2003). By providing access to intellectual literature, databases and digital resources, public university libraries enable students and faculty to stay abreast of the latest developments in their fields, facilitating cutting-edge research and informed teaching. University libraries also support the development of critical thinking, problem-solving and information literacy skills, which are essential for academic success and lifelong learning (American Library Association, 2000). By fulfilling these roles, university libraries contribute significantly to the achievement of university education mandates, the advancement of knowledge, the development of critical thinkers and the preparation of students for success in an increasingly complex and interconnected world. Thus, the preservation and

protection of the environment is viewed as one of the concerns of university libraries.

In recent times, the preservation and protection of the environment has become one of the central concerns of the Sustainable Development Goals (SDGs). The need for preservation of the environment is crucial due to the negative impacts of human activities, which are detrimental to human survival. Yasir, *et al.,* (2020) affirmed that the negative impact of human activities has become a matter of great concern, as these threaten human survival directly or indirectly if not resolved carefully. The increased cases of environmental damage caused by human activities have raised global and public concern, and have also prompted many countries to encourage business owners to urgently adopt eco-friendly practices and orient their employees on sustainable practices (Umrani, Channa, Yousaf, Ahmed, Pahi, & Ramayah, 2020; Awujoola and Babatunde, 2025). These and many other environmental concerns have underscored the need for environmental protection in university libraries.

Mwanzu, Nguyu, Nato and Mwangi (2023) observed that, in an ideal scenario, university libraries across the globe should actively engage in the Green Library Initiative (GLI), integrating sustainable practices seamlessly into their operations to contribute significantly to the global sustainability agenda. A green library is a library that exhibits green practices. These libraries serve as information hubs for promoting environmental awareness and sustainability within the university. A green library refers to any library that promotes sustainability through education, operations and outreach (Aulisio, 2013). The concept of "green" in this study refers to the practice of environmental management. When an organisation such as a library goes green, it becomes conscious of the resources used in delivering services and of the waste products emitted from it. University libraries that promote green services are socially responsible, managing resources well and protecting the environment. It must therefore be stated that green libraries are institutions where green practices are undertaken.

Green practices refer to all related activities with the specific aim of helping organisations to reduce the environmental impacts of their operations as well as save money (Chukwuka, 2016). Green practices can include recycling of waste, going paperless, producing products that can be recycled, producing hybrid cars and engines with less carbon emission, using alternative sources of

energy (geothermal, solar, among others), planting and replanting trees, and using energy-efficient bulbs for reduced energy consumption. University libraries, as the information dissemination units of the university, also have the responsibility of undertaking practices that will result in environmental sustainability. Green practices in the context of university libraries can include installing energy-efficient technology, ensuring eco-efficient landscaping, formulating green policies, engaging in green partnerships and using natural resources. Green services involve offering services that promote sustainability, such as book-sharing programmes, eco-friendly printing options and community outreach initiatives (Hartman, 2020; Antonelli, 2008).

Studies have, however, indicated contradicting findings on green practices in libraries. Atanda and Awujoola (2025) revealed a high green practice among personnel in public university libraries in Oyo. While some indicated low green practices, others revealed high levels. For instance, libraries are currently significant consumers of space, energy, paper, toner, chemicals and plastics, with studies showing increases in libraries' carbon footprints (Chowdhury, 2010; Khalid et al., 2021). Contrary to expectations, computers and the age of information technology have actually magnified demands for paper, printer cartridges and computers. These practices continue to result in environmental hazards that are inimical to the healthy living of not only librarians but also library users and the broader community. Aparna and Prasanth (2019) affirmed that funding, awareness, support from authority and training were factors hindering the incorporation of green practices in organisations, of which libraries are no exception. This finding affirmed that most university libraries have failed to undertake practices that would ensure the sustainability of their work environment. One factor that can influence green practices in university libraries is the level of green awareness among library personnel.

Awareness is the cognitive state of being conscious of and able to recognise and understand one's internal and external environment. It encompasses a wide range of mental activities, including self-awareness, environmental awareness and temporal awareness (Essington, 2021). Awareness is fundamental to cognition and behaviour, as it allows individuals to reflect on their experiences, interact with their surroundings and plan future actions. Awareness is often described in terms of levels or states,

ranging from full consciousness to unconsciousness. When an individual is fully aware of an event, things and practices, this helps him or her in comprehending how they perceive themselves and the environment. It also explains how individuals integrate what they are aware of into a coherent sense of reality (Seth, 2018). According to David (2022), awareness is the ingredient for belief, as every other skill, quality and task undertaken can be traced to it. The author stressed that awareness gives knowledge, and knowledge guides individuals in knowing what they need to do and the direction in which to make changes to improve and succeed. Furthermore, the need for awareness can lead an individual to seek more information for the next line of action. This implies that awareness about green infrastructure and values could serve as a remote factor motivating engagement in green practices.

Jaganivas and Mavily (2020) found that increasing awareness and participation in green practices among library professionals could significantly contribute to a more sustainable library environment, with benefits extending to the broader community. In a related study, Gupta (2020) found that libraries that engage in educational campaigns on environmental sustainability witness a measurable increase in staff and user participation in eco-friendly initiatives. Emmanuel and Okojie (2023) revealed that the majority of academic librarians in the North Central region of Nigeria were unaware of the concept of green libraries; some of these library personnel confirmed that they were hearing about it for the first time through the study. However, only a few library personnel attested to the fact that they were aware of the concept and its importance.

From the foregoing, the preservation of the university library environment becomes crucial because of the negative impact neglect could have on the general welfare of the human environment. Understanding green practices by library personnel in universities requires a certain level of green awareness among these personnel. Therefore, this study investigated the influence of green awareness on library personnel in public universities in Southwestern Nigeria.

Statement of the Problem

Many organisations, including university libraries in several countries, especially developing countries such as Nigeria, are being faced with the need to prioritise safe environmental affairs in

their operations as a result of emerging global environmental concerns. The harm done to the ozone layer, if not properly curtailed, could lead to severe environmental, health and economic impacts on not only human beings but on every living thing. Many libraries engage in environmentally harmful practices with serious effects on the environment. This is evident in inadequate recycling facilities, over-reliance on paper, dependence on non-energy-efficient technologies, noise pollution, land pollution, air pollution and minimal use of sustainable materials in their construction and maintenance, among others. Poor green practices in libraries will not only contribute to environmental degradation but will also undermine the institution's commitment to sustainability and environmental stewardship. Literature and personal observation have, however, revealed low green practices among library personnel in public universities in developing countries such as Nigeria. A possible reason could be a low level of awareness of green practices among library personnel. The level of awareness of green practices among library personnel in university libraries could be a clog in the wheel of successful green practices by the personnel. If the level of consciousness exhibited by library personnel in public universities is low, it could affect their decision to engage in green practices. It is on this backdrop that the study investigated the influence of green awareness on green practices by library personnel in public universities in Southwestern Nigeria.

Research Questions

The following research questions were answered in the study:

1. What are the green practices by library personnel in public universities in Southwestern
1. Nigeria?
2. How often do library personnel undertake green practices in public universities in Southwestern Nigeria?
3. What is the level of green awareness of library personnel in public universities in Southwestern Nigeria?

Hypothesis

The null hypothesis was tested at the 0.05 level of significance:

1. There is no significant relationship between green awareness and green practices by library personnel in public universities in Southwestern Nigeria.

Methodology

The study adopted the descriptive survey design of a correlational type. The population comprised all 271 library personnel, including heads of libraries (university librarians), in the 25 public universities in Southwestern Nigeria. The National Open University was treated as a single institution with different centres. The instrument used for data collection was the questionnaire and it was validated by five experts in the Department of Library and Information Studies and the Centre for test and measurement in the University of Ibadan. The data collected were subjected to Cronbach's Alpha reliability test. The result yielded 0.82, which was adjudged to be reliable. The data collected were analysed using descriptive and inferential statistics and done using the Statistical Package for Social Sciences (SPSS) version 28 software. A total of 244 copies of the questionnaire were retrieved out of 277 copies administered, representing a 90.03% rate of return. The study observed ethical considerations, which included informed consent, anonymity of the respondents, confidentiality and seeking approval from the respective institutions.

Results

Research Question 1: What are the green practices by library personnel in public universities in Southwestern Nigeria?

The types of green practices undertaken by library personnel was measured across the six major dimensions previously identified, as indicated in Table 1.

Table 1: Green Practices Undertaken by Library Personnel in Public Universities in Southwestern Nigeria

S/N	Statement	SD f(%)	D f(%)	A f(%)	SA f(%)	Mean	SD	Remark
Energy Efficiency Practices								
1	My library manages and monitors energy consumption by turning off unused devices and electric lamps	178 (73.0)	2 (0.8)	25 (10.2)	39 (16.0)	1.69	1.176	Disagree
2	My library insists on the installation of energy-efficient lighting	15 (6.1)	14 (5.7)	143 (58.6)	72 (29.5)	3.11	0.767	Agree
3	My library uses natural lighting sources to reduce energy consumption	22 (9.0)	39 (16.0)	102 (41.8)	81 (33.2)	2.99	0.925	High
	Weighted Mean					2.86		
Sustainable Design Practices								
4	My library uses sustainable building materials during renovation	35 (14.3)	46 (18.9)	65 (26.6)	98 (40.2)	2.93	1.079	Agree
5	My library integrates water-efficient fixtures	13 (5.3)	44 (18.0)	86 (35.2)	101 (41.4)	3.13	0.891	Agree
6	My library incorporates indoor green spaces	6 (2.5)	46 (18.9)	59 (24.2)	133 (54.5)	3.31	0.861	Agree
	Weighted Mean					3.23		
Green Services								
7	My library promotes book-sharing programmes	35 (14.3)	25 (10.2)	128 (52.5)	56 (23.0)	2.84	0.940	Agree
8	My library offers eco-friendly printing options	22 (9.0)	39 (16.0)	102 (41.8)	81 (33.2)	2.99	0.925	Agree
9	My library engages in community outreach on sustainability	35 (14.3)	46 (18.9)	65 (26.6)	98 (40.2)	2.93	1.079	Agree
	Weighted Mean					3.23		
Green Information and Communication Technologies								
10	My library uses digital resources to reduce paper consumption	13 (5.3)	44 (18.0)	86 (35.2)	101 (41.4)	3.13	0.891	Agree
11	My library employs energy-efficient ICT equipment	6 (2.5)	46 (18.9)	59 (24.2)	133 (54.5)	3.31	0.861	Agree
12	My library manages e-waste responsibly	9 (3.7)	27 (11.1)	72 (29.5)	136 (55.7)	3.37	0.824	Agree
	Weighted Mean					3.18		

Waste Reduction and Recycling Practices								
13	My library has facilities for recycling paper and plastics	51 (20.9)	34 (13.9)	83 (34.0)	76 (31.1)	2.75	1.110	Agree
14	My library donates old materials to smaller libraries	23 (9.4)	54 (22.1)	91 (37.3)	76 (31.1)	2.90	0.951	Agree
15	My library reduces paper consumption through digitisation	28 (11.5)	50 (20.5)	88 (36.1)	78 (32.0)	2.89	0.987	Agree
	Weighted Mean					3.05		
Green Procurement Practices								
26	My library always insists on the purchase of environmentally friendly products	167 (68.4)	22 (9.0)	43 (17.6)	12 (4.9)	1.59	0.945	Disagree
27	My library prioritises and suggests local suppliers when sourcing for materials and products	11 (4.5)	233 (95.5)	0 (0.0)	0 (0.0)	1.95	0.208	Disagree
28	My library helps in the evaluation of suppliers to ensure their usefulness for environmental sustainability	96 (39.3)	148 (60.7)	0 (0.0)	0 (0.0)	1.61	0.490	Disagree
29	My library always includes sustainable criteria in procurement policies	32 (13.1)	133 (54.5)	75 (30.7)	4 (1.6)	2.21	0.680	Disagree
30	My library ensures that librarians are actively involved in the review of procurement policies to align with green practices	178 (73.0)	17 (7.0)	48 (19.7)	1 (0.4)	1.48	0.819	Strongly Disagree
	Weighted Mean					1.77		
	Grand Weighted Mean					2.89		

Mean Ranges: 0.00–1.49 = Strongly Disagree; 1.50–2.49 = Disagree; 2.50–3.49 = Agree; 3.50–4.00 = Strongly Agree.

From Table 1, the green practices of library personnel in public universities in Southwestern Nigeria yielded the following weighted means: energy efficiency – 2.86; sustainable design – 3.23; green services – 3.23; green information and communication technologies – 3.18; waste reduction and recycling practices – 3.05; and green procurement practices – 1.77. All the identified green practices recorded high means, with the exception of green procurement, which recorded the lowest weighted mean of 1.77.

Nevertheless, the average grand weighted mean of all green practices of 2.89 indicates moderate green practices overall.

Research Question 2: How often do library personnel undertake green practices in public universities in Southwestern Nigeria?

The frequency at which library personnel undertake green practices was measured across the six major dimensions previously identified, as indicated in Table 2.

Table 2: Frequency of Green Practices by Library Personnel

S/N	Green Practices Area	N (%)	R (%)	O (%)	Of (%)	Mean	SD	Interpretation
1	Engages in energy efficiency	35 (14.3%)	25 (10.2%)	128 (52.5%)	56 (23.0%)	2.84	0.940	Occasionally
2	Practices sustainable design	22 (9.0%)	39 (16.0%)	102 (41.8%)	81 (33.2%)	2.99	0.925	Occasionally
3	Prioritises green services	35 (14.3%)	46 (18.9%)	65 (26.6%)	98 (40.2%)	2.93	1.079	Occasionally
4	Provides green ICT	13 (5.3%)	44 (18.0%)	86 (35.2%)	101 (41.4%)	3.13	0.891	Often
5	Practices waste reduction & recycling	6 (2.5%)	46 (18.9%)	59 (24.2%)	133 (54.5%)	3.31	0.861	Often
6	Promotes green procurement	35 (14.3%)	25 (10.2%)	128 (52.5%)	56 (23.0%)	2.84	0.940	Occasionally
	Weighted Mean					3.01		

N = 244; Scale: 1 = Never, 2 = Rarely, 3 = Occasionally, 4 = Often

The data in Table 2 present the frequency at which library personnel in public universities in Southwestern Nigeria undertake green practices across the six dimensions. Overall, the weighted mean frequency across all six green practice areas stands at approximately 3.01, which falls within the occasional range on the scale. This reveals that green practices are undertaken at a moderate frequency level among library personnel in public universities in Southwestern Nigeria. While waste reduction and recycling, as well as green ICT, are practised often, the remaining four areas are only occasional. This indicates that, although awareness and some implementation exist, there is considerable room for increasing the regularity and consistency of green

practices across all dimensions to achieve more sustainable library operations.

Research Question 3: What is the level of green awareness of library personnel in public universities in Southwestern Nigeria?

Table 3: Level of Green Awareness of Library Personnel

S/N	Statement	SD (%)	D (%)	A (%)	SA (%)	Mean	SD	Remark
1	I am conscious of the environmental impact of library operations	22 (9.0)	39 (16.0)	102 (41.8)	81 (33.2)	2.99	0.925	High
2	I am aware of the concept of energy efficiency and its importance in library management	35 (14.3)	46 (18.9)	65 (26.6)	98 (40.2)	2.93	1.079	High
3	I am aware of the principles of sustainable building design in library settings	13 (5.3)	44 (18.0)	86 (35.2)	101 (41.4)	3.13	0.891	High
4	I am aware of energy-saving practices, such as turning off unused devices	6 (2.5)	46 (18.9)	59 (24.2)	133 (54.5)	3.31	0.861	High
5	I am aware of the use of natural light and ventilation within the library to reduce energy consumption	35 (14.3)	25 (10.2)	128 (52.5)	56 (23.0)	2.84	0.940	High
6	I am aware of the importance of digital resources instead of printed materials when possible	22 (9.0)	39 (16.0)	102 (41.8)	81 (33.2)	2.99	0.925	High
7	I am aware of the importance of green procurement through the unit saddled with the responsibility	35 (14.3)	46 (18.9)	65 (26.6)	98 (40.2)	2.93	1.079	High
8	I am aware of the rationale for the library's recycling and waste management practices	13 (5.3)	44 (18.0)	86 (35.2)	101 (41.4)	3.13	0.891	High
9	I am aware of the usefulness of waste reduction by adopting	6 (2.5)	46 (18.9)	59 (24.2)	133 (54.5)	3.31	0.861	High

	sustainable practices, such as paper reduction and double-sided printing							
10	I am well informed about the sustainable disposal of electronic waste (e-waste) in the library	9 (3.7)	27 (11.1)	72 (29.5)	136 (55.7)	3.37	0.824	High
11	I am aware of the role of green information and communication technologies (ICTs) in reducing the library's environmental footprint	51 (20.9)	34 (13.9)	83 (34.0)	76 (31.1)	2.75	1.110	High
12	I am aware of local and global environmental issues as related to library practices	23 (9.4)	54 (22.1)	91 (37.3)	76 (31.1)	2.90	0.951	High
13	I am conscious of the fact that adopting green practices in libraries can significantly contribute to environmental conservation	28 (11.5)	50 (20.5)	88 (36.1)	78 (32.0)	2.89	0.987	High
14	I am conscious of the need to prioritise eco-friendly products when possible	17 (7.0)	35 (14.3)	111 (45.5)	81 (33.2)	3.05	0.869	High
	Weighted Mean					3.04		High

Mean Ranges: 1.00–1.33 = Low; 1.34–2.67 = Moderate; 2.68–4.00 = High

Overall, the green awareness section reveals a high level of awareness among library personnel in public universities in Southwestern Nigeria. The overall weighted mean of 3.04 indicated that library personnel are aware of green practices.

Hypothesis 1: There is no significant relationship between green awareness and green practices by library personnel in public universities in Southwestern Nigeria.

Table 4: Relationship between Green Awareness and Green Practices by Library Personnel

Variable	N	Mean	Std. Dev.	R	P value	Remark
Green practices	244	10.0720	3.62432	0.422	0.000	Sig
Green awareness	244	6.1646	4.62505			

Table 4 presents the result of the relationship between green awareness and green practices by library personnel in public universities in Southwestern Nigeria. The result revealed a positive and significant relationship between green awareness and green practices ($r = 0.422$; $p < 0.05$). Therefore, the null hypothesis is rejected at the 0.05 level of significance. This implies that green awareness has a significant relationship with green practices by library personnel in public universities in Southwestern Nigeria.

Discussion of Results

Green practices undertaken in library personnel in public universities

The finding revealed a moderate level of green practices by library personnel in public universities in Southwestern Nigeria. Among the green practices being undertaken, as reported by library personnel, are energy efficiency through the use of LED bulbs to conserve energy, turning off electrical appliances not in use, sustainable design and leveraging the digitisation of resources through repositories.

This finding is consistent with several studies conducted in Nigeria and other developing countries. Adeyemi, *et al*. (2024) similarly observed moderate green library practices in Kwara State, while Ogundare and Oyediran (2020) and Okpidi-Urhibo (2023) reported that academic libraries in Nigeria are making some progress but are still far from full adoption. Sustainable design practices emerged as the strongest dimension. Library personnel showed strong commitment to the use of sustainable building materials during renovations, green building certifications, water-efficient fixtures and indoor green spaces. This finding aligns with Edwards (2009) and Williams (2021), who emphasised that structural and design-related green practices tend to receive higher attention because they are visible and often tied to renovation projects. It also supports Mwanzu et al. (2023), who noted growing interest in green design among African academic libraries.

Energy efficiency practices presented a contrasting picture. While adoption of energy-efficient lighting, natural lighting and energy-saving equipment was relatively encouraging, basic energy-monitoring behaviours such as turning off unused devices remained very weak. This selective implementation mirrors the findings of Adeniran and Oyewusi (2022) and Asim and Ahmad (2022), who observed misconceptions about some green practices among library personnel in Nigeria.

However, a study carried out in South East Nigeria discovered that most university buildings' environmental concerns and functionality were inadequate, leaving staff and students unhappy. Similarly, the finding of moderate green practices contradicts the findings of Chowdhury (2010) and Khalid et al. (2021), which revealed an increasing trend in libraries' carbon footprints. In addition, the findings of this study are at variance with Noh and Ahn (2018), who observed that an insignificant number of people undertake green practices to sustain their environment, affirming low green practices. The timeframe between the current study and previous studies, as well as differences in locations, could account for discrepancies in findings. The growing awareness about green practices through media and technological devices could have informed greater consciousness and practice.

Frequency of green practices in public universities

Library personnel in public universities in Southwestern Nigeria engage in green practices at a moderate frequency, predominantly at the occasional level. This finding supports earlier observations by Adeniran and Oyewusi (2022) and Emmanuel and Okojie (2022), who noted that while awareness of green practices exists among Nigerian librarians, actual regular implementation is still limited. Waste reduction and recycling, together with green ICT practices, are performed more frequently than other areas. These dimensions appear to benefit from being relatively easy to integrate into daily routines, a position also supported by Collins (2021) and Miller (2010), who found that recycling and digital initiatives often become habitual faster than other green practices.

In contrast, sustainable design execution, green services and green procurement are carried out only occasionally. Even where adoption levels are relatively high, such as in sustainable design, the frequency of actual day-to-day application remains moderate. This gap between adoption and consistent practice was

also highlighted by Okpidi-Urhibo (2023) and Asim and Ahmad (2022), who attributed it to heavy workload, lack of continuous reinforcement and weak monitoring systems. The moderate frequency across most dimensions suggests that green practices are still largely driven by individual efforts or periodic campaigns rather than being institutionalised into standard operating procedures.

This situation is typical of many developing-country contexts. Studies by Warnasooriya (2019) and Alabi (2020) similarly revealed that green practices in African libraries tend to be event-based rather than routine. In comparison, Binks et al. (2014) and Jankowska (2011) reported much higher frequencies of green practices in developed library systems where institutional policies and monitoring mechanisms have made sustainability part of daily organisational culture. The current moderate frequency in Southwestern Nigeria therefore indicates the need for stronger mechanisms to move green practices from occasional to regular and habitual actions.

Level of green awareness of library personnel in public universities

Relationship between green awareness and green practices

This finding on the significant relationship between awareness of green and green practices by library personnel of public university libraries aligns strongly with several previous studies in Nigeria and beyond. Adeniran and Oyewusi (2022) reported a similar positive relationship between green awareness and sustainability practices among librarians in academic libraries. Likewise, Emmanuel and Okojie (2022) found that awareness was a key driver of green library initiatives in Ghanaian academic libraries. The result also supports Fu et al. (2018) and Yafi et al. (2021), who established that awareness significantly predicts pro-environmental behaviour in organisational settings. However, while the relationship is significant in this study, it is not overwhelmingly strong. This partially contradicts studies such as Alabi (2020) and Warnasooriya (2019), which suggested that awareness alone could lead to very high adoption rates. The moderate strength of the relationship in this study indicates that awareness is important but must be supported by other factors especially institutional support—to produce strong behavioural outcomes.

Conclusion

Green awareness greatly determines green practices by library personnel in universities in southwestern Nigeria. It is expected that library personnel in university libraries have adequate knowledge of what constitute green and its practices, this knowledge will greatly transform the perceptive of library personnel to green practices and would influence their exhibition of positive attitude to these practices. The study therefore concludes that green awareness influences green practices.

Recommendations

Based on the findings, the following recommendations are made:

1. University library personnel should intensify more on green practices such as green procurement and green energy efficiency as they were found to be less undertaken in university libraries.
2. University management should set out policy and mechanism to ensure that green practices are undertaken adequately and frequently by library personnel in university libraries.
3. University library management should design and deliver comprehensive green awareness training programmes to increase green awareness of library personnel in university libraries.
4. In addition, workshops, seminars, e-learning modules and peer-learning networks should be employed to broaden and deepen the green awareness profile of library personnel, thereby enhancing consistency and institutionalisation of green practices.

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RELATIONSHIP BETWEEN LEADERSHIP STYLES OF CATHOLIC FEMALE RELIGIOUS AND ADMINISTRATIVE EFFECTIVENESS OF SECONDARY SCHOOLS IN THE SOUTH-WEST, NIGERIA

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Abstract
The study investigated the influence of leadership styles on administrative Effectiveness of Catholic Secondary Schools in the South-west, Nigeria. The proportionate-to-size sampling technique was used to select 46 (60%) Catholic Secondary Schools out of 76 in the South-west, Nigeria, and 1112 (70%) teachers, while the 92 administrators in the selected schools were enumerated. The instruments used were TFLS (r = 0.88), DLS (r = 0.84), ALS (r = 0.86), TLS (r = 0.79), PLS (r = 0.92), SLS (r = 0.87), TS (r = 0.81), HS (r = 0.94), CS (r = 0.79), and AE (r = 0.96) scales. The data were analysed using descriptive statistics and Pearson's product moment correlation at 0.05 level of significance. Only transformational leadership was commonly practiced with significant mean value of 2.57, while delegative leadership (x = 2.33); authoritative leadership style (x = 2.15); transactional leadership (x = 2.07); participative leadership (x = 2.198) and servant leadership style have mean value of 2.30 were rarely practiced at the threshold of 2.50. The findings also showed a strong positive correlation between transformational, delegative, participative, and servant leadership styles and administrative effectiveness (r = 0.839, 0.895, and 0.805 respectively, P < 0.05). There was also a moderate positive relationship between transactional leadership and administrative effectiveness (r = 0.591, P < 0.05). However, the results indicated a strong negative correlation between authoritative leadership style and

administrative effectiveness (r = -0.746, P < 0.05). The study concluded that Catholic secondary schools in the South-west, Nigeria used transformational leadership often, while transactional leadership has influenced on their administrative effectiveness. Therefore, school administrators should use endeavour to use transactional leadership to enhance administrative effectiveness.

Keywords: Leadership Styles, Catholic Female Religious, Technical and Human Skills, Catholic Secondary Schools in Nigeria

Introduction

One of the most crucial aspects of the educational system is seen to be administration (Alani, 2020). Every educational system's ability to succeed is mostly determined by how well it is run. The total is always bigger than the sum of its parts in the social system that is the school. As a result, learning, behaviour, and cognition are crucial, as are administrative planning and individual initiative, coordination and communication, bureaucratic discipline, and professional skill. Making education relevant to the development of society begins with secondary schools' administrative effectiveness (Brown, 2023). Since education is seen as the means of cultivating the intellect for creativity as well as teaching values and tolerance that support the economic, social, cultural, and political development of nations and individuals, administrative effectiveness is crucial in educational institutions where the main goal is the development of human capacity (Ayushi, 2018).

Therefore, at all levels of the educational system, administrative efficiency guarantees that school operations are carried out effectively in ways that improve the achievement of the specified educational goals.

Leadership within educational institutions is a multifaceted process. It encompasses more than only mastering various leadership styles or aligning suitable leader behaviour with certain situations (Harris, 2013). Leadership encompasses a process of social influence. Irwin (2021) stated that leadership is the process of persuading and assisting others to ensure their willingness to take appropriate actions. Effective strategies for enhancing school leadership include the selection and training of leaders, taking new leadership roles, manipulating the environment, and reforming educational institutions (Kouni, Koutsoukos and Panta, 2018). The

effectiveness and styles of leadership used by school administrators significantly influence the nature of educational institutions. Leadership style encompasses not only instrumental and behavioural activities but also symbolic and cultural dimensions. The leader deliberately influences people to organise activities and relationships within a group or organisation (Ndongko, 2014). A leader is one responsible for organising, directing, and overseeing others. They are visionaries who inspire and galvanise their team to achieve the intended objective (Pandey, 2023). Effective leadership skills must be cultivated through education and practice (Pandey, 2023). Consequently, leadership entails the identification of a goal and the attainment of that aim.

Ogunode (2023) stated that leadership styles assist leaders in offering answers to organisational activities in their particular challenges. It has been shown that leadership style affects both school achievement and leadership conduct in the educational system (Leithwood and Sun, 2022; Yusuf, 2023). For a school administrator to effectively lead towards fulfilling its potential, he/she ought to have a good relationship and also have a knowledge of the territory. In addition, some of the indices of leadership styles that a school leader or administrator should imbibe are innovative strategies, vision, direction, teamwork, motivation, commitment, enthusiasm and achievement-oriented. An effective school leader should be able to use various leadership philosophies in various contexts to solve problems encountered in secondary school administration and accomplish objectives (Spears, 2010). These leadership philosophies include participatory leadership, authoritarian leadership, transactional leadership, transformational leadership, servant leadership, and delegative leadership. Situations and context determine how school leaders use different leadership philosophies (Day, 2014; Hallinger, 2021; Yusuf, 2022; Northouse, 2023; Northouse, 2024).

Transformational leadership in schools plays a crucial role in enhancing teachers' performance, motivation, commitment, and job satisfaction. It fosters effective school administration, creates a positive school climate, and boosts students' academic achievement (Avolio, 2014). This leadership style promotes collaborative problem-solving and decision-making, ensuring quality outcomes at all levels. It also strengthens staff commitment, capacity to meet goals, and dedication to professional

development, contributing to the achievement of school objectives (Kouni and Koutsoukos, 2018). Delegative leadership style means assigning responsibilities to staff and giving them the necessary authority to get the job done (Stonehouse, 2015). Good school leaders tell their staff what they expect and then leave them to go about achieving the goal by taking good initiative. Innovation and creativity are encouraged, not stifled. Delegation also trains members and builds up a second line of leadership. Delegation is perhaps a great means to get a lot of things done with the limitations of our time. Delegation leadership style simply means getting many people involved in working towards a goal.

The authoritative leadership style prioritises task completion over human considerations and excludes followers from participating in decision-making (Wagbara and Ukaigwep, 2019). On the other hand, transactional leadership is characterised by a focus on tasks and followers, effectively reconciling organisational requirements with subordinate demands (Kreitner, 2021). It relies on exchange relationships where leaders provide extrinsic rewards, either positive or negative, to ensure compliance and uniformity (Cardona, 2020; Kreitner, 2021). The participative leadership style operates on the belief that professional staff possess the expertise and have the right to participate in organisational decision-making. It assumes a shared set of values among staff and formal representation within decision-making bodies. This democratic model relies on achieving decisions through consensus (Bush, 2023). Participative leadership fosters effective communication between leaders and staff, both formally and informally (Obi, 2023). This open communication encourages the exchange of ideas, boosts morale, and strengthens support for decisions made (Northouse, 2023).

Catholic school leadership is grounded in the philosophy of service, where leaders aim to guide others through acts of service. This aligns with Greenleaf's (2017) belief that true leaders are first and foremost servants, a concept known as servant leadership. This suggests that a leader must demonstrate humility, putting the needs of others before their own to genuinely practice servant leadership. This leadership style prioritises leading by personal example and a readiness to make sacrifices (Ellis, 2018). A principal embodying servant leadership is motivated by a profound dedication to the welfare of others. Their objective is to motivate

and enable others to embrace a similar mindset (Fiebig and Christopher, 2018).

This study investigated the influence of leadership styles and managerial skills of Catholic female religious on the administrative effectiveness of secondary schools in South-West, Nigeria.

Research Questions

What are the commonly used leadership styles (transformational, delegative, authoritative, transactional, participative and servant leadership styles) by Catholic female religious in the administrative effectiveness of secondary schools?

Hypothesis

H_{01}: There is no significant relationship between leadership styles of Catholic female religious and administrative effectiveness of secondary schools in the South-West, Nigeria.

Methodology

This study employed the descriptive survey research design. The study's population consisted of 2,759 religious sisters serving as school administrators and Catholic secondary school teachers in the South-west geo-political zone of Nigeria. A sample of 1,204 respondents, including both administrators and teachers, was selected from Catholic secondary schools across the six states in the region. The instrument used was titled “Administrative Effectiveness and Leadership Style Questionnaire (LSQ)”. It was divided into the following four sections:

Section A: This captured demographic variables of religious sisters such as age, position, educational qualification, and years of work experience.

Section B: It captured the administrative effectiveness of secondary schools which was captured on a four point Likert scale that cuts across 4 - Great Extent, 3- High Extent, 2- Low Extent, 1- Not at All, and respondents were allowed to tick where appropriate. This section had twenty items.

Section C: It consisted of the Leadership Styles. The section was captured through a four point Likert scale which cuts across 4-

Often, 3- Sometimes, 2- Rarely, 1- Not at All. It had sub-scales which were Transformational Leadership, Delegative Leadership, Authoritative Leadership, Transactional Leadership, Participative Leadership and Servant Leadership scales. Each of the sub-scales had 5 items making 30 items altogether.

Section D: It captured the Managerial Skills and was captured through a four point Likert scale of 4- Great Extent, 3-High Extent, 2- Low Extent, 1- Not at All. It had three sub-scales which were Conceptual Skill, Human Skill and Technical Skill. This section had fifteen items.

The reliability coefficient for the instrument designed for this research was 0.97 after the data collected from 30 respondents was further submitted for reliability analysis using Cronbach alpha. In addition, a total of 1,204 respondents were drawn and questionnaires were administered on them, while 1,044 copies were retrieved giving a 86.7% rate of return of the instruments.
Data obtained was analyzed using different approaches based on the instrument the researcher considered appropriate for the purpose of the research work and for each hypothesis earlier formulated. The demographic data and research questions were analyzed using frequency counts and simple percentage and standard deviation, while the hypotheses was tested with the use of Pearson Product moment correlation at 0.05 level of significance.

Result and Discussion

Answering of Research Question

Research Question

What are the commonly used leadership styles (transformational, delegative, authoritative, transactional, participative and servant leadership styles) by Catholic female religious in the administrative effectiveness of secondary schools?

Table 1: Commonly Used Leadership Styles (Transformational, Delegative, Authoritative, Transactional, Participative and Servant Leadership Styles) by Catholic Female Religious in Administrative Effectiveness of Secondary Schools

S/N	ITEMS	O	S	R	NA	Mean	Std. Dev.
Transformational Leadership							
1.	Leaders encourage subordinates to improve themselves.	349 (33.4%)	160 (15.3%)	363 (34.8%)	172 (16.5%)	2.65	1.106
2.	The secret to being an effective leader is to provide direction without applying pressure.	342 (32.8%)	98 (9.4%)	361 (34.6%)	243 (23.3%)	2.51	1.17121
3.	Personal attention and mutual respect are accorded to subordinates	266 (25.5%)	158 (15.1%)	346 (33.1%)	274 (26.2%)	2.39	1.129
4.	Leaders motivate followers to go above and beyond what is expected of them.	334 (32.0%)	221 (21.2%)	243 (23.3%)	246 (23.6%)	2.61	1.161
5.	Promotes intelligence, rationality and careful problem solving	382 (36.6%)	125 (12.0%)	412 (39.5%)	125 (12.0%)	2.73	1.081
	Weighted mean					**2.57**	**1.129**
Delegative Leadership							
1.	Assigns responsibilities to subordinates	296 (28.4%)	265 (25.4%)	268 (25.7%)	215 (20.6%)	2.61	1.103
2.	Leaders provide their followers total autonomy to resolve issues independently.	124 (11.9%)	319 (30.6%)	347 (33.2%)	254 (24.3%)	2.29	.966

3.	Most of the time, followers want little involvement from the boss.	78 (7.5%)	304 (29.1%)	300 (28.7%)	362 (34.7%)	2.09	.963
4.	Leaders give subordinates the necessary authority to get the job done	149 (14.3%)	237 (22.7%)	373 (35.7%)	285 (27.3%)	2.23	1.007
5.	It is a means to get a lot of things done with the limitations on our time	276 (26.4%)	220 (21.1%)	266 (25.5%)	282 (27.0%)	2.46	1.148
	Weighted mean					**2.336**	**1.0374**
Authoritative Leadership							
1.	Subordinates need to be supervised closely, else, they are not likely to do their work	110 (10.5%)	143 (13.7%)	528 (50.7%)	263 (25.2%)	2.09	.895
2.	Leaders provide instructions to followers and demand unquestioning obedience.	168 (16.1%)	126 (12.1%)	415 (39.8%)	335 (32.1%)	2.12	1.035
3.	Limit subordinates' participation in decision-making	212 (20.3%)	172 (16.5%)	442 (42.3%)	218 (20.9%)	2.36	1.027
4.	All authority and responsibility are centered on the leader	119 (11.4%)	243 (23.3%)	260 (24.9%)	422 (40.4%)	2.05	1.044
5.	Subordinates avoid work as much as possible since they only see it as a need to make a livelihood.	108 (10.3%)	260 (24.9%)	379 (36.3%)	297 (28.4%)	2.17	.958
	Weighted mean					**2.158**	**0.9918**
Transactional Leadership							

1.	The task or job is seen as a contract between the leader and the followers.	170 (16.3%)	100 (9.6%)	413 (39.6%)	361 (34.6%)	2.07	1.043
2.	Leader promotes uniformity by providing extrinsic rewards to subordinates	113 (10.8%)	121 (11.6%)	432 (41.4%)	378 (36.2%)	1.97	.954
3.	Exchange of rewards for good job performance	77 (7.4%)	208 (19.9%)	416 (39.8%)	342 (32.9%)	2.01	.907
4.	Leaders give orders and clarify procedures	246 (23.6%)	98 (9.4%)	277 (26.5%)	423 (40.5%)	2.16	1.190
5	It is task-oriented and follower-oriented	157 (15.0%)	214 (20.5%)	294 (28.2%)	379 (36.3%)	2.14	1.072
	Weighted mean					**2.07**	**1.0332**
Participative Leadership							
1.	People are essentially capable and will do well if given a task.	218 (20.9%)	212 (20.3%)	368 (35.2%)	246 (23.6%)	2.38	1.061
2.	Involvement of subordinates (group) is given adequate attention	154 (14.8%)	272 (26.1%)	133 (12.7%)	485 (46.5%)	2.09	1.143
3.	Welfare of the subordinates is given adequate attention	137 (13.1%)	155 (14.8%)	268 (25.7%)	484 (46.4%)	1.94	1.065
4.	Consensus is the method by which decisions are made.	144 (13.8%)	197 (18.9%)	382 (36.6%)	321 (30.7%)	2.15	1.012
5.	Effective communication between the leader and subordinates	282 (27.0%)	180 (17.2%)	296 (28.4%)	286 (27.4%)	2.43	1.155

	Weighted mean					**2.198**	**1.0872**
Servant Leadership							
1.	Leaders are servants	259 (24.8%)	134 (12.8%)	476 (45.6%)	175 (16.8%)	2.45	1.039
2.	Leaders promote the well-being of their subordinates	201 (19.3%)	221 (21.2%)	356 (34.1%)	266 (25.5%)	2.34	1.058
3.	Leaders help subordinates grow in their personal faith	142 (13.6%)	239 (22.9%)	268 (25.7%)	395 (37.8%)	2.12	1.066
4.	Leaders emphasise the subordinates and organisational goal	174 (16.7%)	286 (27.4%)	283 (27.1%)	301 (28.8%)	2.31	1.062
5.	Leaders are unique and exceptional	194 (18.6%)	185 (17.7%)	429 (41.1%)	236 (22.6%)	2.32	1.021
	Weighted mean					**2.30**	**1.04**
	Grand mean						

Source: Fieldwork (2023)

Table 1 revealed the commonly used leadership styles (transformational, delegative, authoritative, transactional, participative and servant leadership styles) by Catholic female religious in the administrative effectiveness of secondary schools. The result revealed that on transformational leadership style 349 (33.4%) and 334 (32.0%) of the respondents signify that leaders encourage subordinates to improve themselves and such leaders motivate their subordinates to surpass both their own and the leader's expectations often, 412 (39.5%), 363 (34.8%), 361(34.6%) and 346 (33.1%) indicated that leaders encourage subordinates to improve themselves, providing guidance without pressure is a key to being a good leader, personal attention and mutual respect are accorded to subordinates and promotes intelligence, rationality and careful problem solving are rarely

practice. The items on transformational leadership have a mean value of 2.57 which is greater than the 2.50 criterion mean which implies that the transformational leadership style is sometimes practiced among Catholic female religious in the administrative effectiveness of secondary schools.

On delegative leadership, 28.4% of respondents indicated that leaders often assign responsibilities to subordinates. However, 33.2% and 35.7% reported that leaders rarely give subordinates complete freedom to solve problems or the necessary authority to complete tasks. Furthermore, 34.7% of respondents stated that subordinates generally prefer minimal input from leaders, while 27.0% viewed this leadership style as a way to accomplish more within time constraints. The items have a mean value of 2.33 which is less than the 2.50 criterion mean. This implies that Catholic female religious in secondary school administration rarely practice delegative leadership.

On authoritative leadership, 50.7% of respondents stated that subordinates rarely require close supervision to complete their tasks. Meanwhile, 39.8% indicated that leaders often give directives and expect unquestioning compliance, and 42.3% observed that leaders rarely involve subordinates in decision-making. Similarly, 36.3% of respondents noted that subordinates rarely see work solely as a means to earn a living and avoid it when possible. However, 40.4% revealed that authority and responsibility are never fully concentrated in the leaders. All the items on authoritative leadership style have a mean value of 2.158 which is less than the 2.50 criterion mean and this implies that the authoritative leadership style is rarely practiced in secondary schools.

On transactional leadership, 39.6%, 41.4%, and 39.8% of respondents indicated that tasks are rarely seen as a contract between leader and follower, leaders rarely promote uniformity through extrinsic rewards, and rewards for good performance are rarely exchanged. In addition, 40.5% and 36.3% of respondents noted that leaders never give orders, clarify procedures, or focus on being task-oriented and follower-oriented. The mean value of 2.07, lower than the criterion mean of 2.50, suggests that transactional leadership is rarely practiced. This indicated its limited role in the administrative effectiveness of Catholic female religious in secondary schools.

On participative leadership, 35.2%, 36.6%, and 28.4% of respondents indicated that people are rarely seen as competent enough to complete tasks effectively, decisions are rarely made through consensus, and communication between leaders and subordinates is rarely effective. In addition, 46.5% and 46.4% revealed that the involvement of subordinates is not given adequate attention, nor is their welfare sufficiently prioritised. The weighted mean for all items on participative leadership was 2.198, which is below the criterion mean of 2.50. This suggests that participative leadership is rarely practiced. Consequently, it plays a limited role in the administrative effectiveness of Catholic female religious in secondary schools.

On servant leadership, 476 (45.6%), 429 (41.1%) and 356 (34.1%) of the respondents reveal that leaders are not servants, leaders rarely promote the well-being of their subordinates and also, and leaders never help subordinates to grow in their personal faith, 395 (37.8%) and 301(28.8%) of the respondents indicated that leaders never emphasise on the subordinates and organisational goal, also, leaders are not unique and exceptional. All the items on servant leadership style have mean value of 2.30 which is less than 2.50 criterion mean. This implies that servant leadership style is rarely practiced among Catholic female religious in administrative effectiveness of secondary schools.

Relationship between Leadership Styles of Catholic Female Religious and Administrative Effectiveness of Secondary Schools in the South-West, Nigeria

Table 2 presents the relationship between the leadership styles of Catholic female religious and administrative effectiveness of secondary schools in South-west, Nigeria.

Table 2: Relationship Between Leadership Styles of Catholic Female Religious and Administrative Effectiveness of Secondary Schools in the South-west, Nigeria

Variables	Administrative Effectiveness	Transformational Leadership	Delegative Leadership	Authoritative Leadership	Transactional Leadership	Participative Leadership	Servant Leadership
Administrative Effectiveness	1						
Transformational Leadership	.839**	1					
	.000						
Delegative Leadership	.895**	.820**	1				
	.000	.000					
Authoritative Leadership	-.746**	.618**	.733**	1			
	.000	.000	.000				
Transactional Leadership	0.591**	.518**	.571**	.688**	1		
	.000	.000	.000	.000			
Participative Leadership	.678**	.544**	.576**	.580**	.473**	1	
	.000	.000	.000	.000	.000		
Servant Leadership	.805**	.706**	.721**	.717**	.463**	.696**	1
	.000	.000	.000	.000	.000	.000	
N	1044	1044	1044	1044	1044	1044	1044
Mean	48.2826	12.9195	11.7174	10.8075	10.3669	11.0192	11.5632
Std. Dev.	15.58116	4.96230	4.23038	3.98611	4.02896	4.44565	4.52020

*. Correlation is significant at the 0.05 level (2-tailed).

Decision was taken based on Evans (1996) suggestion for the absolute value *r* which is 0.00-0.39 “weak positive”, 0.40-0.59 “moderate positive”, 0.60-0.79 “strong positive” and 0.80-1.0 “very strong positive

Table 2 highlights the connection between the leadership styles of Catholic female religious and the administrative effectiveness of

secondary schools in South-west Nigeria. The findings showed a strong positive correlation between transformational, delegative, participative, and servant leadership styles and administrative effectiveness ($r = 0.839$, 0.895, and 0.805 respectively, $P < 0.05$). There was also a moderate positive relationship between transactional leadership and administrative effectiveness ($r = 0.591$, $P < 0.05$). However, the results indicated a strong negative correlation between authoritative leadership style and administrative effectiveness ($r = -0.746$, $P < 0.05$). These results suggest a significant influence of leadership styles on the administrative performance of the schools. Consequently, the null hypothesis was rejected at the 0.05 level of significance.

Discussion

The study examined the relationship between the leadership styles of Catholic female religious and the administrative effectiveness of secondary schools in South-west Nigeria. The results showed a strong positive and significant relationship between transformational, delegative, participative, and servant leadership styles and administrative effectiveness. A moderate positive and significant relationship was also found between transactional leadership and administrative effectiveness. However, authoritative leadership was found to have a strong negative and significant relationship with administrative effectiveness. These findings suggested that leadership styles of Catholic female religious have a notable impact on the administrative effectiveness of secondary schools in South-west Nigeria. Therefore, the study highlighted the importance of effective leadership in improving school administration.

The result supported Ian's (2013) findings, which showed a strong positive correlation between leadership styles and job effectiveness. Ian proposed that good leadership may be comprehensively defined as a process that enhances relationships among internal, external, and individual spheres of activity. Consequently, effective leaders who can harmonise the school's internal and external developmental objectives are successful school leaders. According to Duke, Tucker, Salmonowicz, and Levy (2006), school leadership styles have a significant impact on organisational effectiveness because they reflected the organisation's mindset through appropriate leadership styles displayed during administrative tasks and also significantly

influenced how effective staff members are at their jobs. In addition, Kouni, Koutsoukos, and Panta (2018) proposed a substantial correlation between transformative leadership and contented workers and a good work attitude. Principals served as transformative leaders in the educational field, improving student learning outcomes via improved teacher performance. The findings also support the works of Dirks (2000), Fry (2003) and Wallace (2012) with the previous reviews of Greene (2017) and Brzezińska (2023) that women in leadership positions in Catholic secondary schools exhibited higher administrative effectiveness due to their deployment of transformational leadership style.

Conclusion

The administrative effectiveness of the Catholic female religious was examined as the utilisation of human and material resources which leads to the successful achievement of desired objectives/goals in an organisation. This study examined several factors that contributed to the administrative effectiveness of secondary schools in achieving their goals, including principal and teacher expectations, time on task, classroom organisation, reinforcement and feedback, parental involvement, tutoring, and recitation. Leadership styles were also explored as the methods used by leaders in specific situations or workplaces to achieve objectives. The leadership styles considered in the study included transformational, delegative, authoritative, transactional, participative, and servant leadership. These styles were analysed to comprehend their impact on administrative effectiveness in secondary schools.

The study concluded that transformational leadership was the dominant style among Catholic female religious in secondary schools, while other leadership styles are rarely used. These alternative leadership styles are not commonly practiced or popular in the administrative effectiveness of secondary schools.

Recommendations

The following recommendations were put forward based on the findings of this study:

(i) The Catholic female religious in secondary schools should apply different leadership styles such as (transformational, delegative, authoritative, transactional, participative, and servant leadership) in different situations in the management of Catholic secondary schools. This will improve administrative effectiveness of schools as it was observed to be low. This would enable the schools to gain more recognition and achieve the aims and objectives of the schools.

(ii) The leadership styles of the Catholic female religious in secondary schools should be improved as it was found out that only transformational leadership is sometimes practiced while other leadership styles are rarely practiced. Thus, the practice of different leadership styles could bring more dynamism in secondary schools and improve the level of administrative effectiveness among Catholic female religious.

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INFLUENCE OF DIGITAL TRANSFORMATION ON TEACHING EFFECTIVENESS AND MANAGEMENT OF UNIVERSITY EDUCATION IN SOUTH-WEST, NIGERIA

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Abstract
This study investigated the influence of digital transformation on teaching effectiveness and the management of university education in South-west, Nigeria. The study adopted descriptive survey research design. Three research questions were raised and answered in the study. A purposive sampling technique was used to select 180 respondents from six universities in South-west, Nigeria. A 32 – item structured questionnaire was used to collect data. The instrument was validated through experts' opinion and scrutiny from relevant fields. A reliability coefficient of 0.76 was obtained through test-retest technique. Data collected were analysed using descriptive statistics of mean and standard deviations. Findings from the study on current practices revealed that in most Nigerian universities, digital innovation and technology has not been fully entrenched into the management and the teaching/learning process in Southwest, Nigeria. This was not unconnected with several challenges such as: inadequate digital facilities and ICT infrastructure, poor internet connectivity, poor digital literacy skills, erratic power supply, etc. hindering the effective integration of digital technologies in Nigeria's university system. It was equally revealed that the potentials of digital transformation in promoting teaching effectiveness and university

education management are very great. The study concluded that achievement of the transformative potential of digital innovation in higher education requires a holistic approach that integrates technological investment, human capacity development, effective policy implementation, and strategic partnerships among others. The study recommended that there should be improved funding of the university system, strengthening of digital and ICT infrastructures, among others, to enjoy the full potentials of digital technologies.

Keywords: Digital transformation, Digital literacy, Innovation, Teaching effectiveness, University education management,

Introduction

The continued relevance of higher education institutions to societal needs and expectations is a function of the institutional capability to adapt to global technological innovation and changes. According to Andrew (2022) institutions of higher education that want to remain relevant in the 21st century turn to technology to improve their teaching, learning, student management, and faculty performance. Digital transformation is therefore, one of the key technological strategies or break-through which can be adopted by higher educational institutions to plan, administer, deliver academic services, and facilitate seamless data management. As affirmed by Explorance (2025) technology integration in higher education has emerged as a pivotal driver of success in recent years, rendering digital transformation inevitable for all institutions within this sphere. E-learning and globalisation in the Fourth Industrial Revolution (4IR), characterised by artificial intelligence, big data, and networked systems, are fundamentally transforming educational institutions worldwide to use various digital gadgets (Schwab, 2017, cited by Apata et al. 2025).

Hence, digital applications and new educational technology help students find jobs, accelerate their learning, understand difficult concepts, promote their research, pass examinations, manage their courses, gain online degrees, and much more (Andrew, 2022). In the words of Okebukola (2021) digital transformation has emerged as a pivotal force reshaping various sectors globally, and higher education is no exception. In Nigeria for instance, the integration of digital technologies into university

education has begun to alter how institutions plan, administer, and deliver academic services. This transformation, incorporates the adoption of information and communication technologies (ICTs), data analytics, cloud computing, and virtual learning environments, all aimed at enhancing institutional efficiency, decision-making, and access to quality education (Okebukola, 2021).

Digital Transformation in higher education refers to the strategic incorporation of digital technologies to revolutionize traditional processes and enhance the overall educational experience. It encompasses a multifaceted approach beyond mere digitization, aiming to optimize administrative workflows, streamline communication channels, and enrich learning environments (Explorance, 2025). In other words, digital transformation in university education involves integrating technology into all aspects of the learning experience and administrative processes to enhance efficiency and improve student outcomes. Integrating digital transformation capabilities, according to Mohammed et al. (2021) enable the universities to leverage their delivering capabilities through offshore branches or transnational distance learning. In the same vein, Ogunode and Ndayebom (2023) believed that digitization has the potential to transform the entire higher education system by making teaching, research and the provision of community service more efficient and fast. Digitization of higher education can increase access to teaching and learning, enhance flexibility, and improve the quality of higher education in Nigeria.

It should however, be noted that the desired learning and educational outcomes among students can hardly be achieved without effective teaching. According to Marsh (1987) teaching effectiveness is the ability of the teacher to bring about intended learning outcomes through appropriate instructional processes which involves the alignment of teaching methods, assessment strategies, and learning objectives to ensure that students gain both knowledge and competence. Traditionally, teaching-learning process and the management of university education in Nigeria have been constrained by infrastructural decay, inadequate resources, bureaucratic processes, and inadequate data management systems. However, digital tools now offer more promising solutions to some of these problems. For instance, the use of Learning Management Systems (LMS) such as Moodle and Google Classroom has facilitated remote learning, while

administrative software has improved resource allocation and student information management (Adeleke & Ajadi, 2020). Similarly, digital technology integration in Nigeria's higher education system becomes necessary to meet the challenges of global digital education and to redefine, redesign and reshape the future of higher education system in Nigeria.

Moreover, the challenges and limitations imposed on the educational system during the outbreak of COVID-19 pandemic throughout the world makes digital technology integration inevitable. Furthermore, Onyema et al., (2020) agreed that the outbreak of the COVID-19 pandemic accelerated the adoption of digital tools, pushing universities to rethink traditional education models and embrace more flexible, technology-driven strategies. The outbreak of the COVID-19 pandemic has therefore, sharpened the national consciousness towards the re-evaluation of the traditional approach to teaching and learning especially in universities (Adeniran, 2021). Similarly, Irele (2021) admitted that digital education must be embraced because the post-COVID-19 pandemic has made it impossible to continue with the traditional mode of teaching/learning.

Despite the viable potentials of digital transformation in Nigerian universities, its adoption faces numerous challenges, which included: erratic power supply, limited digital infrastructure, poor internet connectivity, poor digital literacy, and inadequate funding among others. Addressing these challenges is critical for sustaining innovation and ensuring that digital transformation meaningfully impacts effective teaching and university education management in South-West, Nigeria. Hence, this paper examined the influence of digital transformation on teaching effectiveness and the management of university education in South-West, Nigeria, focusing on the current practices, challenges, and prospects for a digitally driven academic future.

Theoretical Framework

The theoretical framework on which the study was anchored were: the Technology Acceptance Model (TAM) developed by Davis (1989) and Transformational Leadership Theory developed by Burns (1978) and expanded by Bass (1985). TAM can generally be used to explain how university lecturers, students, and administrators adopt digital tools and use technology. The key variables are 'perceived usefulness' (PU) and 'perceived ease of

use' (PEOU).These affect actual technology usage, which influences teaching effectiveness and management efficiency. Hence, if users believe digital tools improve teaching or management and are easy to use, adoption becomes higher, improving effectiveness.

Transformational Leadership Theory on the other hand describes how leaders inspire and drive innovation and change. University leadership plays a crucial role in driving digital transformation. Hence, leaders who are visionary, supportive, and adaptive are more likely to implement digital reforms successfully. The key components are 'Idealized influence', 'Inspirational motivation', 'Intellectual stimulation' and 'Individualized consideration'. Effective university leaders who embrace change and invest in staff ICT capacity therefore, foster better teaching and management outcomes. By combining TAM and Transformational Leadership Theory, this framework explains; (1) Why and how digital tools are adopted by stakeholders (TAM) and, (2) What role leadership plays in facilitating digital transformation for teaching and administration (Transformational Leadership).

Statement of the Problem

Adoption of digital technologies has transformed various sectors including educational systems worldwide, creating new opportunities for innovation in teaching and university education management. However, in Nigeria, the extent to which digital transformation has effectively enhanced teaching effectiveness and university education management remains uncertain. Many universities still struggle with inadequate digital infrastructure, inconsistent implementation of learning management systems, low levels of digital literacy among staff and students, and limited institutional support for technology-driven reforms. These challenges hinder the effective integration of digital tools into pedagogy and management, thereby affecting teaching quality, instructional delivery, decision-making efficiency, and overall institutional performance. While some universities have adopted elements of digital transformation, the impact on teaching effectiveness and administrative management has not been comprehensively evaluated. This gap underscores the need to investigate how digital transformation influences both instructional outcomes and the management of university education in Nigeria, as well as the factors that facilitate or impede its success. Hence,

the paper focuses on the current practices, challenges, and prospects for a digitally driven academic future.

Objectives of the Study

The main objective of the study was to assess the influence of digital transformation on teaching effectiveness and the management of university education in South-West, Nigeria. Specifically, the study sought to:

i. assess the current practices of digital transformation on teaching effectiveness, and university education management in Southwest, Nigeria
ii. identify the challenges of digital transformation on teaching effectiveness, and university education management in Southwest, Nigeria
iii. examine the prospects of digital transformation on teaching effectiveness, and university education management in Southwest, Nigeria

Research Questions

The following questions were raised to guide the study:

i. What are the current practices on digital transformation, teaching effectiveness and university education management in Southwest, Nigeria?
ii. What are the challenges of digital transformation on teaching effectiveness and university education management in Southwest, Nigeria?
iv. What are the prospects of digital transformation on teaching effectiveness and university education management in Southwest, Nigeria?

Methodology

The study adopted descriptive survey research design. The population of the study consisted of all senior lecturers, heads of departments, senior administrative officers in all public universities in Southwest, Nigeria. A purposive sampling technique was used to select one hundred and eighty (180) university staff including lecturers from six public universities in Southwest, Nigeria. Purposive sampling technique was used to cater for the various categories of respondents selected for the study. The instrument used for data collection was a self-designed questionnaire tagged

"Digital Transformation, Teaching Effectiveness and Management of University Education Questionnaire" (DTTEMEDQ). This research instrument was subjected to face and content validity through experts' opinion and scrutiny from relevant fields. Three research questions were raised and answered using the mean and standard deviation. A reliability coefficient of 0.76 was obtained through test-retest technique.

Table 1: Sample of Respondents

	University	No of Respondents	Administrative Staff (40%)	Academic Staff (60%)
	University of Ibadan, Ibadan	30	12	18
	Obafemi Awolowo University, Ile-Ife	30	12	18
	Olabisi Onabanjo University, Ago-Iwoye	30	12	18
	Federal University, Oye-Ekiti	30	12	18
	Federal University of Technology, Akure	30	12	18
	Lagos State University, LASU	30	12	18
Total	06	180	72	108

Analysis of Results

Table 2: Mean rating of current practices on digital transformation, teaching effectiveness and university education management

S/N	Items	Mean (X)	S.D	Remarks
1.	My university has adequate ICT infrastructure (computers, internet access, projectors, smart-boards) to support teaching and learning	2.11	0.55	Not Accepted
2.	Internet connectivity in my institution is reliable and readily accessible to staff and students	1.98	0.46	Not Accepted

3.	Lecturers frequently use digital tools (e.g. LMS, Google classroom, Zoom, online videos) to enhance teaching	1.87	0.39	Not Accepted
4.	Online course delivery, blended learning practices and multimedia content are highly integrated to enhance learning	2.16	0.57	Not Accepted
5.	Students regularly access learning materials through online platforms	1.84	0.37	Not Accepted
6.	University management uses digital technology regularly to improve service delivery	1.81	0.32	Not Accepted
7.	University management uses digital systems for decision-making and communication regularly	1.64	0.28	Not Accepted
8	The university provides adequate financial and technical support for digital operations	1.75	0.33	Not Accepted
9.	Staff receive regular training on the use of digital and ICT tools for teaching and administration	2.08	0.52	Not Accepted
10.	Administrative processes such as registration, results processing, and communication are largely digitized	2.76	1.18	Accepted

N = 180; Criterion Mean = 2.50; Standard Mean = 1.92; S.D = 0.42

The current practices as illustrated in table 2 in most Nigerian universities indicated that digital innovation and technology has not been fully entrenched into university education management as well as the teaching/learning process in Southwest, Nigeria. With the exception of item number 10 with mean score of 2.76, all other items have mean score below the criterion mean of 2.50. Hence item 10 was accepted while the remaining items were not accepted. The implication is that digital innovation and technology finds application in administrative processes such as registration, results processing, and communication in most of these universities.

Table 3: Mean rating of the challenges of digital transformation on teaching effectiveness and university education management

S/N	Items	Mean (X)	S.D	Remarks
1.	Inadequate digital facilities and ICT infrastructure limits effective digital transformation in the university system	2.98	1.26	Accepted
2.	Poor internet connectivity disrupts online teaching, learning, and administration	2.63	1.13	Accepted
3.	Many staff members lack adequate digital literacy and ICT skills for digital teaching and management	2.94	1.21	Accepted
4.	Inadequate funding hinders digital literacy and ICT development in my university	3.26	1.28	Accepted
5	There is problem of resistance to adopting new technologies among some university staff	3.08	1.23	Accepted
6.	Erratic power supply often affects the use of digital platforms	2.67	1.15	Accepted
7.	Institutional policies for digital transformation are weak or unclear	2.58	1.10	Accepted
8.	The existing curriculum is not well-structured for digital or blended learning	2.74	1.17	Accepted
9.	Digital learning reduces personal interaction between lecturers and students	3.14	1.25	Accepted
10.	Managing online platforms increases workload and stress for staff	2.78	1.19	Accepted
11.	There is insufficient training for lecturers and administrative staff on online pedagogy and application respectively	2.61	1.12	Accepted

N = 180; Criterion Mean = 2.50; Standard Mean = 2.86; S.D = 1.19

Table 3 presents the mean and standard deviation of responses concerning the challenges faced by higher education institutions in aligning digital transformation to promote teaching effectiveness and university management. From the table, challenges such as: inadequate digital facilities and ICT infrastructure, poor internet connectivity, poor digital literacy skills, erratic power supply, poor funding, resistance to change, lack of adequate ICT skills etc. all combined together to hinder meaningful digital transformation and hence making teaching less effective and university operations and management less productive. The mean score of all the items ranked above the criterion mean of 2.50 hence, the challenges were accepted as real. Respondents accepted the items listed based on an overall mean score of 2.86 and a standard deviation of 1.19.

Table 4: Mean rating of prospects of digital transformation on teaching effectiveness and university education management

S/N	Items	Mean (x)	S.D	Remarks
1.	Digital-assisted teaching could enhance better understanding and improve academic results among students	2.51	1.06	Accepted
2.	Digital tools can be used to promote interaction among students in my class	2.69	1.16	Accepted
3.	Online learning will provide more flexible and personalized education options for the students	3.15	1.23	Accepted
4.	Digital transformation will increase access to quality higher education in Nigeria	2.81	1.20	Accepted
5.	Digital tools will enhance collaboration and innovation in research works	2.67	1.15	Accepted
6.	Digital teaching/learning contributes to the development of students' employability skills	2.84	1.21	Accepted
7.	Data-driven decision-making will improve planning and	3.22	1.25	Accepted

	policy implementation in the university system			
8.	Integration of digital innovation can enhance the global competitiveness of Nigerian universities	2.77	1.19	Accepted
9.	The use of artificial intelligence and analytics can bring significant improvement to university operations	2.56	1.08	Accepted
10	ICT-driven systems will improve efficiency in university management	2.68	1.14	Accepted
11.	Future university management will rely more on paperless administrative systems hence promoting cost-effectiveness	2.72	1.15	Accepted

N = 180; Criterion Mean = 2.50; Standard Mean = 2.78; S.D = 1.17

Results from table 4 indicated that digital innovation has very great potentials in that, it could have positive impacts on the teaching/learning process and university administrative system if properly integrated into the university system. All the items in table 4 have mean scores that are above 2.50 (criterion mean), hence, all the items were accepted. The listed items were accepted based on an overall mean score of 2.78 and a standard deviation of 1.17.

Discussion of Findings

Findings from current practices in the study revealed that, digital technology and innovations have not been sufficiently integrated into the teaching/learning process and institutional management in most of the universities (Table 2). This invariably affects the effectiveness and quality of instructional delivery and the universities' administrative management. This finding was in consonance with the report of Hannan (2023) who affirmed that the massive spread of computer and web applications required organizations to digitize their processes and offer new products, services, and models for doing business. Universities however, appear to be slow to adapt to the changing educational market. The development is not unconnected with the challenges of digital transformation as revealed in Table 3. Some of the identified

challenges included inadequate digital facilities, poor internet connectivity, lack of appropriate digital literacy and ICT skills, erratic power supply, inadequate funding, weak institutional policies for digital transformation, resistance to adoption of new technologies etc. These findings are consistent with the works of Ogunode and Ndayebom (2023), Irele (2021), and Babalola and Genga (2024) where the various problems and challenges associated with digital innovations and integration into higher educational system are identified.

Results from table 4 indicated that the potentials of digital transformation in promoting teaching effectiveness and university education management are very great. Prospects such as provision of more flexible and personalized education options for the students, enhancement of better understanding and improving academic results among students, increasing access to quality higher education in Nigeria, enhancing collaboration and innovation in research works, improving efficiency in university management, planning and policy implementation in the university system among others were all accepted. Essentially, digital transformation holds tremendous potential to enhance the quality of teaching and learning and at the same time streamline management operations across universities in Nigeria.

Conclusion

The study has shown that digital transformation exerts a profound influence on both teaching effectiveness and the management of university education in Nigeria. The adoption of digital technologies and innovations ranging from Learning Management Systems (LMS) and virtual classrooms to automated administrative tools - has the potential to redefine and reshape pedagogical practices, enhance access to educational resources, and improve institutional administrative management. Furthermore, the findings emphasised that when effectively implemented, digital transformation fosters interactive learning environments, data-driven decision-making, and improved administrative efficiency.

However, the impact of digital transformation remains uneven across institutions due to infrastructural deficits, limited digital literacy among staff and students, resistance to change, inadequate funding, and inconsistent policy implementation. While many universities have adopted elements of e-learning and digital

administration, the depth of integration often depends on institutional capacity and government support. Achieving the transformative potential of digital innovation in higher education therefore, requires a holistic approach that integrates technological investment, human capacity development, effective policy implementation, and strategic partnerships among others. Through these coordinated efforts, universities in Nigeria can align with global trends in digital education and foster sustainable academic excellence and administrative efficiency.

Recommendations

The following recommendations are made in line with findings in this study:

1. Higher education funding should be improved to enhance the smooth running of the institutions. This can be done by increasing budgetary allocation to the education sub-sector from the government. Institutions of higher learning should also engage in alternative sources of funding.
2. The federal and state governments, in partnership with university governing councils, should prioritize sustained investment in robust digital infrastructure, including high-speed internet, reliable electricity, and modern computing facilities, to support both instructional and administrative activities.
3. Universities should institute continuous professional development programmes to enhance the digital literacy skills and pedagogical competencies of academic staff and equally provide training for administrative personnel to effectively use digital management systems.
4. The National Universities Commission (NUC) should develop and enforce a comprehensive digital transformation policy that ensures uniform standards, continuous monitoring, and evaluation of ICT integration across all Nigerian universities.
5. Universities should adopt a flexible combination of traditional face-to-face teaching and digital learning

platforms to improve access, engagement, and pedagogical effectiveness.

6. University management systems should be restructured to incorporate integrated digital solutions for data management, communication, finance, and decision-making, thereby improving transparency and operational efficiency.
7. Efforts should be made to ensure that all students, regardless of socio-economic background, have access to the necessary digital tools and resources to participate fully in digital learning.

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MULTIMEDIA-ENHANCED BLENDED LEARNING STRATEGY AND THE MODERATING EFFECT OF DIGITAL SELF-EFFICACY ON ECONOMICS STUDENTS' COGNITIVE ENGAGEMENT

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Abstract

This study determines the effect of a Multimedia-Enhanced Blended Learning Strategy on the cognitive engagement of the learners of Economics and explores the moderating effect of digital self-efficacy as a moderating variable. The quasi-experimental pre-test, post-test, control group design of 2x2 factorial was adopted. The respondents were 200-level undergraduate students of Economics from two Universities in Oyo State, Nigeria. The participants were 119 using an intact class. The universities were randomly assigned to the experimental and control groups. The experimental group received a Multimedia-Enhanced Blended Learning Strategy that included videos, animations, simulations, info graphics and interactive work with online activities, with the control group receiving conventional lectures. A Cognitive Engagement Scale (r- 0.89); Digital Self-Efficacy Questionnaire (r – 0.83), and Multimedia-Enhanced Blended Learning Instructional Package were used to gather data. Analysis of Covariance (ANCOVA) was used for data analysis at a 0.05 significance level. The results indicated that the Multimedia-Enhanced Blended Learning Strategy had a positive impact on students' cognitive engagement. However, digital self-efficacy was not significantly directly or indirectly related. The results of the study show that well-structured multimedia blended learning has an effect on improving student's cognition, even though students' digital self-efficacy is low. It is recommended that the quality of the instructional design in higher education should be improved and the degree of integration of multimedia teaching in Economics teaching should be enhanced.

Keywords: Higher education, multimedia instruction, students' engagement, digital competence, Nigeria

Introduction

Lower cognitive engagement in higher education (HE) among students in Economics has become an important issue; since low participation and shallow learning habits are still a problem for the quality of economic thinking and academic achievement (Fredricks et al., 2019). Cognitively disengaged students are more likely to memorise information instead of developing critical thinking skills, which restricts their ability to analyse and draw conclusions about economic phenomena, to use theory to solve problems in the real world, and to engage in intellectual labour on difficult tasks in school. This is especially true for the subject of Economics, where students are required to study abstract topics such as market equilibrium, elasticity, and macroeconomic models. In this context, new digital technologies have been changing the nature of education, and universities are questioning conventional education methods and models. Since the onset of COVID-19, universities around the world have increased their focus on utilizing technology to improve flexibility, access, and effectiveness in learning (De Bruijn-Smolders & Prinsen, 2024; Oladiti et al., 2025). This is why, blended learning has become one of the most popular teaching models in higher education across the world, which provides an opportunity for active learning, cultivates autonomous learning and enhances educational effectiveness.

In blended learning, instructional videos, animations, simulations and infographics are widely used in education (Akinyemi, Adelana & Olurinola, 2022). The multimedia enhanced blended learning is based on Mayer's Cognitive Theory of Multimedia Learning. This is the theory that learning is more likely derived from the combination of verbal description and images. Some recent studies have shown that the application of multimedia technology in teaching is an effective tool that facilitates meaningful learning, motivates and enhances students' knowledge retention (Dang et al., 2026; Oladele, 2024). Moreover, the use of blended learning and the inclusion of multimedia resources enables students to be involved in the process of learning and fosters their thinking abilities.

Student engagement is a multi-dimensional phenomenon that involves behavioral, emotional and cognitive dimensions and

has important implications for academic outcomes and future learning outcomes (Fredricks et al., 2019). Students' lack of engagement has a negative impact on learning outcomes, knowledge retention, and critical thinking skills. Low student engagement has been associated with economic education in various contexts, such as low academic achievement and high dropout rates, as well as low ability to transfer the knowledge of theory to real-life economic problems. Thus, higher education institutions focus mainly on developing students' cognitive engagement, which refers to the allocation of psychological resources to the academic tasks at hand, expressed as the level of self-regulation and perseverance when approaching challenging tasks of the kind that require complex thinking (Fredricks et al., 2019). Cognitive engagement reflects deep learning, critical thinking and concentration on the task. According to research, it is important for the effective use of blended learning in these environments to foster interaction and reflection on learning and to provide opportunities for active learning (De Bruijn-Smolders & Prinsen, 2024). Learning characteristics have been reported to explain the differences in level of engagement that can be observed among learners engaged in the same instructional activity.

In a digital learning environment, the focus of research has been on the aspects of engagement that are influenced by digital self-efficacy. Digital self-efficacy is the self-confidence that one has in using digital tools. It is designed based on Bandura's Social Learning Theory and technologies are good to effective conducting learning tasks (Bandura, 1997). Students with high digital self-efficacy are likely to have a positive attitude towards the online learning platform, use multimedia efficiently, actively participate in the online learning process, and solve technical issues that occur during the online learning process. The positive correlation between digital self-efficacy and students' engagement, learning outcomes, self-regulation and satisfaction in blended and online teaching and learning has been demonstrated recently (Luo & Zhou, 2024; Wang et al., 2025).

Numerous studies in education research have been conducted on how to relate blended learning to cognitive engagement. But the effectiveness of using a multimedia enhanced blended learning, based on the evidence, can be influenced by the student’s confidence in using digital technology. High digital self-

efficacy students can seamlessly access, manipulate and interact with digital information, making it more possible to use the digital learning materials. However, a digital low self-efficacy student may face challenges in operating technology-based learning environments and this may impact their learning and engagement (Akinyemi, Adelana & Olurinola, 2022; ElSayad, 2024). It suggests that digital self-efficacy is a moderator variable which can either amplify or diminish the relationship between blended learning using multimedia and cognitive engagement.

In parallel with the digitalisation of the world, developing countries have placed a bet on the technology-based learning, making it more accessible and more refined, and more relevant to learners. Despite all these efforts, there remain a number of difficulties for successful learning in the developing world, such as digital illiteracy, technological frameworks, connectivity, and the attitude of the learners towards learning with the support of technology (UNESCO, 2024). Sub-Saharan Africa is an area with limited digital learning infrastructure and capacity in educational institutions where the challenges surround how educational institutions can maximise the impact of digital learning without adequate infrastructure and human capacity. The use of digital education in Higher Education Institutions (HEIs) in Nigeria has come a long way in the past ten years, especially since the outbreak of COVID-19, which has led to an increase in the adoption of digital education and blended learning. To supplement the face-to-face learning experience, higher education institutions are applying learning management systems, virtual classroom technology, digital library, video conferencing and multimedia instructional technology, inspired by the development of the internet. The developments are in accordance with the national and institutional policy in the field of Digital Transformation and in building up Quality of Teaching and Learning.

The foregoing notwithstanding, the use of technology enhanced learning in Nigerian universities still has a lot of challenges. Lack of digital infrastructure, weak internet connectivity, weak power supply are reported (Aina & Ogunyemi, 2023; Sifawa & Horo, 2026) in addition to low levels of access to digital devices and disparities in students' digital skills between institutions are reported (Aderibigbe & Omotayo, 2024). These difficulties frequently impact students' engagement, interaction and participation in a blended learning context. As a result, the learners'

access to the media learning material does not guarantee learning outcomes if the learners are not confident and competent in using the media.

This is a challenge for the teaching of Economics because a learner has to be able to perform a number of activities or be capable of doing a number of activities including, but not limited to, analysing economic data, interpreting statistics, evaluating different economic policies, solving problems that do or can affect a community and applying economic theories to real-life situations and examples. The tasks listed above require learners to have a lot of active mental engagement with the task at hand and the materials to be used. Strategies that employ blended learning with multimedia frameworks most effectively can support learners' mental engagement in economics by simplifying the analytical tasks with learning resources such as case studies, simulations, videos, and digital, interactive learning tools. The learning framework that best promotes engagement, participation and active learning is blended learning frameworks blended with multimedia resources.

Studies or explorations on readiness for e-learning, academic performance of students and digital skills among other factors have been conducted in Nigeria, while research on student attitude toward e-learning has been carried out by several researchers (Sifawa & Horo, 2026; Aderibigbe & Omotayo, 2024). The studies, however, have focused on very little, the application of blended learning models enhanced with multimedia, and students' cognitive involvement during the learning process in economics. Moreover, the research conducted so far have been based primarily on the direct relationship of variables and the digital self-efficacy of the learners have not been taken into account. In this case, the self-efficacy of the learners is important because the frames and multimedia technologies for learners' blended learning will not be effective if the learners do not have a sufficient self-efficacy in digital.

Given the Nigerian universities' enhanced effort in digital learning technology and the continuous disparities in students' cognitive learning outcomes of B. Econ students, determination of the optimal moment of the use of multimedia augmented flexible learning in Nigerian universities is critical. Given that self-efficacy can help determine the extent of cognitive engagement of learners in Nigerian universities, it is critical that a study of this nature be

conducted in Nigeria. This gap needs to be addressed timely to offer insights to teachers, curriculum planners and policy makers and to aid in developing effective learning frameworks that incorporate technology in learning. This study thus filled this gap by discussing the relationship between the use of multimedia enhanced blended learning, cognitive engagement in Economics and the moderating role of digital self-efficacy. The results of the study are expected to contribute to the debate on educational technology and involvement in the learning process in Nigeria.

Statement of the problem

Digital learning aids have been more adopted in the Nigerian Universities, but the cognitive engagement of learners in Economics has been inconsistent and inadequate. That is, some students show superficial learning of course content, a lack of economic thinking, and a lack of perseverance in executing complicated tasks, whereas others seem to be hardly affected by digital learning interventions (De Bruijn-Smolders & Prinsen, 2024). The variation indicates that simply having digital learning materials is not enough for better cognitive engagement: factors at the context and individual levels are likely to moderate or mediate instructional outcomes. It is one thing that many students struggle to grasp the concept of economics in an abstract manner, especially with the teachers' dominant style of teaching. However, the integration of Multimedia-Enhanced Blended Learning Strategy into students' engagement are increasing with little or no report whether it can enhance students' cognitive engagement in Economics. Thus, the effect of this type of technique, namely multimedia-enhanced blended learning strategy on students' cognitive engagement in Economics was identified in this study. It also, explored the moderating effect of digital self-efficacy on cognitive engagement of students.

Hypotheses

H_o 1: There is no significant effect of Multimedia-Enhanced Blended Learning Strategy on students' cognitive engagement in Economics.

H_o 2: There is no significant effect of digital self-efficacy on students' cognitive engagement in Economics.

H_o 3: There is no significant interaction effect of Multimedia-Enhanced Blended Learning Strategy and digital self-efficacy on students' cognitive engagement

Methodology

This study adopted a pre-test, post-test, control group quasi-experimental research design. The design was considered appropriate because intact classes were used, and random assignment of individual participants was not feasible. A multi-stage sampling method was used in this study. The participants for the study consist of all 200 level in Education Economics in both state and federal universities in Oyo state. One federal (University of Ibadan) and one state (Emmanuel Alayande University of Education, Oyo) university were purposively selected for having Education Economics as a programme and assigned to experimental (Multimedia-enhanced blended learning strategy) and control (Conventional lecture method) group using simple random sampling technique. Intact class of 200 level Education Economics students was used because they are beginning core Economics courses such as microeconomics and macroeconomics which involve abstract concepts that can benefit greatly from multimedia resources. A total of 119 participants had undergone the study.

Three validated instruments were used to collect the data. They are: Cognitive Engagement Scale for Economics Students (CES-ES) which was used to measure students' cognitive learning engagement in Economics with reliability coefficient of 0.89 and Digital Self-Efficacy Questionnaire (DSEQ) which assessed students' confidence using digital tools for learning with reliability coefficient of 0.83. Also, Multimedia-Enhanced Blended Learning Instructional Package (MEBLIP) which contains instructional packages including videos and/or animations, simulations, infographics and online discussion exercises provided in a blended learning mode.

Pre-tests were administered to the experimental and control groups at the beginning of the study to get baseline data on cognitive engagement and digital self-efficacy. Later, the experimental group was instructed in Economics with the blended learning approach that included the use of multimedia materials including videos, animations, simulations, infographics and online interactive discussions. The control group, on the other hand, was

taught using the conventional lecture method. The intervention lasted for a period of 12 weeks. At the end of the intervention period, post-tests were administered to both groups using the same instruments for pre-tests to determine changes in students' engagement levels and digital-self efficacy.

In the experimental group, students were taught Introduction to Microeconomics I (using the Multimedia-Enhanced Blended Learning Strategy, which combined face-to-face instruction with structured digital learning activities. A Multimedia enhanced blended learning strategy was developed that makes use of text, audio, video, animation and short quizzes to teach the students the lesson Money in Economics. The teacher introduced each topic briefly in class and guided students on the learning objectives before directing them to the multimedia package. The students interact with the package, watch the videos, read the text, and navigate their way through the package. And for every wrong answer chosen by the students, the student must go over the question before he can proceed to the next module. The informed consent of the participants was ensured.

Data collected were analyzed using both descriptive and inferential statistics. Descriptive statistics, including mean and standard deviation, were used to summarize the data. Analysis of Covariance (ANCOVA) was employed to test the hypotheses at a 0.05 level of significance.

Results

The results of the study are presented in the order of hypotheses were stated:

H_{o1}: There is no significant effect of Multimedia-Enhanced Blended Learning Strategy on students' cognitive engagement in Economics.

Table 1: Summary of ANCOVA of Post-test Attitude Scores by Treatment and Digital Self-efficacy

Tests of Between-Subjects Effects

Dependent Variable: Post cog

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	474.741[a]	4	118.685	4.915	.001	.147
Intercept	2050.155	1	2050.155	84.901	.000	.427
Pretest cog	13.915	1	13.915	.576	.449	.005
Treatment	312.831	1	312.831	12.955	.000	.102
Digital self-efficacy	25.385	1	25.385	1.051	.307	.009
treatment * Digital self-efficacy	47.625	1	47.625	1.972	.163	.017
Error	2752.839	114	24.148			
Total	78254.000	119				
Corrected Total	3227.580	118				

a. R Squared = .147 (Adjusted R Squared = .117)

The ANCOVA analysis showed a main effect of treatment on students' cognitive engagement, $F(1,114) = 12.955$, $p < .001$, Partial $\eta^2 = .102$. The results showed that there was a significant difference between the students who experienced the Multimedia-Enhanced Blended Learning Strategy and the comparison group in terms of cognitive engagement. The p value is less than .05, thus the null hypothesis that the treatment had no effect was rejected. The Partial Eta Squared value of .102 suggests that around 10.2% of the variation in students' cognitive engagement was due to the treatment. According to the Cohen's guideline, the result showed moderate practical effects, this indicated that the Multimedia-Enhanced Blended Learning Strategy was effective to increase the students' cognitive involvement in Economics.

Next is to present the estimated marginal means of the post-test cognitive engagement scores to compare the adjusted level of cognitive engagement between students exposed to the Multimedia-Enhanced Blended Learning Strategy and conventional strategy, controlling for the covariates.

Table 2: Estimated Marginal Means of Post-test by Treatment

Estimates

Treatment	Mean	Std. Error	95% Confidence Interval Lower Bound	Upper Bound
Experimental	26.707[a]	.682	25.355	28.058
Control	23.357[a]	.633	22.104	24.610

The table 2 shows that the students in the experimental group had a higher adjusted mean score (Mean = 26.71) than the students in the control group (Mean = 23.36). Further, the confidence intervals indicate that the experimental group was higher than the control group. This indicates that the students exposed to the Multimedia-Enhanced Blended Learning Strategy showed higher level of cognitive engagement than the students exposed to the traditional teaching strategy.

Bonferroni Post-Hoc comparison of post-test was conducted to determine whether the difference between the experimental and control groups was statistically significant. It is presented next.

Table 3: Bonferroni Post-Hoc Analysis of Post-test by Treatment

Pairwise Comparisons

(I) treatment	(J) treatment	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b] Lower Bound	Upper Bound
Experimental	Control	3.350*	.931	.000	1.506	5.194
control	Experimental	-3.350*	.931	.000	-5.194	-1.506

Table 3 shows a statistically significant mean difference of 3.350 in favour of the experimental group ($p < 0.05$). This indicates that students taught using the Multimedia-Enhanced Blended Learning Strategy performed significantly better in terms of cognitive engagement than those taught using the traditional method.

H_{o2}: There is no significant effect of digital self-efficacy on students' cognitive engagement in Economics.

From the table 1 above, the main effect of digital self-efficacy was not statistically significant, F (1,114) = 1.051, p = .307, Partial η^2 = .009. This result suggests that students' levels of digital self-efficacy did not significantly influence their cognitive engagement in Economics. Therefore, students with different levels of digital self-efficacy did not significantly differ in their cognitive engagement scores.

H_{o3}: There is no significant interaction effect of Multimedia-Enhanced Blended Learning Strategy and digital self-efficacy on students' cognitive engagement in Economics.

From the table 2, the interaction effect between treatment and digital self-efficacy was not statistically significant, F (1,114) = 1.972, p = .163, Partial η^2 = .017. This implies that digital self-efficacy did not significantly moderate the effect of the Multimedia-Enhanced Blended Learning Strategy on students' cognitive engagement. In other words, the effectiveness of the Multimedia-Enhanced Blended Learning Strategy was relatively similar for students regardless of their level of digital self-efficacy. The treatment improved cognitive engagement across students, but the magnitude of the improvement did not depend significantly on their digital self-efficacy.

Discussion of Findings

Effect of Multimedia-Enhanced Blended Learning Strategy on Students' Cognitive Engagement in Economics

The study found that the use of Multimedia-Enhanced Blended Learning Strategy in teaching Economics resulted in higher levels of cognitive engagement among students when compared with the conventional method. This suggests that blended learning incorporating multimedia resources can advance students' mental engagement, constructive thinking, focus, and participation in learning activities. The result is in agreement with the research of De Bruijn-Smolders and Prinsen (2024), Akinyemi and Salami (2023) where he noted that blended learning systems in higher education, which use interactive digital resources, improve cognitive engagement and participation in learning to a great extent. (2026), multimedia-based blended learning systems increased learning engagement. In another vein, Aina and Ogunyemi (2023) noted that blended learning strategies, when

integrated with multimedia resources, improved learners' participation and learning experiences in Nigerian universities.

However, the study compares with Alammary (2023), where blended learning systems, with low instructional and technological environmental quality, had low fulfillment of students' engagement. Also, Kebritchi et al. (2022) stated that learning systems, where students are not ready to learn, and lack the required digital skills, engagement in learning is low, despite the use of advanced technologies.

The current study showed that blended learning with multimedia resources had the ability to represent economic concepts in different formats, such as through videos, animations, and other flexible resources, graphics, and interactive activities. Economics concepts are often abstract and difficult for students to visualize. The multimedia components may have reduced cognitive overload and facilitated deeper processing of information, thereby increasing students' willingness to invest effort in learning activities. Furthermore, the flexibility offered by blended learning may have enabled students to revisit learning materials, learn at their own pace, and engage more meaningfully with course content (Kumo, Shehu, & Dayo, 2025; Adeneye & Gbadamosi, 2025).

Effect of Digital Self-Efficacy on Students' Cognitive Engagement in Economics

The results indicated that the main effect of digital self-efficacy on cognitive engagement learning in Economics was insignificant. This suggests that students with different levels of confidence in digital technologies had almost the same level of cognitive engagement in the learning process. This was different from Wang, Li, and Chen (2025), who found that students who had higher levels of digital self-efficacy were more engaged and active in learning with the help of technology. Also, Luo and Zhou (2024) found that students who had high digital self-efficacy were more self-regulated and engaged in a blended learning environment. In Nigeria, Yusuf and Bello (2024; Akinyemi, Adelana, and Olurinola (2022) found positive correlation of digital self-efficacy and students' engagement in higher education.

On the other hand, the finding was consistent with the study of ElSayad (2024), who **found** that self-efficacy could not be considered an independent predictor of engagement when the

design of the instruction was sufficiently considerate and the learning activities were flexible to accommodate students with different levels of technological competence. Similarly, the study of Onojah and others (2023) found that the effect of digital self-efficacy on learning outcomes was negligible when students received due help and support from instructors. The likely explanation for the finding is that the university students of today are more knowledgeable of the digital world and more experienced with online learning. Therefore, the differences in digital self-efficacy were likely not big enough to result in differences in cognitive engagement. It is also possible that the blended learning environment, augmented by multimedia, offered enough instructional support and user-friendly digital resources, which resulted in minimal effect of the individual differences. As a result, students with both high and low levels of digital self-efficacy may have been able to participate effectively in learning activities.

Moderating Effect of Digital Self-Efficacy on the Relationship between Multimedia-Enhanced Blended Learning Strategy and Cognitive Engagement

The study showed that the combined effect of Multimedia-Enhanced Blended Learning Strategy and students' digital self-efficacy on cognitive engagement was statistically not significant. This shows that digital self-efficacy did not significantly interact with the instructional strategy in influencing cognitive engagement. This means that the effectiveness of the Multimedia-Enhanced Blended Learning Strategy was more or less the same, despite the varying levels of students' digital self-efficacy. The findings indicate a deviation from the model proposed by Social Cognitive Theory (Bandura, 1997) wherein the expectation is that self-efficacy levels of an individual would influence the individual's reaction to a given learning situation. The study findings also disagree with Luo and Zhou (2024) who noted that learners with high self-efficacy beliefs gained more advantages from the technology-based learning situation, and Wang et al. (2025) who noted that self-efficacy enhanced the link between the use of technology and learners' engagement.

The findings, however, are consistent with some recent research which indicates that design of the instruction has more of an effect on engagement than individual characteristics of learners. De Bruijn-Smolders and Prinsen (2024) claimed that most blended

learning designs would cater for engagement of a variety of learners with many options for different types of participation and interaction. Aina and Ogunyemi (2023) noted that the designing of blended learning activities resulted in increased participation of students regardless of their previous technological experiences. The absence of a significant moderation effect might be the result of the Multimedia-Enhanced Blended Learning Strategy that was used in the study. The strategy might have been engaging, interactive, and easy to use, thus, providing an advantage to all students, regardless of their levels of digital self-efficacy.

The availability of instructor support, peer collaboration, and accessible multimedia resources may have reduced the dependence of engagement on students' technological confidence. Another plausible explanation is that the participants possessed relatively similar levels of digital self-efficacy, limiting the likelihood of detecting a moderating effect (Oladele, 2024). Therefore, while digital self-efficacy remains an important learner characteristic, its influence may be less pronounced in well-designed multimedia-enhanced blended learning environments.

Policy implications

Taking into account the results of this study, it is evident that there is a need to rethink educational policies and practices in the tertiary education sector. Since the Multimedia-Enhanced Blended Learning Strategy considerably improved students' cognitive engagement, educational policymakers and University managers should incorporate this strategy in Economics teaching and other related fields. This would call for investing in digital infrastructure for teaching and learning, such as access to stable internet, effective learning management systems and multimedia resources for teaching blended learning. Capacity building of lecturers would also be a prerequisite and would involve designing and facilitating blended learning workshops built around multimedia resources.

Moreover, the insignificant effect of digital self-efficacy implies that learners' confidence in digital tools is of less value and that a well-structured instructional design would be of more value. Thus, policies should incorporate blended learning that takes into consideration varying levels of digital competence among learners. In addition, universities should enhance the digital support services for students that include orientation and troubleshooting services. Policies should move away from a technology adoption stance to a

multimedia design stance that meaningfully and intentionally enhances students' cognitive engagement and learning.

Conclusion

The study asserts that the Multimedia-Enhanced Blended Learning Strategy is a valuable instructional strategy that can be used to enhance cognitive engagement of learners in Economics. The study also notes that cognitive engagement of learners was enhanced by the blended learning strategy that heavily relied on multimedia resources and that digital self-efficacy, both as a direct and a moderating variable was of no value. Thus, blended learning that is both multimedia resource intensive, and self-efficacy of learners focused, would support cognitive engagement of learners in Economics.

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UNDERGRADUATE PERCEPTIONS OF DIGITAL LITERACY SKILLS AND GRADUATE EMPLOYABILITY: A STUDY OF 300-LEVEL STUDENTS AT EMMANUEL ALAYANDE UNIVERSITY OF EDUCATION, NIGERIA

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Abstract
This study investigates the perceived roles of digital literacy skills in enhancing graduate employability prospects among undergraduates at Emmanuel Alayande University of Education, Oyo, Nigeria. Adopting a descriptive survey design, the research focused on a sample of 120 respondents selected from 300-level regular students via a simple random sampling technique to ensure equal representation across the university's six faculties. Data were collected using the 'Roles of Digital Literacy Skill in Enhancing Graduate Employability Prospects' (RDLSEGEP) structured questionnaire, which yielded a Cronbach Alpha reliability coefficient of 0.73. The findings indicate that students perceive

foundational digital competencies, such as the ability to search and evaluate digital information (Mean = 3.85) and proficiency in productivity software (Mean = 3.70), as the most critical for employability. Conversely, specialized technical skills like basic programming and coding (Mean = 2.30) were perceived as less essential for general graduate prospects. The study established a strong consensus that digital literacy directly facilitates job acquisition (Mean = 3.90) and enhances workplace productivity. Consequently, the study recommends the formal integration of practical digital literacy training into academic curricula, the establishment of robust university digital resource centers, and a multi-stakeholder collaboration between government and industry to bridge the existing skills gap.

Keywords: Digital literacy, Digital Skills, Digital Human Capital, Graduate Employability.

Introduction

Digital literacy is the comprehensive capability to access, manage, comprehend, integrate, communicate, assess, and produce information effectively and securely using digital technologies. This proficiency is essential for academic success, future career prospects, and participation in today's technologically driven society. Sifting through vast amounts of information in various formats in the digital age involves searching, evaluating, applying, and producing information with a discerning mindset. Effective communication is vital in virtual environments. It encompasses expressing ideas clearly, asking relevant questions, maintaining respect, and building online and offline trust. Digital skills refer to the competencies required to effectively use information and communication technologies (ICT) in various aspects of life (Gałan, 2022). These skills are essential in the 21st century and enable individuals to navigate and utilize digital tools and technologies for information management, communication, collaboration, critical thinking, creativity, and problem-solving (Saputra et al., 2021).

Digital literacy is fundamental to students' long-term success and personal economic well-being. Employers are increasingly recognizing the benefits of employing people with the knowledge and skill to harness the potential of technologies and may use this to differentiate between potential employees. Many institutions see a natural synergy in linking digital literacy initiatives

with other priorities such as developing graduate attributes, employability and transferable skills. These digital literacy skills will enable students to use computer to network from various platforms which provide multiple opportunities for team work and collaboration (Aroles, et al 2021).

Digital literacy is a broad set of critical skills necessary to navigate the complexities of the digital age. These encompass the ability to proficiently use digital devices to access, evaluate, analyze, apply, and synthesize data. More importantly, it effectively leverages information and communication technologies to seek, understand, assess, create, and communicate digital information. These multifaceted skills cover operational, information navigation, critical thinking, social interaction, and creative expression (Dewi, et al., 2021). According to Cetindamar-Kozanoglu and Abedin (2020), understanding and utilizing digital literacy has become increasingly important in today's professional landscape, irrespective of industry or job function. As mentioned earlier, digital literacy has been identified as a crucial factor for graduate employability, particularly in today's digital age.

The importance of life-career skills in enhancing students' employability is substantial. These skills play a critical role in equipping individuals with the knowledge and capabilities required to effectively manage the emotional and social aspects of the professional sphere. Extensive research has demonstrated the positive impact of life-career skills on graduates' employability. Scholars posit that when students possess the knowledge and aptitude to navigate the intricacies of life and the workplace, they can better concentrate and focus on enhancing their competencies for employability (Clarke, 2018; Van Laar, et al 2019).

Despite this, limited studies have reported the significance of life-career knowledge in improving graduate employability. Several empirical studies have established a clear correlation between digital literacy skills and graduate employability (Adegbite & Hoole, 2024; Govender & Adegbite, 2021). They emphasize the necessity for higher education institutions to integrate digital literacy skills into their curriculum in response to the demands of modern technology in the 21st century.

Digital literacy involves the acquisition of right habits, attitudes, skills and what it takes to survive in the face of unemployment. Despite the importance and emphasis on digital literacy skills on employability of fresh graduates in Nigerian labour

market, it is unfortunate that responses of employers of labour on the use of modern technology by recent graduates reveal that these skills are lacking. Employers view that graduates are not yet ready to enter and face the complexities and challenges of the world of work in the era of modern technology. Graduates are deficient in transferable skills required of the workforce in the era of modern technology and are unable to excel in today's workplace probably due to little or absence of practical approach to the teaching and learning in tertiary institutions. Indeed, it is always preferable for young graduates to acquire multiple skill sets, including digital and non-digital skills, to enhance their employment prospects Nair etal… 2019).

Schlech et al. (2017) in their study found that one needs to alter their interpersonal skills for the digital space when working in a global environment. This is mainly because digital relationships are harder to cultivate and often lack the professional intimacy that can be witnessed in physical spaces.

Bejaković and Mrnjavac (2020) contend that employability is highest when individuals possess skills like digital literacy, Information and communication technology (ICT) skills, readiness for lifelong learning etc. The digitally literate will be able to perform work-related tasks better and have a richer learning experience throughout life (Anthonysamy et al., 2020). Digital skills have been described as central to employability and obtaining employment (Lissitsa & Chachashvili-Bolotin, 2019;). It has been postulated that a lack of such skills negatively impacts productivity, compensation, appraisal, and employment opportunities. Graduate employability has been a key concern for researchers and policy makers in the last few years. Many scholars have focused their research efforts in this direction and found that digital literacy capabilities are a key concern when it comes to students' employability (Peacock & Bacon, 2018).

A collaborative international body can also be set up to advance digital literacy, training and retaining efforts (Lyons, 2019). The responsibility of training also lies with employers. Uber, for example, as part of their recruitment process mandates its drivers to attend digital training (Mwakatumbula & Moshi, 2020). Since much of the research has been focused on students, a lot of onus has been placed on educational institutions to impart the necessary digital skills to students.

Promoting digital literacy in tertiary education requires coordinated institutional, policy-driven and pedagogical strategies. These are various ways of promoting digital literacy in tertiary education: (UNESCO, 2018) reported that digital literacy should be embedded across disciplines, not treated as a standalone course. Students need to develop competencies such as information evaluation, digital communication, and content creation within their fields. Lecturers must be digitally competent to effectively transfer skills. Continuous professional development is essential. Encourage adoption of e-learning platforms and digital pedagogy. Organize workshops and training on emerging technologies (European Commission, 2020). Provision of computers, smart classrooms, and digital libraries. Adequate access to technology is foundational. Reliable internet connectivity across campuses (World Bank, 2020). OECD (2019) opine that institutions should offer structured programs to enhance students' digital competencies. Digital literacy workshops and orientation programs. Peer mentoring and ICT help desks. Commonwealth of Learning (2020) reported that blended learning environments expose students to digital tools regularly. International Telecommunication Union (2018) submitted that clear policies help sustain digital literacy initiatives, develop institutional digital strategies and there should be allocate funding for digital transformation projects. Redecker (2017) identify collaboration with industry and tech organizations enhances exposure. Internship programs in tech-related fields.

Recently, there is a noticeable absence of comprehensive research investigating the relationship between digital literacy skill and graduate employability. This gap in research can be attributed to the limited quantity and quality of studies in this specific domain. Most existing studies are not primarily descriptive and lack in-depth analysis of causal relationships using advanced methodologies. Therefore, the paper aims to address these gaps and contribute to a more comprehensive understanding of these important areas.

The main objective of the paper is to study the roles of digital literacy skill in enhancing graduate employability prospects while the specific objectives are stated below:

i. To assess the types of digital literacy skills in enhancing employability prospect for graduate in Nigeria
ii. To determine the roles of digital literacy skills in enhancing employability prospect among graduate in Nigeria

iii. To examine possible measures to promote digital literacy skills in tertiary education so as to serves as tool for employability prospects among graduate

Research Questions

This paper aims to answer the following questions:

i. What are the types of digital literacy skills in enhancing employability prospect for graduate in Nigeria?
ii. Are there roles of digital literacy skills in enhancing employability prospect among graduate in Nigeria?
iii. What are the possible measures to promote digital literacy skills in tertiary education so as to serves as tool for employability prospects among graduate?

Methodology

The research adopted a descriptive survey design. The population comprises all undergraduates of Emmanuel Alayande University of Education, Oyo. Simple random sampling was used to select 120 respondents across six faculties in the university. The instrument used for the study was a structured questionnaire titled The Roles of Digital Literacy Skill in Enhancing Graduate Employability Prospects (RDLSEGEP), which was used to collect relevant information on the roles of digital literacy skill in enhancing graduate employability. The questionnaire items were weighted thus: strongly agree (4 points), agree (3 points), disagree (2 points), and strongly disagree (1 point). The cut-off points for accepting an item were 2.50 which were obtained by (4+3+2+1) / 4 = 2.50. Therefore, the acceptable level of mean was 2.50 and above for agree while those that obtained below 2.50 were regarded as disagree.

Validity of the instrument (RDLSEGEP) was ensured by subjecting it to through scrutiny by experts in Educational Evaluation. Reliability of the instrument (RDLSEGEP) was ascertaining using Chronbach Alpha. The reliability Coefficient was found to be 0.73. Data analysis involved frequency counts and simple percentages for demographic characteristics, while mean scores were utilized for research questions, with a 2.50 mean score set as the acceptance threshold.

RESULTS AND DISCUSSION OF FINDING

Research Question 1: What are the types of digital literacy skills in enhancing employability prospect for graduate in Nigeria?

Table 1: Mean Scores and Standard Deviations of Types of Digital Literacy Skills

S/N	Items	Mean	Std. Deviation	Decision
1	Ability to search and evaluate digital information effectively.	3.85	0.45	Accepted
2	Proficiency in using productivity software (e.g., Microsoft Office, Google Docs).	3.70	0.50	Accepted
3	Competency in social media for professional networking.	3.10	0.80	Accepted
4	Cybersecurity awareness and safe digital practices.	3.65	0.55	Accepted
5	Online collaboration and remote work proficiency.	3.50	0.60	Accepted
6	Knowledge of basic programming and coding.	2.30	0.90	Rejected
7	Digital content creation (e.g., graphics, videos, presentations).	2.80	0.75	Accepted
8	Data literacy and analytical skills.	3.25	0.65	Accepted
9	Understanding of cloud computing and storage.	3.00	0.70	Accepted

Table 1 reveals the types of digital literacy skills considered important for enhancing graduate employability prospects in Nigeria. The majority of items had mean scores above the 2.50 acceptance threshold. "Ability to search and evaluate digital information effectively" (Mean = 3.85) and "Proficiency in using productivity software (e.g., Microsoft Office, Google Docs)" (Mean = 3.70) were rated highest, indicating that respondents strongly believe these are crucial skills. "Cybersecurity awareness and safe digital practices" (Mean = 3.65) and "Online collaboration and remote work proficiency" (Mean = 3.50) also demonstrated high levels of agreement. Skills such as "Data literacy and analytical skills" (Mean = 3.25), "Competency in social media for professional networking" (Mean = 3.10), "Understanding of cloud computing and storage" (Mean = 3.00), and "Digital content creation (e.g., graphics, videos, presentations)" (Mean = 2.80) were also accepted as important. However, "Knowledge of basic programming and coding" had a mean score of 2.30, falling below the acceptance threshold, suggesting it is perceived as less critical

for general graduate employability compared to other digital literacy skills.

Research Question 2: Are there roles of digital literacy skills in enhancing employability prospect among graduate in Nigeria?

Table 2 Mean Scores and Standard Deviations of Roles of Digital Literacy Skills

S/N	Items	Mean	Std. Deviation	Decision
1	Digital literacy improves graduates' ability to secure jobs.	3.90	0.40	Accepted
2	Employers prefer graduates with strong digital skills.	3.80	0.48	Accepted
3	Digital skills enhance workplace efficiency and productivity.	3.75	0.52	Accepted
4	Digital literacy supports continuous learning and career advancement.	3.60	0.58	Accepted
5	Online job application processes require digital literacy skills.	3.55	0.60	Accepted
6	Graduates with digital skills have better entrepreneurial opportunities.	3.20	0.70	Accepted
7	Digital literacy skills are essential for remote and hybrid work environments.	3.45	0.62	Accepted

Table 2 presents the roles of digital literacy skills in enhancing graduate employability prospects. All items recorded mean scores well above the 2.50 acceptance criterion, indicating strong agreement among respondents that digital literacy plays a significant role. "Digital literacy improves graduates' ability to secure jobs" (Mean = 3.90) received the highest mean score, signifying that respondents overwhelmingly believe digital skills directly contribute to job acquisition. Similarly, "Employers prefer graduates with strong digital skills" (Mean = 3.80) and "Digital skills enhance workplace efficiency and productivity" (Mean = 3.75) were highly accepted, confirming the value employers place on these

competencies and their impact on work performance. Other accepted roles include supporting "continuous learning and career advancement" (Mean = 3.60), facilitating "online job application processes" (Mean = 3.55), enabling participation in "remote and hybrid work environments" (Mean = 3.45), and offering "better entrepreneurial opportunities" (Mean = 3.20). These findings collectively affirm the critical and multifaceted roles of digital literacy in enhancing graduate employability in Nigeria.

Research Question 3: What are the possible measures to promote digital literacy skills in tertiary education so as to serves as tool for employability prospects among graduate?

Table 3 Mean Scores and Standard Deviations of Possible Measures to Promote Digital Literacy Skills

S/N	Items	Mean	Std. Deviation	Decision
1	Integration of digital literacy courses into tertiary education curricula.	3.95	0.35	Accepted
2	Provision of free or affordable digital literacy training programmes.	3.80	0.45	Accepted
3	Establishment of digital resource centres into various universities.	3.70	0.50	Accepted
4	Encouraging student participation in digital skill development competitions.	3.40	0.60	Accepted
5	Collaboration between universities and industries to provide digital training.	3.65	0.55	Accepted
6	Provision of scholarships for ICT and digital literacy programmes.	3.30	0.68	Accepted
7	Inclusion of digital competency assessments in university evaluations.	3.10	0.75	Accepted
8	Regular training and workshops for students on emerging digital tools.	3.55	0.58	Accepted
9	Encouraging faculty members to integrate digital tools into teaching methods.	3.70	0.50	Accepted
10	Government support for digital literacy initiatives in education.	3.85	0.40	Accepted
11	Establishing mentorship programmes for digital skills enhancement.	3.25	0.72	Accepted

Table 3 outlines the possible measures to promote digital literacy skills in tertiary education for enhanced graduate employability. All 11 items received mean scores above the 2.50 acceptance threshold, indicating strong agreement from respondents on a range of effective strategies. "Integration of digital literacy courses into tertiary education curricula" (Mean = 3.95) was identified as the most crucial measure, suggesting a strong belief in formalizing digital literacy education. "Government support for digital literacy initiatives in education" (Mean = 3.85) and "Provision of free or affordable digital literacy training programmes" (Mean = 3.80) also garnered very high support, emphasizing the need for policy-level intervention and accessible learning opportunities. Other highly supported measures include "Establishment of digital resource centres into various universities" (Mean = 3.70), "Encouraging faculty members to integrate digital tools into teaching methods" (Mean = 3.70), and "Collaboration between universities and industries to provide digital training" (Mean = 3.65). These findings collectively point to a comprehensive approach involving curriculum reform, resource provision, institutional support, and multi-stakeholder collaboration as vital for promoting digital literacy among graduates.

Discussion of Findings

The findings from research question 1, revealed the types of digital literacy skills that can enhance graduate employability, it reveals a strong consensus among respondents regarding the importance of practical and fundamental digital competencies. Skills such as the ability to search and evaluate digital information effectively, proficiency in productivity software, cybersecurity awareness, and online collaboration were highly rated. These results suggest that employers and the workforce value foundational digital skills that facilitate immediate productivity and safe interaction in the digital environment. The findings corroborated with Gałan, 2022) who also identified different digital tools that can enhance employability among youth.

The findings from research question 2 strongly affirm the significant roles of digital literacy skills in enhancing graduate employability prospects in Nigeria. The high agreement across all items indicates that respondents recognize digital literacy as a key determinant in securing jobs, improving workplace efficiency, enabling continuous learning, and facilitating remote work. This

corroborates the work of Adegbite & Hoole, 2024; Bejaković and Mrnjavac (2020), Anthonysamy et al., 2020,; Lissitsa & Chachashvili-Bolotin, 2019, who found that digital literacy enhances employability.

Furthermore, the results from research question 3, identifying possible measures to promote digital literacy in tertiary education, point towards a multi-pronged approach. The overwhelming support for integrating digital literacy courses into curricula underscores the need for formal and structured education in this area. The emphasis on government support, free training programs, and the establishment of digital resource centres suggests a desire for systemic, accessible, and well-resourced initiatives. The strong agreement on involving faculty in integrating digital tools and fostering university-industry collaboration indicates a recognition that both pedagogical innovation and practical exposure are essential. The finding is in line with the work of UNESCO, 2018, OECD, 2019, World Bank, 2020, European Commission (2020), Commonwealth of Learning (2020), who also identified most of these ways of promoting digital literacy.

Conclusion

Based on the findings of this study, it can be concluded that digital literacy skills are indispensable for enhancing graduate employability prospects in Nigeria. There is a clear recognition among the undergraduate students that core digital competencies are vital for navigating the contemporary job market, performing effectively in the workplace, and seizing entrepreneurial opportunities. While foundational and practical digital skills are highly valued, more specialized skills like programming are currently perceived as less universally essential.

Recommendations

The following recommendations were made for the study:

Tertiary institutions in Nigeria should formally integrate comprehensive digital literacy courses into all academic curricula, making them mandatory for all students, regardless of their field of study. This would ensure that all graduates acquire essential digital skills before entering the job market.

Universities should prioritize the establishment and continuous upgrading of digital resource centers, including access to high-speed internet, modern computers, and relevant software. This will

provide students with the necessary tools and environments for practical digital skill development.

Regular training and workshops should be organized for faculty members to enhance their digital competencies and encourage them to integrate digital tools and teaching methodologies into their courses.

Emphasis should be placed on practical, hands-on training in productivity software, online collaboration tools, cybersecurity, and digital content creation, as these were identified as highly critical skills.

Project-based learning that requires the application of digital tools should be encouraged. Universities should actively seek partnerships with industries and businesses to provide students with real-world digital training, internships, and mentorship opportunities. This collaboration can also inform curriculum development to ensure that the digital skills taught are aligned with current industry demands.

The Nigerian government, through relevant education agencies, should provide robust support and formulate policies that promote digital literacy initiatives in tertiary education. This includes funding for digital infrastructure, training programs, and research in digital skills. Finally, tertiary institutions should consider integrating digital competency assessments into their evaluation processes to gauge students'.

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ENVIRONMENTAL SUSTAINABILITY AND UNIVERSITY GOVERNANCE IN NIGERIA: IMPLICATIONS FOR EDUCATIONAL EFFECTIVENESS AND INSTITUTIONAL DEVELOPMENT

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Abstract
This paper examines the concept of environmental sustainability within the context of Nigerian universities, with particular emphasis on the role of university governance and school plant management in promoting sustainable learning environments. Adopting a conceptual and analytical approach, the study explores key dimensions of the university physical environment, sustainability practices, and international frameworks guiding environmentally responsible campuses. The paper argues that inadequate attention to environmental sustainability in Nigerian universities undermines educational effectiveness, institutional efficiency, and the health and well-being of campus users. Drawing on existing literature and global best practices, the study highlights the implications of poor environmental management, including compromised academic goals, health risks, and reduced institutional aesthetics. It concludes that sustainable environmental practices are essential for achieving educational objectives and institutional development. The paper recommends the integration of sustainability principles into university governance, curriculum, and operational practices to ensure a conducive and future-oriented learning environment

Introduction
Environmental sustainability has become a trending issue of concern across different fora. Man's activities on earth have a lot of impact on the environment and this in turn has been observed to have adverse effects on human life and wellbeing. The educational community is not left out of this concern. Environmental

sustainability refers to the careful use and management of the physical environment in such a way that it can continue to support life, wellbeing and activities of both human beings and the non-humans as it is meant to be even in the future. Ensuring this in educational environments, especially university campuses, is crucial. Some important areas of concern include; the university physical environment and the integration of environmental sustainability as an important feature of the university environment. This implies that environmentally friendly practices and culture could be introduced into university activities and operations, whether it be academic such as in curriculum and research or it be normal day to day occurrences. A study across hundreds of publications has reported a lack of priority for sustainability plans in university governance and consideration for only a minute aspect of sustainability issues. (Mayara and Vanderley 2025) Such paradigm shift would require the interest and contribution of university heads and administrators to successfully occur. Thus, Nigerian university leaders are important participants to be enlisted for this pursuit in spite of their usually, immensely hectic load.

The international declarations and initiatives promoting environmental sustainability on university campuses are essential tools to consider in order to promote environmental sustainability in Nigerian universities. Implications of the absence of environmental sustainability in Nigerian universities have been identified, some of which include challenges to set academic goals of both the students and the institution, loss of aesthetics in the environment as well as the expected inspiration that could give, health challenges such as respiratory issues and vector borne diseases that can thrive in an unkempt environment. (Musa and Vicent 2023, Okogun 2023) A university environment when not sustainably managed could be found unconducive for learning and work which may induce inefficiency and ineffectiveness amongst university students and workers. Thus, the importance of ensuring environmental sustainability should not be undermined as a responsibility of university leaders and administrators and this they would have to see as such. Rather, efforts should be put in place through the adoption of the principles of environmental sustainability to ensure that the university environment is conducive for learners and workers. A quick look at the QS world ranking on social and environmental sustainability impact of universities revealed that only two Nigerian universities appeared

on the ranking; one private and one public. Neither was below the 900th position. (QS World university rankings 2025) All these and more showcase the need for attention in this area.

The university physical environment / school plant

The university physical environment is its school plant. This is the location, milieu or terrain as well as the surroundings, setting and even the atmosphere in which the university operates. It is the external surroundings in which a university is domiciled and from which it contributes to and influences the world around it. The physical environment or school plant also includes all the features of nature whether visible or not as well as all material resources which exist or are in use in a university and these must be used sustainably if future users of the campus will have a fair share of access to these natural resources that should be for all be it past, present or future inhabitants. Thus, the site, buildings, equipment and structures whether permanent or not and other resources; natural or otherwise, made available for the purpose of effective learning and teaching in a school (Amanchukwu and Ololube 2015, Abdullah 2016 and Khan 2021) should always be employed with consideration for basic sustainability concerns especially when taking into cognizance that a learning environment is like a nursery in which learners at whatever level are raised.

Usually, a university is situated on a large expanse of landed property. This is often more than the mass in use in educational institutions at lower levels like the primary or secondary. However, the bigger the land mass the more the efforts for proper running and maintenance are likely to be. The efforts required to ensure a sustainable use will also, likely be more. Thus, it is not unlikely that university administrators and managers will have a more arduous task in the sustainable management of their school plant than other educational managers. This also puts forward the urgency of paying consistent attention to the school plant at this level of education as there may be more to attend to. Thus, a university physical environment or school plant is a major task for educational administrators in the university especially when sustainability features are being introduced or enforced. Challenges of school plant management in government owned universities have been identified by Musa and Vincent (2023). These include poor attitude of staff and students, excessive use of available facility and resources due to over enrolment, funding

issues, insecurity, corruption, lack of required school management skills amongst vice-chancellors and so on. The enumerated challenges show that there is much for educational managers to pay attention to with respect to school plant management if the university environment will emerge as being a sustainable environment for all times. Also, since lack of school plant management skills has been identified amongst vice chancellors, it is not unlikely that it is a critical aspect as the sustainability of the physical environment of the university may be elusive and requiring prompt attention.

Environmental sustainability as an important feature of the university environment

The school plant having been identified to include everything in a school physical environment (Abdullah 2016) is prominent in its important role play as the milieu for the achievement of all educational goals. Owing to the fore going, the sustainability of the environment becomes a very important feature that school managers and administrators must pay attention to since the concept of a sustainable environment appears to be emerging a very crucial issue for all in recent times. While different stakeholders tend to look into different aspects of sustainability in the school environment, the role of educational managers as a rallying point for the overall implementation of sustainability tenets for a sustainable environment in schools cannot be over emphasised and should not be undermined. Otherwise, it is not unlikely that the connecting points by which efforts of different stakeholders and interest groups could be linked may be missing,

According to Bassey (2021) Effective management of a school plant includes appropriate decision making by the school manager and other stakeholders to build the school plant in such a way that all needs envisaged for the achievement of goals and objectives for the establishment of the school are put in place. The goals and objectives of an organisation are always the targets of administrators and managers and doing things in a manner that they will be fulfilled in a school is the responsibility of educational managers and administrators. These decisions should not only include buildings and other material resources although they are germane to the achievement of educational goals. Rather, decisions of educational managers and administrators should include such important indices of a sustainable environment as the

quality of the air in the environment, availability of water for the maintenance of a sustainable environment and such other important resources and processes that will preserve the hallmarks of nature in the university physical environment. These are all very important in the physical environment of a school because they are likely to promote efficiency and effectiveness in the institution when they are in proper working order.

In a study by Okogun (2023) the learning environment and how it is perceived by students influenced academic performance. This shows the importance of the condition of the school plant in achieving good academic performance which is one of the most important reasons for schooling. It is thus important that the definition of a good condition for a school plant should include the sustainability viewpoint because sustainability promotes judicious use of the environment while considering both current and future users and provides for all. In order to ascertain consistent achievement of educational goals, educational managers in conjunction with other professionals and stakeholders need to ensure that facilities are not only available but are maintained and used in a sustainable manner such that the environment is preserved for the benefit of posterity while serving present users well too. Thus, it appears that environmental sustainability is emerging as a very important factor that could influence learners' outcomes and institutional performance. For instance, a study by Adesuyi (2019) on indoor air quality in Nigerian universities in Lagos, showed air pollutants at levels higher than acceptable limit by WHO. Moreso, good air quality was reported to improve workplace productivity and poor air quality could give rise to health and comfort challenges as well as absenteeism. This portrays how air quality as a sustainability indicator could influence learners' outcome and institutional performance in general.

Invariably, the idea of sustainability does not only take care of the urgent needs of today but it also factors in the important needs of all times, the future inclusive. For instance, the need for safety in the school plant has been identified as a responsibility that educational administrators must take on (Atanda 2013) and an inclusion of environmental sustainability priorities could most likely promote this necessity automatically. The school plant should therefore be holistically planned, designed and managed without leaving out the important indices of environmental sustainability.

Environmental sustainability in Nigerian universities

A university environment can be said to be sustainable where the environment is used in such a way that the needs of the future are not compromised by the activities of today. A sustainable university environment thus implies a proper use of the physical and natural components of the university campus and continuously so; an absence of which may spell danger now and for the future. Already, the world is aware of the unquantifiable negative impact of human activities on the environment. Schools, including universities have always been a part of these activities which have had a negative impact on nature since large volumes of solid wastes and other pollutants are inevitably generated daily. This is apart from other similar adverse impacts from other activities. In the past, it was largely due to ignorance but now that the facts are brought to light it is important that people take cognizance of the effect of their activities on the environment.

According to Gough (2016), for going to 20 years, governments of developed nations have set goals which include having a sustainable school environment where young people can learn to live sustainably in their environment. It seems not much has been done in this respect in the developing nations. Where schools have been mandated to become sustainable schools or green schools in which having a sustainable environment is of great importance in countries like UK, Australia and Canada, university environments here in Nigeria seem to still be left untended when findings from different studies are considered (Musa and Vincent 2023, Okogun 2023 and QS World university rankings 2025). The apparent dearth in literature on the subject of environmental sustainability in universities in Nigeria leaves no doubt that there is much to be desired in this regard. The findings from foreign countries give a great contrast on the other hand. In fact, a study by Hosein, Balloo, Byrom and Essau (2023) showed that of three aspects of the university environment which included social, cultural and physical, only the physical environment did not have an impact in predicting employment outcomes of young people in the UK. This suggests that the conduciveness and suitability of university environment have been so harmonized according to a minimum standard that it is no longer a factor that can influence student outcomes negatively. In Nigeria on the contrary, studies still point to the fact that the state of the physical environment did not meet international standards and still

influenced student outcomes or performances (Okogun 2023, Ogobiri and Abule 2024) While it seems to be common knowledge that the environment should be used sustainably which implies its use in such a way to engender over all human well-being for now and the future, there seems to be a paucity of research into the issues of environmental sustainability in the university system or their indicators in literature locally.

In some developed countries as earlier mentioned, the government has raised a pursuit for sustainable schools and for some, like England; the goal should have been actualized by 2020. By then, all their schools should have become sustainable schools according to the plan (Huckle 2009). The concept of sustainable schools looks at the different dimensions of sustainability with application in the school community which includes the school premises itself and the larger community it interacts with such as its host community and or wherever the students have come from. The influence of the school can extend that far. Thus, sustainable schools are schools that blend sustainability into every area of school life (Huckle 2010). In Nigeria, a need for universities in which environmental sustainability principles are eschewed is pertinent (Abenu, Yusufu and Ugochukwu 2024). That is, the entire school or university community takes into consideration their own contribution to the sustenance of the features of nature around them for posterity by their everyday activities. Similarly, the university leadership is expected to promote environmental sustainability by their decisions and operations.

Actions in a sustainable university environment are taken with the plausible impact on the natural university environment in view. Gough (2016) considering the post-Millennium Development Goals Agenda points out that as part of the core of global learning for the twenty first century, environmental sustainability education remains required. Without doubt, the provision of a sustainable university environment seems the practical ground for the achievement of this required goal. This is because putting to practice what is set as a goal as a lifestyle of the university community would ingrain the lessons more into the students than anything else. More so, the attainment of a sustainable university environment does not engage only some stakeholders in the university, rather, it involves everyone; management, staff, students and visitors alike. This gives it a far-reaching effect wherever it is properly adopted.

Environmental sustainability practices in universities

Universities have adopted different practices over the years to gradually inculcate environmental sustainability principles into their institution. Weenen (2000) described a university as an organisation with a purpose that it fulfills by implementing programmes within the context of the operation of faculties, possibly located on a campus. Several universities have been part of the debate about the content of the concept of sustainability being one of the biggest challenges of the twenty-first century. The considerations cover the ways in which to integrate it into their university policy, organisation and activities. Presently, environmental sustainability practices in Nigerian universities still leave a lot to desire relative to international patterns. Nigerian universities too could engage in these debates both locally and internationally. Our universities getting involved would ensure that we have a voice in the discuss as well as serve as an eye opener to things going on around the world or even locally in other institutions that could be beneficial for adoption in Nigerian universities.

Universities around the world are dealing with the challenge of sustainability in many different ways. Approaches may vary from aiming to function as an environmentally friendly company to formulating principles and signing declarations, establishing totally new institutions, or focusing the mission and management of an existing university on the quest for sustainability. Nigerian universities could strengthen their sustainability practices by taking on or joining in any of the listed approaches as a measure to dealing with the environmental sustainability challenges being faced on the different Nigerian campuses. The Talloires declaration which will be further explored in this work is an example of an existing international declaration on environmental sustainability. Only two Nigerian universities are on the list of members and the extent of their involvement could not be ascertained. Whereas the UK and USA had multiple member universities to their credit (USLF 2019) This attests to the need for Nigerian universities to hone their performance with regard to environmental sustainability.

Some other approaches of different universities to the issue of sustainability include initiatives towards promoting waste recycling, effective waste management and efficient use of energy so as to reduce the university's ecological foot print in its natural environment. These three initiatives which are related to reducing

the ecological foot print could possibly be instructive for adoption in Nigerian universities as they touch on everyday issues related to life and practice such as waste management, recycling and energy use. Waste management, recycling and energy use are pertinent issues which if taken care of could move Nigerian universities forward significantly. Others embrace paying attention to principles of environmental responsibility and adopting 'environmentally friendly operations central to its strategy'. Another approach is signing a declaration to make environmental research and education core in the institution such as making effort to include it both in their curriculum and operations. Some other institutions include it in housekeeping practices of the institution's environmental unit (Douglas Anyan, Acheampong and Awopone 2025, Jehtae, Awang and Ahmad 2021, Weenen 2002) A number of foreign universities recognize their sustainability responsibilities as well as encourage their students and community to do the same. This is a pattern for Nigerian universities to adopt too. Some of such declarations or initiatives at the international level aimed at promoting sustainability on campuses are discussed below.

International declarations and initiatives promoting environmental sustainability on university campuses and lower levels of education

Universities and other institutions of learning have seen the need to draw a common goal in other to pursue environmental sustainability together. Some of such declarations and initiatives for promoting environmental sustainability on university campuses whose fundamental principles can be adopted by universities in Nigeria are examined. Also, a cursory look at activities at lower levels of education in other parts of the world could serve as an impetus to indeed pursue environmental sustainability well in Nigerian universities. It follows that if so, much is being done even at lower levels in those places, adoption of some of such activities or adaptation of what already exists for better outcomes is imperative.

The Talloires declaration

The Talloires Declaration (TD) is a 10-point action plan. The TD ten-point action plan aims at integrating sustainability and environmental literacy in the teaching, research activities and outreach of colleges and universities (ULSF2015). It was the first

proclamation towards sustainability on higher education campuses across the world. The ten points aimed at the following: A rise in awareness of the importance of environmental sustainability. It is such that every opportunity available will be used to raise awareness both to the public, government, industries and the tertiary institutions themselves about environmental sustainability. The declaration also hopes for the education given by member institutions to be able to produce environmentally responsible citizens and faster environmental literacy for the citizens at large. More than the above, the member institutions are expected to live up to what they are called to proclaim. It is expected that the practice of what they promote will be evident on their campuses. More so, this should involve all stakeholders in the institution's community.

To achieve the ten-point action plans, interdisciplinary collaboration is also encouraged for better outcomes. If indeed the action plans are what they should be, partnership with lower levels of education may be necessary so as to influence them towards environmental sustainability. This should influence both the secondary and primary schools in their practice and towards interdisciplinary teaching for better outcomes. A progress in all the previously discussed action plans should result in greater national and international influence of practicing member institutions. It should be such that their services get broadened and they are available to reach out all the more to promote environmental sustainability. Above all, having put all the foregoing in place, they hold the responsibility to maintain it as such. Nigerian universities could benefit from enlisting and participating in this foremost effort on environmental sustainability in universities.

The Higher education 21 project

The Higher Education 21 project (HE-21) which began in 1997 is another initiative. It was initiated by some universities in the UK and aims at initiating and promoting examples of best practice for sustainability in institutions of tertiary education. The goal of the project was perpetual improvement which should be achieved within the two-year period of the project. Even more seriously, some institutions have attempted to become sustainability universities to wholly pursue and push the sustainability agenda as the need for this has been observed or encountered in their

university community. Examples include the University of Waterloo Canada and the University of Michigan. (Weenen 2000).

Other Efforts and Initiatives

At the lower levels of education, a sustainable environment has been pursued by various measures at the international scene. At a time UNICEF (2017) was looking at building a sustainable school environment for children in terms of school supplies and the type of furniture provided. This was to the effect that such supplies provided be ones in line with environmental sustainability principles. Hence, such supplies must not be made of materials inimical to the environment. A sustainable environment has also been pursued and measured since 1994 according to the eco-school movement by the following seven steps: raising an eco-committee in the school, environmental review, having an action plan, curriculum links, informing and involving the school community, Monitoring and evaluating and creating a memorable slogan to unite the entire school in this pursuit for a sustainable environment. An eco-school flag is obtained if all the measures above are in place or are being worked at (Echo-school 2019). The Australian government also published a document which was for the purpose of environmental education for sustainability across all years of schooling as well as serve as a framework for achieving the goals. It gives the following as indicators of sustainable environment in schools: existence of objectives in the school's management plan/policies that include sustainability and sustainable practices, the availability of School Environmental Management Plan (SEMP) and whether it's in use (implementation), inclusion of long term vision for sustainability in the school's SEMP, Consideration (or inconsideration of environmental consequences of its actions (e.g. when purchasing products or during construction/demolition), environmental audit completed for baseline data (Commonwealth of Australia 2006). Nigerian universities may want to adopt having a SEMP too and where they do, ensuring its implementation. Locally however, very little has been reported in terms of providing and securing a sustainable environment across the different levels of education. This is unlike the international sphere which has a lot of work done and ongoing with respect to environmental sustainability at the different level of education

Challenges of environmental sustainability in Nigerian universities

The few studies available show a range of challenges of environmental sustainability in Nigeria.

Lack of integration of sustainability in university practices: A study by Allu (2018) was carried out with the aim of promoting the inclusion of sustainability principles and practices in the university system in Nigeria. The very essence of the purpose of the researcher for promotion of integration of sustainability in university practices shows the dearth in this field. The study covered three geographical zones in Nigeria represented by a university for each zone. A survey gathering the perception of both academic and non-academic staff on the subject of integrating sustainability in the university was conducted. The findings showed a consensus on the need for integrating sustainability in Nigerian universities.

No consensus on responsibility for integration of sustainability concepts into the university: In the study by Allu (2018) there was no consensus in their perceptions as to who should be responsible for establishing it in the university system. The lack of consensus on the perception of who is responsible for the integration of sustainability suggests that there are no definite structures or practices of integrating sustainability in most Nigerian universities as at now. Similarly, Abdul-Azeez (2018) worked on developing a sustainable development assessment or rating system which he opines should be part of the university campuses ranking. A couple of existing environment sustainability ranking tools were reviewed and a preferred rating system was presented. However, the extent of adoption or integration is unknown.

Lack of evaluation of environmental sustainability compliance: within individual universities and across Nigerian universities, there are no clearly known assessment patterns to determine consistently the extent of compliance with environmental sustainability principles. Adedeji (2014) examined some of the problems of sustainability in the Nigerian University System using Federal University of Technology, Akure (FUTA) as a case study. While the researcher showed that FUTA offered courses that are relevant to the furtherance of sustainability. There are no empirical studies to confirm or negate the effectiveness of the institution as

a contributor to sustainable development in Nigeria. The universities of technology in the country could be very useful tools to this end.

Low knowledge about environmental sustainability: There is a general dearth in knowledge about environmental sustainability concepts. Oyeyoade and Araloyin (2019) conducted a survey covering the South-Western Nigerian universities. The findings showed that basic green benefits were unfamiliar to a sizeable number of respondents and was attributed to lack of familiarity with the concepts. Babatunde (2014) also reported low knowledge across different groups of undergraduates. Introduction of environmental sustainability principles into university curricula may be urgently required.

Lack of policy direction and government intervention: Policies that will promote environmental sustainability and green management are not available. Similarly, government intervention on the issue is not forthcoming. These are some of factors identified as inimical to implementation of green concepts and promotion of environmental sustainability in the universities. Oyeyoade and Araloyin (2019)

Lack of training for relevant personnel: Apart from obvious challenges like lack of government intervention, policies, absence of inclusion of sustainability concept in school curricula, lack of necessary training for relevant personnel appears to be a challenge facing meaningful takeoff environmental sustainability pursuits in Nigeria. Without relevant personnel to drive and push it, environmental sustainability may remain a mirage.

Resistance to change: Sustainability in Nigerian universities and the change or innovation required to achieve it is faced with the problem of resistance to change in Nigerian universities. How to manage this is part of the germane issues challenging sustainable development in Nigerian universities. For this, the introduction of sensitization programmes to the different groups of people concerned in the Nigerian universities is recommended (Wali and Okai 2019)

Implications of lack of environmental sustainability in Nigerian universities

The challenges identified above if allowed to continue could have grave implications as the aftermath of the shortage represented by these challenges. Any set of challenges portrayed in a given context or area connotes the absence or lack of a subject of concern which if left untended could infuse undesirable outcomes or open up to such impending risks. A lack of environmental sustainability may have such implications for users of the university environment both in the present and in the future. This being the reason why environmental sustainability in the university environment should attract unwavering attention from university managers and administrators. Such implications include but are not limited to the following;

Compromise of set academic goals: Goals of both the students and the institution could be at risk of becoming unfilled either totally or partially due to a lack of environmental sustainability. For example, a student's desire to study and emerge into the market place from a given institution may go unfulfilled if the environmental sustainability practices of the university cannot support the health and wellbeing of the student. Odourous wastes piles in and around the university campus which continuously asthma or other respiratory challenges could make it impossible for a student to continue and finish in a particular university. Similarly, a university's goal for instance to host and train the most brilliant minds could be compromised for similar reasons.

Loss of aesthetics in the university environment: beauty from nature and manmade efforts when properly combined is expected to inspire all stakeholders and users of the university campus and environs. However, when environmental sustainability is endangered or jeopardized in the university environment such aesthetics could be imperilled. Also, the expected derivatives that such inspiring scenery could generate may be lost. For instance, littering, indiscriminate felling of trees, improper waste handling and management, shortage of water all connote a lack of environmental sustainability. All these and more of such could deprive the university of its expected aesthetics and the inspiration that could be derived from it.

Health challenges: an absence of environmental sustainability in the university could permit some risks to the health of community members such as respiratory issues from practices that challenge environmental sustainability such as indiscriminate burning and openair combustion of wastes. Similarly, vector borne diseases can thrive if the environment is unkempt.

Inconducive learning and work environment: A university environment when not sustainably managed could be found inconducive for learning and work which may induce inefficiency and ineffectiveness amongst university students and workers.

Conclusion

Environmental sustainability has emerged as a critical dimension of university administration and educational effectiveness in contemporary society. This paper has demonstrated that the condition of the university physical environment significantly influences teaching, learning, health, and institutional productivity. In Nigerian universities, however, inadequate attention to sustainability practices continues to hinder the achievement of educational goals and institutional development.

The study concludes that integrating environmental sustainability into university governance, planning, and daily operations is essential for creating conducive learning environments and ensuring long-term institutional viability. Universities must move beyond theoretical awareness to practical implementation of sustainability principles through policy frameworks, funding, and stakeholder engagement. Achieving sustainable university environments is therefore both an administrative responsibility and a strategic imperative for national development.

Recommendations

To combat the problems of environmental sustainability, Nigerian universities should set up functional and not just cosmetic environmental units or departments as an administrative organ to see to proper care of the university environment as well as an intense promotion and pursuit of environmental sustainability in the universities.

There is a need to provide adequate funds to make the efforts towards environmental sustainability a reality.

University leaders, managers and administrators in Nigeria would need to pledge a commitment to this course and fulfill it.

The university curriculum could be updated to include environmental sustainability in what learners get to learn while in the university irrespective of their course of study in order to inculcate the necessary changes in the students' disposition with respect to environmental sustainability. This can both influence the learners as users of the university environment and their operations in the larger society.

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FROM TYPEWRITER TO AI: A CENTURY OF TECHNOLOGICAL SHIFTS IN NIGERIAN UNIVERSITY EDUCATION

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Abstract
Over the past seven decades, Nigerian university education has experienced significant technological transformation, evolving from the use of chalkboards, printed notes, and manual typewriters to modern information and communication technologies (ICT) and emerging artificial intelligence (AI) applications. This paper examines five major phases of this evolution: early audiovisual aids and manual typewriting in the mid-twentieth century; the rise of broadcast media and micro-teaching in the 1970s and 1980s; the ICT and e-learning revolution in the 2000s and 2010s; the expansion of computerized assessment and online learning in the 2010s and early 2020s; and the current integration of AI in teaching, learning, and academic support services. Using archival records, policy documents, and recent empirical studies, the paper identifies key drivers such as national ICT policies, institutional leadership, and professional development, alongside challenges including inadequate infrastructure, limited funding, digital literacy gaps, and socio-cultural resistance. The study concludes by proposing a framework for inclusive and responsible AI-driven transformation in Nigerian universities emphasizing infrastructure, capacity building, ethical governance, and continuous evaluation to support a future-ready and equitable university system.

Keywords: Educational Technology, Typewriter, ICT, e-learning, Artificial Intelligence, Nigerian universities,

Introduction

The history of Nigerian university education is inseparable from the history of technology. As universities have expanded their

mandates in teaching, research, and community service, they have continually sought tools that could enhance knowledge transmission, improve efficiency, and widen access. Globally, higher education has moved from print-based instruction to broadcast media, then to digital and networked learning, and now toward data-driven and intelligent systems (Agbarakwe, & Chibueze, 2024). In Nigeria, this trajectory has unfolded within a context marked by colonial legacies, post-independence nation building, fluctuating economic fortunes, and persistent infrastructural challenges.

In the early decades of Nigerian universities, teaching and learning were dominated by face-to-face lectures supported by chalkboards, printed handouts, and manual documentation. The introduction of audiovisual aids in the mid-twentieth century represented the first attempt to enrich instruction through technology. Over time, radio, television, and micro-teaching studios enabled more mediated forms of pedagogy, particularly in teacher education. The turn of the twenty-first century, however, marked a more radical shift. The diffusion of computers and internet connectivity opened Nigerian universities to global information flows, transforming libraries, classrooms, and administrative systems. Learning management systems, digital repositories, and virtual classrooms redefined access to knowledge and enabled distance education on an unprecedented scale.

More recently, advances in artificial intelligence especially in natural language processing, adaptive learning, automated assessment, and data analytics have introduced new possibilities for personalized learning and institutional decision-making (Agbarakwe, & Chibueze, 2024). Although AI adoption in Nigerian universities remains nascent, it has generated significant interest among policymakers, administrators, and educators seeking to modernize higher education and align it with the demands of the digital economy. Despite these developments, technological integration in Nigerian universities has been uneven and often fragile. While some institutions have emerged as pioneers, many others struggle with unreliable power supply, limited broadband access, inadequate funding, and insufficient staff capacity (Ogunode., Idoko, & Peter, 2024). Policies have frequently articulated ambitious visions, yet implementation has lagged behind rhetoric. This paper situates contemporary AI adoption within a longer historical arc of technological change in Nigerian

higher education. It maps five major phases of evolution, examines the drivers and barriers shaping each phase, and analyses policy and institutional responses over time. By doing so, it seeks to answer three interrelated questions: How has educational technology evolved in Nigerian universities over the past century? What factors have enabled or constrained these shifts? And what lessons can guide the responsible integration of AI in the years ahead? The paper ultimately argues that sustainable AI transformation will depend not merely on acquiring new tools but on addressing long-standing structural gaps in infrastructure, capacity, governance, and equity.

Historical Phases of Technology in Nigerian Universities

The evolution of educational technology in Nigerian universities can be understood as a sequence of overlapping phases, each shaped by global technological trends and local socio-political realities. These phases did not replace one another neatly; rather, new technologies were layered upon existing practices, producing hybrid systems in which analogue and digital tools often coexisted. Together, they reveal a pattern of gradual modernization punctuated by moments of accelerated change (Babalola, & Aramide, 2020).

Phase I: Early Audio-Visual Aids and Manual Typewriters (1950–1970)

The foundations of educational technology in Nigerian higher education were laid during the colonial and early post-independence periods. Instruction was largely lecture-based, reflecting British academic traditions, but educators increasingly experimented with visual and auditory aids to enhance comprehension and standardize teaching. Chalkboards, charts, slides, overhead projectors, filmstrips, and educational films became common features in classrooms, especially in science and teacher education (Babalola, & Aramide, 2020).

By the early 1960s, universities such as the University of Ibadan had established audiovisual units, often with support from international organizations like UNESCO. These units produced instructional materials, managed film libraries, and trained staff in media use. Similar centres later emerged at Ahmadu Bello University, the University of Lagos, Obafemi Awolowo University, and the University of Nigeria, Nsukka. The creation of these units

marked the institutionalization of educational media services and signaled early recognition of technology's pedagogical value (National Information Technology Development Agency. (2023).
Alongside audiovisual tools, manual typewriters played a central role in academic life. They were indispensable for preparing lecture notes, typing theses, producing examination scripts, and training students in business and secretarial studies. In many universities and colleges of education, mastery of the typewriter symbolized modern office competence. However, the mechanical nature of typewriters limited editing flexibility and efficiency, and their continued use into the late twentieth century increasingly appeared anachronistic as word-processing technologies advanced elsewhere. Pedagogically, this phase remained largely teacher-centred. Technologies were deployed to support existing instructional methods rather than to transform them. Yet the period was significant in that it introduced Nigerian universities to systematic technology use, created professional roles in educational media, and laid the groundwork for later ICT-driven reforms.

Phase II: Broadcast Media and Micro-Teaching (1970–1980)
The second phase coincided with Nigeria's rapid expansion of education following the oil boom of the 1970s. Demand for trained teachers and standardized instruction encouraged experimentation with broadcast media and video technologies. Educational radio and television programmes were used to supplement lectures, disseminate expert knowledge, and reach wider audiences beyond individual campuses.

More transformative was the adoption of micro-teaching using closed-circuit television (CCTV) and video recording. Colleges of education and universities such as Alvan Ikoku College of Education and Obafemi Awolowo University established micro-teaching studios where trainee teachers could conduct short lessons, watch their recorded performances, and receive structured feedback. This approach shifted teacher education toward reflective practice and skills development, enabling students to analyse specific teaching behaviours such as questioning techniques, classroom management, and use of instructional aids.

Micro-teaching represented one of the earliest instances in Nigerian higher education where technology directly reshaped

pedagogy rather than merely enhancing content delivery. It fostered a more interactive and learner-focused approach, emphasizing practice, feedback, and continuous improvement. Nevertheless, the high cost of equipment, technical complexity, maintenance challenges, and unreliable power supply limited widespread adoption. Only a handful of relatively well-resourced institutions could sustain such facilities. Despite these constraints, this phase marked a conceptual shift toward mediated and technology-informed pedagogy that would later be amplified by digital tools.

Phase III: ICT Revolution and the Emergence of E-Learning (2000–2010)

The turn of the twenty-first century ushered in a digital revolution in Nigerian universities. The diffusion of personal computers, mobile devices, and internet connectivity transformed how information was accessed, stored, and shared. Universities began establishing computer laboratories, ICT directorates, and campus networks to manage growing digital infrastructure. Federal policy interventions played a crucial role in this phase. The National Policy on ICT in Education (2010) and subsequent implementation guidelines articulated a vision of ICT as a catalyst for educational quality, access, and efficiency (Federal Republic of Nigeria., 2010). Agencies such as the National Information Technology Development Agency (NITDA) supported capacity building through training programmes and equipment distribution, while telecommunications liberalization expanded internet availability (National Information Technology Development Agency, 2023; Agbarakwe, & Chibueze, 2024).

E-learning platforms and learning management systems (LMS) emerged as central tools for blended learning. Systems such as Citadel E-Learning enabled lecturers to upload course materials, administer quizzes, and interact with students online (Awodele, Kuyoro, Adejumobi, & Makanju, 2011). Digital libraries expanded access to scholarly resources, reducing dependence on limited physical collections. The National Open University of Nigeria (NOUN) became the flagship of distance education, delivering programmes through virtual classrooms, online assessments, and digitized learning materials to learners across the country (Ezema Nworgu, Ebem, Echezona, Ugwu, Ezugwu, Asogwa, Ozioko, & Ukwandu, 2021).

This phase marked a shift toward more flexible and student-centred learning. Students could access resources beyond classroom hours, collaborate virtually, and engage in self-paced study. However, the benefits were unevenly distributed. Urban and better-funded institutions advanced more rapidly, while many rural campuses struggled with low bandwidth, outdated hardware, and limited technical support. The persistence of traditional lecture methods alongside emerging e-learning practices reflected both cultural inertia and infrastructural constraints. Overall, the ICT revolution redefined Nigerian universities' relationship with knowledge, positioning them within global digital networks but also exposing deep inequalities in access and capacity.

Phase IV: Computerized Assessment and Online Learning (2010–2020)

As ICT infrastructure matured, attention turned toward digitizing assessment and expanding online learning. Computer-based testing (CBT) became increasingly common for large undergraduate courses, entrance examinations, and distance learning programmes. Universities adopted CBT to manage growing enrolments, reduce examination malpractice, ensure faster grading, and improve administrative efficiency. The mid-2010s saw broader experimentation with online and blended learning, but it was the COVID-19 pandemic that forced a rapid and unprecedented shift to virtual instruction. Universities deployed platforms such as Zoom, Google Classroom, Moodle, and institution-specific LMS to sustain teaching during campus closure (Ezema Nworgu, Ebem, Echezona, Ugwu, Ezugwu, Asogwa, Ozioko, & Ukwandu, 2021). This emergency transition revealed both the potential and fragility of Nigeria's digital readiness. While some institutions adapted quickly, many faced serious challenges: unstable power supply, insufficient bandwidth, limited access to devices for students, and inadequate staff training in online pedagogy. Studies from universities such as the University of Nigeria, Nsukka documented security concerns, low system reliability, and skills gaps that constrained effective synchronous learning.

Despite these difficulties, this phase normalized the use of virtual classrooms and digital assessment in Nigerian higher education. It accelerated digital literacy among staff and students and created institutional awareness that online learning was no

longer optional but integral to modern university operations. Importantly, it also prepared the ground for more advanced applications, including AI-driven tools, by familiarizing stakeholders with data-driven and platform-based systems.

Phase V: AI Integration and Emerging Technologies (2020–2025)

The current phase represents Nigeria's entry into the era of artificial intelligence in higher education. AI applications ranging from automated grading and plagiarism detection to intelligent tutoring systems, chatbots, and recommendation engines are beginning to shape teaching, learning, and academic support services. Generative AI tools, including large language models, are increasingly used by students and lecturers for writing assistance, tutoring, and content generation, often ahead of formal institutional policies (Igbo, Imo, Jidere, & Ugwu, 2025).

Empirical studies report early adoption of AI in areas such as marketing education, where automated feedback systems correlate with improved student performance, and in academic libraries, where AI supports cataloguing, information retrieval, and research assistance (Awodele, Kuyoro, Adejumobi, & Makanju, 2011; Ibrahim, Taura, Iliyasu, & Lukman, 2024). Libraries, in particular, are exploring AI to manage growing digital collections and provide personalized user services. At the policy level, government initiatives such as the launch of a national AI Academy and the drafting of a National AI Strategy signal recognition of AI's strategic importance for human capital development and economic competitiveness. These efforts aim to position Nigeria within the global AI ecosystem while addressing skills gaps among students and public servants (Igbo, Imo, Jidere, & Ugwu, 2025).

Yet AI adoption remains nascent and uneven. Many universities lack the computational infrastructure, reliable data systems, and skilled personnel required for advanced AI deployment. Ethical concerns relating to data privacy, algorithmic bias, academic integrity, and potential job displacement are prominent. Socio-cultural perceptions also shape acceptance, as some educators view AI with suspicion, fearing erosion of traditional academic values. This phase marks a shift from digitization to intelligent automation and personalization (Ibrahim, Taura, Iliyasu, & Lukman, 2024). Whether AI becomes a transformative force in Nigerian higher education will depend on

how effectively institutions address long-standing structural constraints while developing robust ethical and governance frameworks.

Drivers of Technological Shifts in Nigerian University Education

The trajectory of technological change in Nigerian universities has been shaped by interacting drivers and barriers that either enabled or constrained adoption across different phases.

Technological and Infrastructure Development

Key drivers include improvements in telecommunications, declining costs of digital devices, and government-backed ICT initiatives. Investments in campus fibre-optic networks, data centres, and broadband connectivity exemplified by institutions such as Obafemi Awolowo University demonstrate how infrastructure can catalyse innovation. NITDA's programmes in equipment provision and training further accelerated ICT diffusion. However, infrastructure remains uneven. Many universities still contend with erratic power supply, limited bandwidth, obsolete hardware, and inadequate maintenance (Awodele, Kuyoro, Adejumobi, & Makanju, 2011). These weaknesses constrain not only basic e-learning but also advanced applications such as cloud computing and AI, which demand stable and scalable systems.

Academic and Professional Development

The emergence of educational technology as a discipline and the formation of professional associations helped institutionalize expertise in media use and instructional design. Academic champions and specialized units advocated for technology integration, conducted research, and trained colleagues. In recent years, digitally savvy students and younger faculty have become important change agents, experimenting with online platforms and AI tools even in the absence of formal policies. Their bottom-up innovations often precede institutional reforms, highlighting the role of agency in technological change.

Barriers to Technological Shifts in Nigerian University Education

Chronic underfunding of public universities continues to constrain infrastructure renewal, research development, staff training, and

technological innovation in Nigerian universities. Although government allocations to education have increased nominally in recent years, they remain significantly below international benchmarks. For example, the Federal Government allocated approximately ₦2.18 trillion to education in the 2024 budget, representing about 7.9% of total national expenditure, while the proposed 2025 allocation of ₦3.52 trillion accounted for only about 7.3% of the national budget. These figures remain far below the UNESCO recommendation of 15–20% and Nigeria's own National Policy on Education target of 26% of annual budgets devoted to education (UNESCO, 2022; National Policy on Education 2013).

Persistent funding deficits have contributed to deteriorating infrastructure, inadequate digital facilities, unreliable electricity and internet connectivity, overcrowded classrooms, and limited investment in staff development and research capacity. Capacity gaps in instructional design, data science, cybersecurity, educational technology, and AI ethics further hinder effective technology integration across universities. While national ICT and digital education policies often articulate ambitious modernization goals, implementation remains weak because of inadequate funding, fragmented institutional coordination, inconsistent leadership, and poor monitoring mechanisms.

Socio-cultural factors also shape technological adoption within Nigerian universities. Resistance to institutional change, fears of job displacement, concerns over academic integrity and plagiarism, and unequal access to digital devices and internet services influence attitudes toward emerging technologies, particularly AI-driven systems. The digital divide between urban and rural institutions, as well as between well-funded federal universities and less-resourced state institutions, further deepens inequalities in access and utilization. Consequently, technological transformation in Nigerian universities has often been incremental, uneven, and vulnerable to disruption despite growing policy attention and increased global emphasis on digital higher education.

Policy and Institutional Responses: Progress and Gaps

Nigeria's policy landscape reflects growing recognition of technology's role in higher education, yet implementation gaps persist. The National ICT Policy in Education (2010) and subsequent guidelines mandate integration across teaching,

learning, and administration. More recent AI initiatives aim to build national capacity and governance frameworks. However, limited funding, weak coordination among agencies, and insufficient institutional readiness undermine policy impact. At the institutional level, universities such as Obafemi Awolowo University and NOUN illustrate what sustained leadership and investment can achieve: campus-wide networks, dedicated ICT units, LMS governance, and large-scale online delivery. Yet many universities lack comprehensive digital strategies, relying instead on fragmented projects driven by donor funding or individual champions. The result is a patchwork of adoption levels and standards across the system.

Framework for Future AI-Enabled Transformation

Building on historical lessons, a future-oriented framework for AI integration in Nigerian universities rest on five interrelated pillars: capacity building, infrastructure development, pilot implementation, ethical governance, and continuous evaluation (Igbo, Imo, Jidere, & Ugwu, 2025). First, capacity building must extend beyond basic ICT skills to include data literacy, AI pedagogy, instructional design, and ethics for faculty, librarians, and administrators. Second, infrastructure upgrades should prioritize reliable power, broadband connectivity, secure cloud services, and scalable computing resources. Third, carefully designed AI pilot projects in assessment, tutoring, and library services can demonstrate value while allowing controlled experimentation. Fourth, clear governance frameworks are needed to address data protection, intellectual property, accountability, and fairness. Finally, continuous monitoring and evaluation should track learning outcomes, equity impacts, and system performance to guide evidence-based scaling.

Discussion

The century-long transition from manual typewriters and chalkboards to digital platforms and artificial intelligence reflects both the resilience and adaptability of Nigerian universities in the face of enduring structural constraints. Since the establishment of the first-generation universities in the mid-twentieth century, successive waves of technological innovation have consistently been presented as catalysts for educational modernization, improved teaching quality, administrative efficiency, and expanded

access to knowledge. From audiovisual teaching aids and broadcast media to computers, internet technologies, e-learning platforms, and AI-enabled systems, each phase introduced new possibilities for transforming higher education. However, the outcomes of these innovations have often fallen short of expectations because of persistent infrastructural deficits, inadequate funding, weak institutional capacity, and inconsistent policy implementation.

The uneven pace of technological adoption across universities further reflects broader inequalities within Nigeria's higher education system. Federal universities located in urban centers have generally benefited from relatively better funding, international partnerships, donor interventions, and stronger ICT infrastructure, enabling them to adopt digital technologies more rapidly. In contrast, many state-owned and rural institutions continue to struggle with unstable electricity supply, poor internet connectivity, insufficient computer laboratories, and limited technical expertise. Consequently, while some universities have integrated learning management systems, virtual classrooms, and AI-supported administrative tools into their operations, others still rely heavily on traditional teaching methods and manual administrative processes. This disparity reinforces existing educational inequalities and limits the capacity of less-resourced institutions to compete in an increasingly digital global academic environment.

The emergence of artificial intelligence represents a particularly significant phase in this historical trajectory. AI technologies offer unprecedented opportunities for personalized learning, automated assessment, academic analytics, research support, virtual tutoring, and institutional efficiency. Globally, universities are increasingly deploying AI-driven tools to improve student engagement, enhance curriculum delivery, strengthen research productivity, and support data-informed decision-making. Nigerian universities are also gradually experimenting with AI applications in teaching, library services, student support systems, plagiarism detection, and administrative management. If effectively implemented, AI could improve educational access, reduce administrative inefficiencies, support adaptive learning, and strengthen the international competitiveness of Nigerian higher education institutions.

Nevertheless, historical experience demonstrates that technological innovation alone cannot guarantee meaningful educational transformation. Earlier waves of ICT adoption frequently failed to achieve their full potential because investments in technology were not accompanied by corresponding investments in human capacity development, maintenance culture, institutional reform, and governance structures. Similar risks confront the current AI transition. Without adequately trained academic staff, robust digital infrastructure, ethical governance frameworks, reliable data systems, and sustainable funding mechanisms, AI may become another underutilized innovation that widens rather than reduces educational inequalities.

Moreover, the Nigerian context presents unique socio-cultural and ethical considerations that require careful attention. Concerns about job displacement, algorithmic bias, data privacy, academic integrity, and unequal digital access shape perceptions of AI adoption within universities. Resistance to change among academic and administrative personnel may also slow implementation efforts, particularly where technological reforms are perceived as threats to established institutional practices. In addition, disparities in students' access to internet-enabled devices and stable connectivity could deepen exclusion if AI-driven educational systems are introduced without adequate support mechanisms.

For AI to contribute meaningfully to higher education transformation in Nigeria, implementation strategies must therefore extend beyond technological acquisition. They should prioritize inclusive infrastructure development, continuous professional training, ethical and regulatory frameworks, interdisciplinary collaboration, and context-sensitive innovation policies. Equally important is the need for strong institutional leadership and long-term investment in research and digital capacity building. A sustainability-focused approach that recognizes Nigeria's economic realities and social diversity will be essential to ensuring that AI enhances educational quality and equity rather than reproducing existing structural disadvantages.

Ultimately, the historical evolution of educational technology in Nigerian universities demonstrates that successful transformation depends not merely on the availability of new technologies, but on the broader political, economic, institutional, and cultural conditions that shape their adoption and use. The AI

era offers substantial opportunities, but realizing these opportunities requires deliberate, coordinated, and inclusive strategies capable of addressing the systemic challenges that have historically limited technological progress in Nigerian higher education.

Conclusion and Policy Recommendations

Nigerian universities have traversed distinct technological eras: analogue instructional media, broadcast innovations, ICT and e-learning, computerized assessment, and now AI-driven systems. This evolution reveals both the system's adaptive capacity and the enduring impact of structural constraints.

To harness AI for inclusive and sustainable transformation, the paper recommends that:

1. Federal Ministry of Education (FME), National Universities Commission (NUC), and Tertiary Education Trust Fund (TETFund) should establish a coordinated national AI capacity-building programme for universities through partnerships with technology companies, research institutes, and international development agencies. This programme should fund staff training, postgraduate scholarships, AI research hubs, and professional certification in areas such as instructional design, data science, cybersecurity, and AI ethics.
2. Federal and State Governments, in collaboration with the Nigerian Communications Commission (NCC) and Rural Electrification Agency (REA), should prioritize long-term investment in digital infrastructure by improving electricity supply, expanding broadband access to underserved campuses, and supporting rural connectivity initiatives. Universities should also be supported to develop resilient campus networks, smart classrooms, and sustainable energy systems for digital learning environments.
3. Universities, NUC, and professional regulatory bodies should integrate digital literacy, AI competencies, and technology ethics into staff development programmes and academic curricula across all disciplines. Regular training workshops, curriculum reviews, and interdisciplinary AI education initiatives should be institutionalized to ensure both staff and students can use emerging technologies responsibly and effectively.

4. The National Information Technology Development Agency (NITDA), NUC, and university governing councils should develop and enforce clear governance frameworks for AI adoption in higher education. These frameworks should address data protection, academic integrity, algorithmic accountability, ethical use of AI tools, cybersecurity standards, and equitable access for disadvantaged institutions and students.
5. Universities, TETFund, and educational research agencies should implement pilot AI projects in areas such as teaching, student assessment, academic advising, and library services, while establishing mechanisms for continuous monitoring and evaluation. Successful pilot programmes should be scaled gradually using evidence-based models, with lessons shared across institutions to promote best practices and reduce implementation failures.

If these steps are pursued, Nigerian universities can move beyond legacy technologies such as manual typewriters and fragmented ICT systems and position themselves as dynamic hubs of innovation within Africa's knowledge economy.

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INFLUENCE OF DIGITAL INNOVATIONS ON LECTURER EFFECTIVENESS IN COLLEGES OF EDUCATION IN SOUTHWESTERN NIGERIA

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Abstract
This study investigated the influence of digital innovations on lecturer effectiveness in Colleges of Education in Southwestern Nigeria. The independent variable, digital innovation, was 165perationalized through four dimensions: virtual classrooms, educational apps, online assessment tools, and digital content creation. Lecturer effectiveness was measured using teaching evaluation ratings. The target population comprised 1,543 academic staff from four purposively selected Colleges of Education in Southwestern Nigeria. A sample of 150 lecturers was drawn using stratified random sampling at a 95% confidence level and a 5% margin of error, yielding approximately 9.7% of the total population. A quantitative correlational design was employed, with data collected from 150 lecturers across four colleges using a validated structured questionnaire (Cronbach's α = 0.89 for digital innovations; α = 0.91 for lecturer effectiveness). Pearson correlation analysis revealed significant positive relationships between each dimension of digital innovation and lecturer effectiveness: virtual classrooms (r = 0.41, p < 0.01), educational

apps (r = 0.36, p < 0.05), online assessment tools (r = 0.39, p < 0.01), and digital content creation (r = 0.44, p < 0.01). Multiple regression results indicated that the four innovations collectively explained 62% of the variance in lecturer effectiveness ($R^2 = 0.62$, F (4, 145) = 58.90, p < 0.001), with digital content creation (β = 0.32, p < 0.001) and virtual classrooms (β = 0.29, p < 0.01) emerging as the strongest predictors. All five hypotheses were supported, confirming that each digital innovation significantly enhances lecturer effectiveness. The study recommends systematic integration of these tools into pedagogical practices and professional development programmes to elevate teaching quality in teacher education institutions.

Keywords: Digital Innovations, Lecturer Effectiveness, Virtual Classrooms, Educational Apps, Online Assessment Tools, Digital Content Creation, Colleges of Education, Southwestern Nigeria

Introduction

The rapid evolution of digital technologies has transformed educational landscapes globally, compelling higher education institutions to adopt innovative tools to enhance teaching and learning processes (Ogunode & Ndayebom, 2023; Oluwatade, 2024). In Nigeria, the integration of digital innovations in tertiary institutions, particularly Colleges of Education, remains uneven despite national policies promoting ICT in education (Federal Ministry of Education, 2019). These colleges, responsible for training future teachers, face unique challenges in leveraging technology to improve instructional delivery (Orji & Ukeh, 2022). The effectiveness of lecturers—measured through student engagement, content mastery, and pedagogical outcomes—serves as a critical indicator of institutional quality (Mada, 2025). This study focuses on four key digital innovations: virtual classrooms, educational apps, online assessment tools, and digital content creation, examining their collective and individual impacts on lecturer effectiveness in Southwestern Nigeria.

The theoretical foundation of this research is anchored in the Technology Acceptance Model (TAM) by Davis (1989), which posits that perceived usefulness and ease of use determine

technology adoption and effectiveness. TAM is extended here with the Constructivist Learning Theory (Vygotsky, 1978), which emphasises active knowledge construction facilitated by digital tools. Together, these frameworks suggest that when lecturers perceive digital innovations as useful and user-friendly, they are more likely to integrate them effectively, thereby enhancing teaching outcomes (Hanmfe & Masara, 2024). This dual-framework approach provides a robust lens for understanding how technological affordances translate into pedagogical effectiveness. Despite the global surge in digital adoption in education, many lecturers in Nigerian Colleges of Education continue to rely on traditional chalk-and-talk methods. This persistence is attributed to inadequate infrastructure, limited digital literacy, and resistance to change (Orji & Ukeh, 2022; Olorode, 2021). Studies conducted in comparable contexts indicate that while some institutions in Southwestern Nigeria have invested in ICT infrastructure, actual utilisation by academic staff remains consistently low (Mada, 2025). Such underutilisation undermines the potential of digital tools to foster interactive, student-centred learning environments—essential for preparing pre-service teachers for 21st-century classrooms (Ogunode & Ndayebom, 2023). The implications of poor adoption are far-reaching: students receive inadequate exposure to technology-enhanced pedagogy, graduate teachers enter schools ill-equipped for digital classrooms, and institutional accreditation ratings suffer from low innovation indices (Ene, 2023; NCCE, 2023). Furthermore, poor utilisation perpetuates a digital skills gap among pre-service teachers, with cascading effects on the quality of primary and secondary education (Orji & Ukeh, 2022). Research consistently demonstrates that when lecturers fail to model effective technology use, their students—future teachers—reproduce the same technology-averse practices in their own classrooms (Olorode, 2021). Bridging this gap requires an evidence-based understanding of which specific digital innovations most powerfully predict lecturer effectiveness.

Evaluation reports from the National Commission for Colleges of Education (NCCE) indicate consistently low ratings in instructional innovation and student engagement in many Southwestern colleges (NCCE, 2023). A 2023 survey by the Committee of Provosts revealed that only 28% of lecturers in Southwestern Colleges of Education regularly use digital tools in teaching (Ene, 2023). This low adoption rate persists despite the

availability of virtual learning environments and mobile apps. Consequently, lecturer effectiveness remains stagnant, affecting graduate teachers' preparedness for technology-enhanced classrooms in primary and secondary schools (Oluwatade, 2024).

Statement of the Problem

Lecturers in Southwestern Nigerian Colleges of Education often deliver content through monolithic lectures, with minimal use of interactive digital platforms. This traditional approach fails to accommodate diverse learning styles and reduces opportunities for real-time feedback—both critical for teacher training institutions. Without empirical evidence on how specific digital tools influence effectiveness, institutions lack data-driven justification for targeted investments.

As established in the literature, many colleges suffer from unreliable internet connectivity, outdated hardware, and insufficient training in digital pedagogy (Orji & Ukeh, 2022; Olorode, 2021). The low adoption rate of digital tools persists despite the availability of virtual learning environments and mobile apps. Consequently, lecturer effectiveness remains stagnant, affecting graduate teachers' preparedness for technology-enhanced classrooms in primary and secondary schools.

Hypotheses

H_1: There is a significant positive relationship between virtual classrooms and lecturer effectiveness.

H_2: There is a significant positive relationship between educational apps and lecturer effectiveness.

H_3: There is a significant positive relationship between online assessment tools and lecturer effectiveness.

H_4: There is a significant positive relationship between digital content creation and lecturer effectiveness.

H_5: Virtual classrooms, educational apps, online assessment tools, and digital content creation collectively have a significant positive predictive influence on lecturer effectiveness.

Research Design

This study adopted a **quantitative correlational research design** to examine the influence of digital innovations on lecturer effectiveness in Colleges of Education in Southwestern Nigeria.

The design is appropriate for measuring relationships between variables using statistical techniques such as Pearson correlation and multiple regression (Creswell & Creswell, 2018). A cross-sectional survey approach was employed to collect data at a single point in time from lecturers actively using or exposed to digital tools. This design facilitates the testing of hypotheses and the determination of predictive relationships without manipulating variables, aligning with the explanatory nature of the research objectives.

Population and Sample

The target population comprised 1,543 academic staff from four purposively selected Colleges of Education in Southwestern Nigeria. A stratified random sampling technique was employed to ensure balanced representation, with the sample size of 150 lecturers determined using Yamane's (1967) formula at a 95% confidence level and 5% margin of error. This resulted in approximately 9.7% of the total population being selected. Specifically, 37 or 38 lecturers were randomly drawn from each of the four colleges (Federal College of Education (Special), Oyo; Federal College of Education, Abeokuta; Osun State College of Education, Ila-Orangun; and Adeniran Ogunsanya College of Education, Lagos), yielding a uniform selection rate of 9.7% per institution. Stratification further ensured equal allocation across federal and state colleges (75 respondents each).

This proportional per-college selection, combined with a high response rate (97%, n = 146 valid cases), enhanced representativeness and statistical reliability despite the conservative sample size. The approach balanced scientific rigor with practical constraints, aligning with norms in educational research and supporting robust generalisation within the study population.

Data Collection

Data were collected between January and March 2025 using a structured questionnaire titled "Digital Innovations and Lecturer Effectiveness Questionnaire (DILEQ)." The instrument contained 30 Likert-scale items (1 = Strongly Disagree, 5 = Strongly Agree) across five sections: four measuring digital innovations (6 items each) and one assessing lecturer effectiveness (6 items adapted from validated teaching evaluation scales). The questionnaire was

validated through expert review and a pilot study with 30 lecturers (Cronbach's α = 0.89 for digital innovations; α = 0.91 for effectiveness). Surveys were administered in person and via institutional email, with follow-ups ensuring a 97% response rate (146 valid responses). Ethical approval was obtained and informed consent was secured from all respondents.

Results

Table 1: Pearson Correlation Matrix – Digital Innovations and Lecturer Effectiveness (H_1–H_4)

Variable	M	SD	r	p	N	Decision
Virtual Classrooms (H_1)	3.71	0.88	**.41****	<.01	146	Supported
Educational Apps (H_2)	3.45	0.92	**.36***	<.05	146	Supported
Online Assessment Tools (H_3)	3.58	0.85	**.39****	<.01	146	Supported
Digital Content Creation (H_4)	3.82	0.79	**.44****	<.01	146	Supported
Lecturer Effectiveness (Criterion)	3.94	0.81	—	—	146	—

*Note. *p < .05 (2-tailed); **p < .01 (2-tailed). All correlations are with Lecturer Effectiveness (M = 3.94, SD = 0.81, N = 146). Cohen's effect sizes: H_1 – medium; H_2 – medium; H_3 – medium; H_4 – medium to large. All four hypotheses are supported.*

Combined Predictive Influence of Digital Innovations

Table 5: Multiple Regression – Predictors of Lecturer Effectiveness

Predictor	B	SE	B	t	P	95% CI	VIF
(Constant)	1.12	0.29		3.86	.000	[0.55, 1.69]	
Virtual Classrooms	0.27	0.09	.29	3.00	.003	[0.09, 0.45]	2.12
Educational Apps	0.14	0.08	.16	1.75	.082	[-0.02, 0.30]	1.88

Online Assessment Tools	0.18	0.10	.19	1.80	.074	[-0.02, 0.38]	2.25
Digital Content Creation	0.33	0.09	.32	3.67	.000	[0.15, 0.51]	2.41

R = .788, R² = .62, Adjusted R² = .60, F (4, 145) = 58.90, p < .001

The model is statistically significant and explains 62% of the variance in lecturer effectiveness. Digital content creation (β = .32, p < .001) and virtual classrooms (β = .29, p < .01) are significant predictors. Educational apps and online assessment tools contribute but fall short of significance (p = .082 and .074, respectively). No multicollinearity issues (all VIF < 3).

Discussion of Findings

The findings strongly support $\mathbf{H_1}$, revealing a significant moderate positive correlation (r = .41, p < .01) between virtual classrooms and lecturer effectiveness. This aligns with the Technology Acceptance Model (TAM; Davis, 1989), where perceived usefulness drives adoption. Virtual platforms enable real-time interaction, breakout sessions, and multimedia integration—features that enhance student engagement and pedagogical flexibility in teacher training contexts (Ogwu et al., 2022). In Southwestern Nigeria, where infrastructure varies, lecturers using tools like Zoom and Google Classroom report higher teaching evaluation scores due to improved responsiveness and inclusivity, particularly in large classes.

$\mathbf{H_2}$ is also supported, with educational apps showing a significant positive relationship (r = .36, p < .05) with lecturer effectiveness. Mobile applications such as Kahoot, Quizlet, and subject-specific tools facilitate gamified learning and instant feedback, aligning with constructivist principles of active knowledge construction (Vygotsky, 1978). Despite lower mean adoption (M = 3.45), their impact reflects ease of use and portability, enabling lecturers to extend learning beyond physical classrooms (Oluwatade, 2024). This finding underscores the value of micro-learning strategies in resource-constrained environments.

The results confirm $\mathbf{H_3}$, demonstrating that online assessment tools are significantly correlated with lecturer effectiveness (r = .39, p < .01). Platforms like Google Forms and Moodle quizzes reduce

grading time and provide data-driven insights into student performance (Ogunleye, 2024). This efficiency allows lecturers to focus on instructional improvement rather than administrative tasks. The moderate effect size suggests that while adoption is widespread (M = 3.58), full integration requires training to move beyond basic multiple-choice formats toward authentic, competency-based assessments.

H_4 yields the strongest individual correlation ($r = .44$, $p < .01$), confirming digital content creation as the most potent enhancer of lecturer effectiveness. Lecturers who develop original materials—e.g., interactive e-books, videos, and simulations—engage in deep pedagogical reflection, fostering student-centred learning (Adeyemi & Olaleye, 2023). This active construction process embodies Vygotsky's (1978) zone of proximal development, where customised resources scaffold complex concepts. The high mean score (M = 3.82) indicates growing proficiency, particularly among younger faculty.

H_5 is fully supported by the multiple regression model ($R^2 = .62$, $F(4, 145) = 58.90$, $p < .001$), which explains 62% of variance in lecturer effectiveness—substantially higher than typical technology-impact studies (Tamim et al., 2011). Digital content creation ($\beta = .32$, $p < .001$) and virtual classrooms ($\beta = .29$, $p < .01$) emerge as significant predictors, while educational apps and online assessment tools contribute substantively but not independently due to shared variance. This collective influence validates the extended TAM-Constructivist framework: perceived usefulness and active creation synergistically drive pedagogical outcomes.

The 38% unexplained variance highlights contextual barriers—infrastructure deficits, digital literacy gaps, and policy inconsistencies (Ogunode & Ndayebom, 2023; Orji & Ukeh, 2022)—suggesting that technology alone is insufficient without systemic support. Future interventions should prioritise professional development and institutional enabling environments to sustain and amplify these gains in Nigerian Colleges of Education.

Conclusion

This study conclusively demonstrates that digital innovations particularly digital content creation and virtual classrooms significantly enhance lecturer effectiveness in Southwestern Nigerian Colleges of Education. All the five hypotheses were supported, with the predictive model accounting for 62% of variance in teaching evaluation ratings. The findings affirm that technology, when purposefully integrated, elevates pedagogical outcomes in teacher training institutions.

Recommendations

1. **Policy:** The NCCE should mandate a Digital Pedagogy Certification requiring lecturers to create and share one original digital resource per semester.
2. **Infrastructure:** Colleges must prioritise fibre-optic upgrades and solar-powered ICT labs to sustain virtual classrooms in low-connectivity areas.
3. **Training:** College management and the NCCE should jointly establish annual Digital Teaching Bootcamps for academic staff, focusing on content authoring tools (e.g., Canva, Genially) and assessment platforms.
4. **Research:** Future studies should employ longitudinal designs to track effectiveness gains post-intervention and explore student outcome linkages.

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HIGHER EDUCATION, EMPLOYABILITY AND THE 4TH INDUSTRIAL REVOLUTION IN A GLOBALISED WORLD: THE AFRICAN EXPERIENCE

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Abstract
The fourth industrial revolution (4IR) is transforming economic, social, educational landscapes and human existence through advances in artificial intelligence, robotics, the Internet of Things (IoT), biotechnology, and data analytics technologies. Higher education institutions (HEIs) occupy a central role in preparing an equipped workforce, leading research, generating new and relevant knowledge, and supporting communities through this global transition. Globalisation describes intensifying interconnections among peoples, economies, politics, and cultures across territorial boundaries. Employability as an outcome refers to the capacity of graduates to obtain and sustain meaningful employment in evolving labour markets. Employability depends on technical proficiency, digital literacy, transferable skills (critical thinking, communication, teamwork), and experiential learning opportunities such as internships and industry projects. This paper examines HEIs response to 4IR within a globalised world, focusing on graduate employability.. The research method was qualitative analysis to synthesize observed trends, draw on comparative regional examples. Nigeria's growing HEIs face acute heterogeneity across institutions. Private HEIs increasingly offer

4IR-relevant programmes and partnerships with tech firms, while many public institutions struggle with overcrowding, limited facilities, and faculty shortages; meanwhile Rwanda's coordinated national strategy emphasises ICT adoption, digital skills in vocational and tertiary education, and strong government–industry coordination that facilitate HEI alignment with labour market priorities. Strategic recommendations include effective responses to systemic reforms combining curricular renewal, investment in digital infrastructure, institutional partnerships aligned with 4IR demands, scholarship–to-employment models, continuous faculty development in digital pedagogy and emerging technologies to sustain curricular relevance, and policy coordination between governments, industry, and HEIs.

Key words: higher education, fourth industrial revolution, globalised world, employability

Introduction

The Fourth Industrial Revolution (4IR) — characterised by rapid advances in artificial intelligence (AI), IoT, robotics, big data, and biotechnology — is reshaping work, skills, and institutions globally. For African economies, 4IR presents both a risk of widening inequalities and an opportunity to leapfrog development constraints if higher education equips graduates with relevant technical and transversal skills. The 4IR is rapidly transforming organisational structures, business models, and the economies. Consequently, the global labour market is experiencing fundamental disruption leading to rapidly changing demands on the workforce. Globalisation describes intensifying interconnections among peoples, economies, politics, and cultures across territorial boundaries known in academic and policy discourse during the late 20th century but refers to dynamics with deep historical roots and varied contemporary forms (World Economic Forum, 2025; OECD, 2020; World Economic Forum, 2020).

Within this context, the role of HEIs has become critically important preparing graduates whose competencies extend beyond technical expertise to ensuring they sustain relevance and employability in future work environments. Employability in the 4IR landscape is increasingly understood not merely as an employment outcome, but as a combination of key competencies, skills, qualities, and characteristics that enable flexibility and an individual

to adapt to change. As a result, there are observable trends to consider for ensuring that the gains of 4IR translate to evident benefits locally and globally. Regional studies on Africa and Nigeria emphasize infrastructure gaps, faculty capacity constraints, brain drain pressures, and the growing role of private and transnational providers (ILO, 2025; Matengu, Kadhila and Likando, 2024: Marginson, 2016).

This academic paper aims to conduct a qualitative literature review of higher education, the 4IR, the globalised world and employability. Specifically, the review seeks challenges and ethical considerations, particularly concerning global equity and how can higher education systems particularly in Africa enhance graduate employability in the 4IR within a globalised labour market.

Literature Review

Higher Education

Before the advent of mass higher education, the bulk of scholarly writing about universities was historical or philosophical in orientation – or merely rhetorical. As a result, higher education remained a largely under-theorized domain before the 1960s. The development of mass higher education systems and subsequent decades that encouraged the more systematic development of theories of higher education development. Since the1990s, new institutional types have emerged and rapidly increased, especially in Central and Eastern Europe, and South and East Asia where the number of private higher education institutions are based on corporate(and managerial) rather than academic (and collegial) principles. Thereby influenced the behavior of existing universities. Higher education has become the powerhouse of the new knowledge economy, producing not only highly skilled graduates but also the primary research which powers this new economy.

The frontiers between the academic and the economic systems have also been transcended within a broader system of innovation where research intensive or socially engaged, now extend their missions to embrace new roles and activities. This phenomenon of mission stretch, is likely to become more significant in coming years and place more emphasis on the resourcefulness of institutional leaders and managers. Scott (2010) established that the expansion and diversification of higher education systems after 1945 under a welfare state model, and

especially after 1960, was seen as the climax of long social and educational revolutions from the nineteenth century, but also qualitatively, where critical intellectual values were seen as at the heart of the modern university experience. However, this is changed in the twenty-first century, to more entrepreneurial models in higher education institution governance and the funding, where tuitions (and other quasi-market mechanisms) to replace state grants.

Scott (2010) further noted that the development of modern higher education has been one of the most profound but least celebrated social revolutions of the past half-century. UNESCO (2022) reported that in 1900, about 500, 000 students (1% of the relevant age group) enrolled in higher education in the entire world. but more than100 million students, being one-in-five of young adults during the century. The decline and fall of colonial and Communist empires, have played a role in stimulating the growth of higher education– more comprehensive democratic cultures in Western societies, with Asia and Africa built on foundations of the colonial era. Globally, higher education participation has steadily increased over the past two decades; in the US, over 52% of young people attend some form of college (OECD, 2017). As has been documented elsewhere, university attendance results in myriad benefits for individuals, including increased employability, employment and earning gains (Britton, Dearden, Shephard, & Vignoles, 2016; Knight & Yorke, 2003; Blundell, Dearden, Goodman, & Reed, 2000).

Gleason (2018) confirmed that higher education is a central actor in shaping societal responses to the 4IR. Usually ascribed to universities only due to the global acceptance in its history, scope, and transnational affiliations, however, in most African countries like Nigeria, higher education comprises formal learning beyond the secondary level of education. This includes polytechnics, colleges of education, institutes of technology and universities (NPE, 2013). Being the apex learning institution, universities aim to educate people to think independently and critically, problem-solving in and around their discipline, continuous learning, enable graduates to work independent and collaboratively, civil engagement, and to be open to multiple perspectives. There is recognition, however, that these economic benefits do not encompass the totality of learning in universities, and that in particular they do not necessarily capture learning gain. Otara

(2024) reported that in Singapore, the government encourages people to continue learning throughout their lives to adapt to changing employment requirements, the United Arab Emirates gives priority to science, technology, engineering, and mathematics (STEM) education while South Africa HEIs have successfully adopted virtual and contact instruction technologies, such as AI and the IoTs; South Korea incorporated technology into its education and provides learners with digital learning tools and platforms while Finland adopted a strong affinity for a holistic approach to education that encourages creativity and adaptation and is interdisciplinary.

The Fourth Industrial Revolution

Industrial Revolution (IR) describes distinct but overlapping historical phases where technologies, energy systems, and organisational forms produced and reconfigured economy-wide increases in productivity, major social reorganisation, education system remodelling and geopolitics. Historians, economists and other scholars classify IR into four stages: first IR (1IR) employed the use of mechanization and steam power by late 18th to early 19th century. For instance, in England, industrialization triggered the rise of factory-sponsored education and philanthropic schooling for the workforce training leading to factory acts that required basic education for children in industrial employment which then transitioned to publicly funded primary schooling for compulsory mass schooling oriented to citizenship and basic workforce readiness. This era birthed compulsory basic literacy education (Friedman, 2005).

The second IR (2IR) utilized electricity and the concept of division of labour to create mass production by the late 19th to early 20th century with Germany developing a distinctive dual model combining vocational education and workplace apprenticeship to prepare technicians and artisans for industry resulting in a coherent pathway from secondary education particularly technical-vocational expansion which aligned educational output with industrial needs. The third IR (3IR) birthed digital automation and information technologies from mid to late 20th century, where schools and HEIs integrated computer literacy, programming basics, and STEM-oriented pedagogies. Educational policy focused on science and engineering subjects, while teacher training began to include information technology competencies.

Federal and private initiatives promoted STEM education in the USA, investments in research accelerated technological innovation, K–12 curricula incorporated computing and information literacy thereby expanding lifelong learning provisions as industry skill demands changed. It is the era of the Digital Turn (Steger, 2013; Friedman, 2005).

The founder and executive chairman of the World Economic Forum (WEF), Professor Klaus Schwab introduced the concept of the fourth IR (4IR) to uncover the current technological revolution and digital transformation that pervasively impacts every work of life across the world. Schwab describes the drivers of the 4IR as megatrends in three manifestations and areas in which these breakthroughs have occurred include artificial intelligence (AI) robotics such as machine learning, nanotechnology, biotechnology, quantum computing, blockchain, the IoT, 3D-printing (Schwab, 2016). So far, Singapore has instituted nation-level digitalization and Smart Nation strategies and demonstrated a coordinated systems approach to 4IR preparedness through its curriculum, teacher training and academia-industry linked skills. While Rwanda targeted ICT initiatives to expand access to devices and online learning platforms through concentrated investments in connectivity and school-level digital resources. This era is transforming learning ecosystems. Otara (2024) discovered that the heart of technological innovation in 4IR education is AI because of its capacity to customize learning streams based on specific student needs and ability to offer quick assistance to access learning materials thus boosting student engagement.

Industrial transformations impose new economic structures and workforce requirements that compel education systems to adapt. Each industrial revolution redefines the knowledge, cognitive, socio-emotional and technical skills demanded from learners and prompts new institutional arrangements, curricular emphases, and governance responses. Furthermore, 4IR holds potential for creating cleaner, more inclusive and more resource-secure economies, as well as for improving the management and governance of the global environment as deliberated within academia; the need for dynamism in our post regulatory era, especially with examples like the WikiLeaks saga. Highlighting challenges of the 4IR, contemporary scholars have listed equity concerns and the digital divide as central because uneven infrastructure and capacity undermine system-wide readiness for

4IR demands, the right to privacy, though not accounted for, is becoming a near implausible right given measures taken by many governments to manage real or perceived increased security threats. Beyond fears of nuclear attack, cyber warfare and autonomous warfare (AI-powered weaponry) threatens a new type of war, robo-war, which will require little or no human intervention (Hillman, 2025; Baldwin, 2016).

For Africa, the second industrial revolution is partly experienced as nearly 1.3 billion people lack access to electricity. The continent may be disadvantaged as a result further exacerbate the existing global inequalities. Schwab (2017) noted that since it took almost 120 years for the 1IR to spread outside Europe but less than a decade for the internet to infiltrate the globe, then perhaps the gap between both first and third worlds could close faster with political will of governments, public and private sector commitment, and citizens acceptance of internet benefits.

Globalised World

Globalised world is also known as globalisation which is a historically rooted, multidimensional process characterized by expanding cross-border flows of goods, capital, ideas, and technologies. Globalisation operates with sectoral specificity and geographic unevenness that predate modernity and include ancient long-distance trade networks, late 15th and 16th centuries saw a qualitative acceleration in intercontinental exchange through mercantile capitalism and the rise of transoceanic Early-modern global trade networks by the Portuguese and Dutch maritime expansions and the subsequent Atlantic trading system. The 19th century brought further integration while the 20th century alternated phases of integration and fragmentation: an era of globalisation in the late 19th to early 20th century, a mid-century contraction around global wars and protectionism, and a rapid re-integration from the 1970s onward powered by neoliberal trade policies, containerized shipping, and information technologies. (Baldwin, 2016; Steger, 2013; Friedman, 2005; Stiglitz, 2002).

China's integration into the global economy through its post-1978 economic reforms and accession to the World Trade Organization in 2001 exemplify market-led globalisation in the late 20th and early 21st centuries. Furthermore, South Korean popular culture spread globally through its content production combined with social media distribution reconfigures soft power, identity

politics, and creative labour markets. Technological globalisation with India's IT services as a global centre for information technology, health and business process outsourcing where skills, digital infrastructure, and linguistic advantages enable cross-border service provision (Choudhary, 2025; Petti, 2024; Marginson, 2016).

Contemporary scholarship often treats globalisation as multidimensional and uneven, defined by growing interconnectedness across economic, political, cultural, and technological domains while recognizing differential national capacities and social consequences. Definitions vary by disciplinary lens, producing distinct analytical emphases that matter for measurement and policy. Globalisation scholarship refers to increased competition among institutions, cross-border credentialing, and the commodification of higher education, alongside opportunities created by international collaboration and mobility. A growing body of work on education policy argues that curricula, pedagogy, and institutional strategy must shift from content delivery to lifelong reskilling, interdisciplinarity, and industry-aligned experiences. This paper considers employability as multi-dimensional: technical skill attainment, transferable skill development, labour-market signalling (credentials), and career adaptability across globalized workplaces. Curriculum and pedagogy literature highlights integration of digital literacies, computational thinking, and interdisciplinary skills into core programmes with employability in 4IR contexts requiring both technical competencies and higher-order skills such as critical thinking, creativity, ethical reasoning, and collaboration. Microcredentials, stackable certificates, and lifelong learning pathways are presented as mechanisms to maintain workforce relevance amid rapid technological change (UNESCO 2021; World Economic Forum, 2020; Marginson, 2016).

Employability

Employability as an outcome refers to the capacity of graduates to obtain and sustain meaningful employment in evolving labour markets. Employability depends on technical proficiency, digital literacy, transferable skills (critical thinking, communication, teamwork), and experiential learning opportunities such as internships and industry projects (Ford, 2015; McQuaid and Colin.

2005). Major definitions and conceptual families of employability are

Skills and attributes definition defines employability as the set of skills, knowledge, and personal attributes that enable an individual to obtain and maintain employment. This individual-centric definition underpins many career services and employability skills programs and drives competency frameworks used by universities and employers.

Process and capability definitions views employability as a dynamic capability or process—an individual's capacity to adapt, learn, and navigate labour markets across time. This view emphasises lifelong learning, adaptability, and career self-management rather than fixed skills.

Contextual and multi-level definitions situate employability within contextual constraints and opportunities as an outcome resulting from interactions among individual factors (skills, health), personal circumstances (networks, caregiving responsibilities), and external factors (demand for labour, institutional arrangements). This multi-level framing is prevalent in policy analyses that seek to avoid blaming individuals for structural unemployment.

Therefore, employability is defined here as the capacity of graduates to obtain and sustain meaningful employment in evolving labour markets. Employability depends on technical proficiency, digital literacy, transferable skills (critical thinking, communication, teamwork), and experiential learning opportunities such as internships and industry projects.

The majority of Africa's workforce has attained education at or below secondary or high school level with higher education qualifications in the minority. Therefore, lower skills capabilities for the majority of the workforce that fail to meet the growing demand for higher skills, soft skills and digital skills in addition to skills mismatch developed in the education and training system as against industry requirements. Education curricula need more entrepreneurial education and soft skills to help youth adapt to the future of work. Underfunding of technology and obsolete equipment makes it difficult to adequately train students in vocational areas an prepare them for the job market (Mastercard, 2023).

Measurement Approaches to employability are identified as objective indicators (include employment rates, unemployment durations, job retention, and earnings. Though straightforward, they underrepresent individual capacities in contexts of limited job availability); competency inventories and self reports include surveys and competency inventories measure perceived and demonstrated skills (technical, digital, interpersonal). These instruments are valuable for career counselling and curricular design but face challenges of subjectivity and cross-context validity; finally, composite and multi-dimensional indices combine individual skills, work experience, and labour-market context to produce more nuanced measures. Such indices require rich data, tracer studies and careful weighting to avoid masking heterogeneity across groups (Vurayai, 2025; UNESCO 2021; Rothwell, 2015; Knight and Yorke, 2003).

Research methodology

This paper employs a qualitative, comparative synthesis methodology. Primary methods include thematic analysis of recent academic literature, institutional strategy documents, policy reports, and published case studies. The approach identifies recurring strategies in how HEIs respond to 4IR and globalisation, focusing on curricular reform, pedagogy, industry engagement, governance, and access. The analysis treats employability as multi-dimensional: technical skill attainment, transferable skill development, labour-market signaling (credentials), and career adaptability across globalised workplaces.

Research Questions

The research questions for this paper are:

1. What are the observed trends in higher education in a globalised world?
2. What are the comparative regional examples in Africa?

Discussions

The observed trends in higher education in a globalised world are discussed below

Curricular and pedagogical adaptation

HEIs are increasingly embedding 4IR-relevant content—data science, AI ethics, cybersecurity, and digital engineering—into

undergraduate and postgraduate programmes. However, effective employability outcomes depend less on isolated technical courses and more on integrating digital literacies across disciplinary curricula, enabling domain specialists to apply technological tools to contextual problems. HEIs are beginning to shift beyond knowledge transmission to competency-based curricula that integrate technical digital skills, data literacy, interdisciplinary problem solving, and transferable skills such as communication and adaptability. Pedagogical shifts include active learning, project-based assessment, simulated labs, virtual and augmented reality for experiential training, and micro-credentials that signal discrete competencies to employers (Bennett and McWhorter, 2021; Friedman, 2016; Chen, 2015).

Industry partnership and work-integrated learning

Higher education in a globalised world has strong employer partnerships which are recurrently associated with positive employability outcomes. Dual-degree programmes, apprenticeships, co-op placements, and employer-sponsored projects connect students to real-world tasks, improving technical readiness and professional networks. Industry involvement also helps curricula remain current with emergent skill sets and labour-market expectations. Governance mechanisms—advisory boards, joint research centres, and sponsored labs—ensure sustained curricula-industry alignment (Davis, 2024; Brynjolfsson and McAfee, 2014)

Transferable skills and human capabilities

As automation reconfigures task profiles, non-automatable human capabilities—critical thinking, creativity, complex problem solving, communication, ethical judgement, and intercultural competence—gain salience in higher education across the world. HEIs that intentionally scaffold these capacities through interdisciplinary projects, peer collaboration, and reflective assessment report, stronger employer endorsements of graduate readiness (Lesonsky, 2025; Hillman, 2025; Petti, A. 2024).

Credentialing, microcredentials, and quality assurance

Microcredentials and stackable certificates have emerged as flexible mechanisms for signalling specialized, up-to-date competencies to employers as current trend in higher education.

Although their proliferation raises questions about standardization, portability across jurisdictions, and recognition in globalized labour markets. However, robust quality assurance frameworks and employers' acceptance are meaningfully enhancing employability of recipients. Studies showed that micro-credentials, blended models and modular course designs facilitate lifelong learning and facilitate rapid curricular updates as technologies evolve, support lifelong learning and reskilling pathways for workers displaced by automation (UNESCO, 2022; Cedefop, 2021; UNESCO, 2021; Kayembe and Nel 2020).

Equity and access

The 4IR have driven digital infrastructure investments — broadband, laboratory equipment, cloud services — but they insufficient in themselves alone. One of the observable trends of higher education in a globalised world is that equitable access policies, affordable devices, and support for blended learning modalities are required to avoid deepening digital divides that would exclude marginalised populations from 4IR opportunities. A persistent tension is the risk that rapid technological integration exacerbates existing inequalities. Students with limited digital access or from under-resourced institutions risk falling behind. Policies and institutional strategies that subsidize access and create inclusive learning pathways are becoming essential to higher education models to drive employability and prevent widening skill gaps. In addition, targeted upskilling for underserved groups, recognition and accreditation of prior learning, and policies that support affordable access to reskilling are necessary to ensure broad-based employability gains (UNESCO,2022, 2021; OECD, 2020; Gleason, 2018).

Institutional capacity and strategic agility

Effective leaders act as coalition builders, bridges academic mission with societal needs, ensure policy coherence and regulatory agility, internal stakeholders and external partners management. Current trend with higher education entails institutional leaders cultivate multi-stakeholder alliances with government agencies, private sector firms, and international partners to pool resources and expertise.

Furthermore, higher education in 4IR globally requires strategic visioning and digital strategies by university leaders

articulate digital transformation agendas that prioritize blended learning, research capacity in data science and AI, and partnerships with industry. Institutional inertia, credentialing bureaucracy, and faculty development needs can slow adaptation. Successful institutions cultivate strategic agility through cross-unit collaboration, incentives for curriculum renewal, and investments in faculty training for digitally enhanced pedagogy. Leaders should prioritise faculty development for digital pedagogy, incentivise interdisciplinary research, and redesign assessment to reward applied and project-based learning (Minh-Thu, 2025; Vurayai, 2025, Hillman, 2025).

Comparative regional examples in Africa focusing on Rwanda (East Africa region) and Nigeria (West Africa region) are discussed below

Rwanda

With a population of 14,569,341, Rwanda recognised as an African success story, with efficient institutions and one of the continent's fastest-growing economies, builds its development on its Vision 2050 and National Strategy for Transformation (NST2), with a strong focus on inclusive growth by creating 1.25 million jobs through innovation and digitalisation; prioritizes transformational governance, gender equality, and renewable energy expansion; and climate-smart development and disaster risk management. Recent growth is supported by priority investments in infrastructure and technology. (IMF,2025; Lesonsky 2025; ILO. 2025)

The Centre for the Fourth Industrial Revolution (C4IR Rwanda) launched in partnership with the World Economic Forum and Bill & Melinda Gates Foundation focuses on AI, machine learning, blockchain, and IoT to transform healthcare, agriculture, and education to scale responsible AI across Africa. Some of the innovative applications include drones deliver blood to rural hospitals, a mobile application Babyl enables mobile-based doctor consultations and Blockbonds facilitates financial inclusion via smartphones, and promotes human-centered and equitable technology governance, ensuring security and accountability in tech deployment (WEF & Rwanda Centre for the fourth industrial revolution 2025, UNDP, 2025).

Despite the progress, the 2023 Common Country Analysis shows Rwanda remains a low-income country with serious

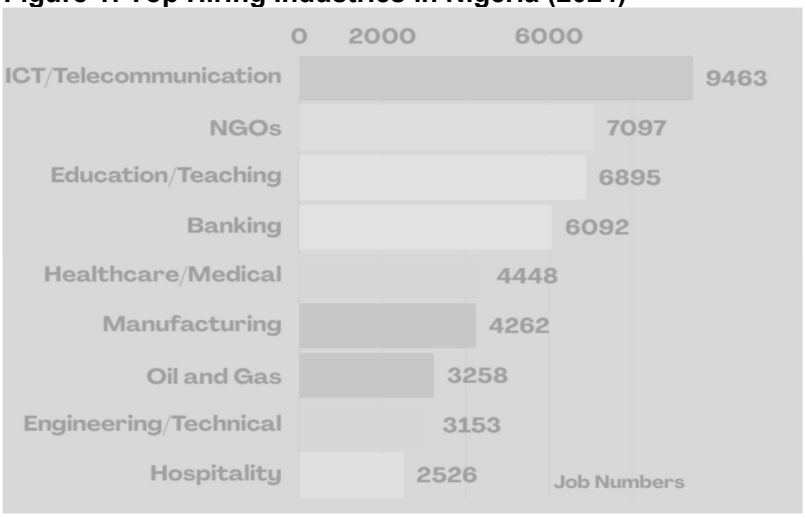
challenges, including high food inflation, inequality, low labour productivity, high unemployment (16.8 per cent overall and 20.5 per cent for youth 16-30),10 gender inequality, low civic engagement, and a poverty rate of 38.2 per cent in 2017 (with 16 per cent in extreme poverty and 22.7 per cent vulnerable to becoming multidimensionally poor (UNDP, 2025).

Nigeria

With an estimated population of 237,527,782, Nigeria's higher education system is large and diverse, with federal, state, and private universities serving a rapidly growing youth population. The national context presents distinct challenges and opportunities for 4IR adaptation. Nigeria's large higher education system faces acute heterogeneity across institutions. Urban universities and private providers increasingly offer 4IR-relevant programs and partnerships with tech firms, while many public institutions struggle with overcrowding, limited lab facilities, and faculty shortages. Short-term vocational and professional upskilling initiatives improve employability for participants but face challenges scaling to the broader graduate population (ILO, 2025, OECD, 2020).

According to MyJobMag Search Report (2025), the ICT/Telecommunication industry had the most hiring activity in 2024, accounting for 15% of hires with 9,643 placements. NGOs followed closely, reflecting strong activity in this industry. Interestingly, Education and Teaching surpassed the Banking industry in 2024, contributing 11% of job hires. The Figure 1 below highlight opportunities for professionals to align their skills with fields that are highly sought after in Nigeria.

Figure 1: Top Hiring Industries in Nigeria (2024)



Source: My JobMag (2025)

However, common barriers to employability include energy, infrastructure and connectivity deficits which prevent equitable access to digital learning and experiential opportunities; regulatory bureaucracies, curriculum rigidity and slow quality-assurance cycles impede timely inclusion of emerging skill sets, microcredentials and industry-aligned modular learning; weak industry collaborations and limited work-integrated learning to demonstrate applied competencies; funding constraints and limited institutional revenue; shortages of faculty with 4IR-relevant expertise and limited opportunities for professional development in digital pedagogy and interdisciplinary research largely due to brain drain and talent mobility. Some of the opportunities and emerging responses to 4IR include the following:

- Growing private sector engagement. Technology firms, telecom operators, and startups increasingly partner with universities to provide training programs, internships, and infrastructure support. Nigeria University-Industry Collaboration and Tech Hubs create pathways for students into the digital economy despite resource constraints. Initiatives that combine entrepreneurship training, coding bootcamps, and work placements demonstrate scalable

approaches to expanding employability in emerging markets.

- Mobile-first innovation. Widespread mobile phone penetration enables mobile learning and low-bandwidth educational solutions that can extend reach to underserved populations.
- Diaspora networks and transnational collaborations. Nigerian academics abroad and international partnerships provide channels for knowledge transfer, mentorship, and joint research.
- Entrepreneurial ecosystems. University-linked incubators and innovation hubs emerge around major universities, focusing on fintech, agritech, healthtech, and creative industries relevant to local development goals.
- Policy momentum. National documents and government pronouncements increasingly emphasize digital economy priorities and skills development aligned with 4IR, creating openings for coordinated action.

Conclusion

The 4IR presents a pivotal moment for African higher education to enhance employability in a globalised world. Success depends on coordinated reforms across curricula, institutional leadership, infrastructure, and labour-market engagement, implemented with strong equity safeguards. With every innovation and advancement in technology validates the need for human welfare and dignity. The 4IR is helping the world to experience better efficiency and higher quality in living, working, being, and developing, but as a complement to the best parts of human nature, such as creativity, empathy, and stewardship.

Although the literature has discussed issues within the 4IR and the need for relevant education, there remains a significant research gap on how different educational systems respond to the challenges of the 4IRs and the educational policies, curriculum reforms, and implementation strategies used to prepare students for the rapidly shifting technological landscape. Policy recommendations commonly call for targeted investments in digital infrastructure, faculty development, industry-university linkages, and regulatory flexibility to recognize alternative· implication: a mixed-provider ecosystem that leverages private-sector training alongside public HEIs can expand access to 4IR skills but requires

quality assurance and articulation pathways to higher education credentials.

Recommendations

- Curriculum and Credentials: Adopt competency-based curricula, recognition and accreditation of prior learning; expand micro-credentials and industry-recognised certifications to support lifelong learning and rapid reskilling.
- Institutional leadership: Reduce bureaucracies, equip HEI leaders with change-management capacity and performance metrics tied to graduate outcomes and industry engagement.
- Digital Infrastructure: Prioritise national and institutional investment in reliable internet, teaching labs, and cloud-based learning platforms with affordability measures for students.
- University-Industry partnerships: Formalise cooperative programmes, employer advisory boards, and joint research centres focused on relevant local 4IR opportunities.
- Inclusive policies: Implement targeted financial support, bridging programmes, and flexible learning pathways for marginalised learners to prevent exclusion from 4IR employment opportunities.Monitoring and evaluation: Develop labour-market observatories and graduate-tracer systems to align programmes with real-time employer needs and adjust curricula accordingly.

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INTEGRATING SOCIAL MEDIA, FRENCH CLUB ACTIVITIES AND CULTURAL IMMERSION AS DETERMINANTS OF FRENCH LANGUAGE PROFICIENCY AMONG UNIVERSITY OF IBADAN STUDENTS IN THE 4IR

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Abstract
The fourth industrial revolution (4IR) is reshaping language education through the integration of digital and experiential strategies for enhanced learning. This study investigates social media usage, French club activities, and cultural immersion programmes as determinants of French language proficiency among students at the University of Ibadan. Anchored in Vygotsky's socio-cultural theory, Siemens' connectivism theory, and Kolb's experiential learning theory, the study adopted a correlational survey research design. Data were collected from 100 students with a purposeful random sampling. Using a four-point likert scale instrument titled ' Social Media, French Club Activities, and Cultural Immersion Programme Questionnaire (SMFCACIPQ),a pilot study confirmed the instrument's reliability. The study was analyzed with the Pearson Product Moment Correlation (PPMC) and SPSS. The instrument yielded a 0.05 level of significance. Findings revealed strong positive correlations between the independent variables and French language proficiency: social media, French club activities, and cultural immersion programs collectively ($r = 0.841$; $p < 0.05$); relative contribution ($r = 0.823$; $p < 0.05$); composite contribution ($r = 0.931$; $p < 0.05$); and cultural immersion programs as the strongest predictor ($r = 0.849$; $p < 0.05$). Based on these findings, the study recommends the formal integration of 4IR digital tools, structured French club activities, and expanded cultural immersion opportunities into university French language curricula to enhance proficiency outcomes.

Key words: Fourth Industrial Revolution, French Language Proficiency, Social Media Usage, Cultural Immersion Program, French Club Activities.

Introduction

Language has always been central to cultural identity, social interaction, and national development. As societies globalise, certain languages such as French have gained stronger international relevance, especially across Africa where they serve diplomatic, economic, and sociocultural functions. French, being one of the world's most widely spoken languages, enhances global bilingualism and strengthens intercultural relationships. Scholars such as Gogura (2019) emphasize that bilingual individuals, particularly in government constitute vital national assets. Bilingualism, however, is only possible when learners achieve mastery of the four essential linguistic competencies: reading, writing, speaking, and listening. In the era of the Fourth Industrial Revolution (4IR), language proficiency has become even more significant as emerging technologies like artificial intelligence, machine learning, and digital learning platforms reshape how languages are acquired and taught.

In the Nigerian context, French proficiency is critically important, given the nation's proximity to Francophone countries and its role within international diplomacy. Adigwe (2019) and Inegbe (2020) argue that French-speaking Nigerians enjoy expanded opportunities in global communication, employment, and engagement with international issues. Recognizing this, the Nigerian government has adjusted its educational curriculum to incorporate 4IR skills, digital learning tools, and socio-educational strategies like cultural immersion programme and French club activities. These initiatives aim to improve students' linguistic competence and ensure that French education remains relevant in a rapidly changing world. Franco et al. (2021) further encourage the expansion of accessible and affordable language learning opportunities to support nationwide bilingualism.

Cultural immersion programmes have long been regarded as one of the most effective approaches to foreign language mastery. Immersion involves placing learners in environments where the target language dominates communication and cultural experiences. Faloju et al. (2022) describe immersion as a holistic strategy exposing students to linguistic and cultural elements

through classes, cultural activities, and interactions with native speakers. For Nigerian university students, the Nigeria French Language Village (NFLV) in Badagry serves as a major immersion center, stimulating a Francophone environment even though it is located within Nigeria. Additional immersion destinations include Francophone countries like Togo and Senegal. Scholars such as Iteogu (2016) and Olakunle (2020) affirm that immersion provides learners with practical communication skills, cultural exposure, and global readiness.

Despite its benefits, the immersion programme faces several obstacles. Cultural clashes, unfamiliar norms, and identity-related challenges hinder students' adaptability, as noted by Adeleke and Adeleke (2018). Parental attitudes and lack of support also restrict participation, since many parents view second language learning as unnecessary. Onyishi and Ogbu (2017) argue that weak parental involvement reduces the programme's success. Furthermore, logistical and financial constraints limit students' ability to travel abroad for immersion. These limitations highlight the need for additional complementary strategies within university settings to strengthen French proficiency beyond immersion alone. One of such complementary strategies is the French Club, or Le Cercle Français, which offers socio-educational activities that promote interactive and engaging language learning outside the conventional classroom. According to Berenfield (2018) and Araromi (2020), French clubs provide an informal but educational environment where students practice French through debates, dramas, quizzes, music, games, discussions, and phonetics exercises. This model reduces learner anxiety, encourages peer-based learning, and enhances communicative competence. Kezie-Osuagwu (2017) notes that students express themselves more freely during club activities because the atmosphere is relaxed and non-judgmental. Through interactive participation, students improve fluency, vocabulary acquisition, and confidence.

French clubs address several gaps observed in traditional classroom instruction, particularly the tendency for teachers to dominate speaking time while students remain passive listeners (Balogun & Idogho, 2016). Club activities reverse this pattern by placing students at the center of communication. Ashraf and Salami (2014) assert that club-based language activities significantly enhance proficiency by offering real-life contexts for language use. However, French clubs also face challenges. Poor

attendance, lack of structured activities, inadequate supervision, and inconvenient meeting locations can diminish their effectiveness. Health issues or academic schedules may also prevent consistent participation. These gaps demonstrate that although immersion and French clubs substantially aid learning, they alone may not fully resolve pedagogical challenges in Nigerian French education. The emergence of the Fourth Industrial Revolution introduces new technological solutions capable of addressing many of these challenges. E-learning and technology assisted pedagogy have transformed language education globally. Pramumat (2020), Guanah and Adeoye (2024) highlight how digital tools increase access to learning regardless of location, offering students flexible and individualized learning opportunities. Technologies such as audio-visual media, recording tools, language apps, and online platforms promote skill development in ways traditional classrooms cannot. Ratheeswari (2018) notes that the integration of information and communication technologies (ICTs) improves educational outcomes by enabling innovative teaching approaches and personalized learning experiences.

Taken together, social media, French club activities, and cultural immersion programmes are reshaping how students learn French in today's technology driven world. Apps like Duolingo and Babbel, make it easier for students to practise at their own pace, get instant feedback, and work through lessons tailored to their individual needs. Even everyday tools like Google Assistant and Alexa have found a place in language learning, helping students work on their pronunciation and build their vocabulary in a natural, low-pressure way. Ajijola (2023) notes that these technologies have opened up quality language learning to students regardless of where they come from or what they can afford. Similarly, Tulenova (2024) observes that digital platforms now connect learners directly with native French speakers around the world, giving students real exposure to how the language sounds and feels in everyday life. This means that even students who are unable to travel for immersion or attend a French club can still access meaningful language experiences. Beyond dedicated learning apps, social media has quietly become one of top. Telegram, and Twitter give students everyday opportunities to use the language, collaborate with peers, and practise beyond the walls of the classroom. Omekwu (2019) describes social media as the as a flexible and accessible communication network that supports

learning anytime and anywhere. Rabbi, Smita, and Mohammed (2020) add that learning through social media also strengthens the relationship between teachers and students, making the learning experience feel more connected and less formal. Students who might be too shy to speak up in class often find it stressless to engage online, which gradually builds their confidence. Through short videos, pronunciation clips, group chats, and discussions, students get to practise all four language skills: listening, speaking, reading, and writing. Over time, these experiences add up and make a real difference to how well students can use French. It is against this backdrop that this study examines how social media usage, French club activities, and cultural immersion programmes together shape French language proficiency among University of Ibadan students, and what their combined influence means for teaching and learning French in the 4IR era.

Research Questions

1. What is the relationship between the Independent variables (social media usage, French club activities, and cultural immersion programs) and the dependent variables?
3. What is the relative contribution of the Independent variables on the dependent variable?
4. What is the composite contribution of the Independent variables on the dependent variable?
5. Which one of the Independent variables most predict the language proficiency of students?

Methodology

This study examined the relationship between social media usage, French club activities, and cultural immersion programme on students' proficiency in the French language. The target population comprised all students enrolled in French language courses at the University of Ibadan. A sample of 100 students was purposively selected from those actively learning French as a foreign language in the Department of European studies, from the 100level to the postgraduate level. Using a correlational survey research design, data was collected through the Social Media, French Club Activities, and Cultural Immersion Programme Questionnaire (SMFCACIPQ), a four-point Likert scale instrument tested at 0.05

level of significance. The responses were analyzed using the Pearson Product Moment Correlation (PPMC) as well as the statistical tool, (SPSS), to explore the relationship between the independent variables (social media, French club activities, and cultural immersion) and the dependent variable (French language proficiency).

Results and Discussion

Table 1: Distribution of Respondents by Preferred Digital Technology for Learning French

Platform	Frequency	Percentage
WhatsApp	11	11%
Google	12	12%
Instagram	6	6%
Facebook	9	9%
YouTube	19	19%
Skype	1	1%
ChatGPT	13	13%
Physical	10	10%
TikTok	6	6%
Duolingo	13	13%
Total	100	100%

Source: Field Survey, 2025

The findings show that YouTube (19%), Duolingo (13%), and ChatGPT (13%) were the most preferred platforms, highlighting students' reliance on digital and AI-supported learning. Google (12%) and WhatsApp (11%) also played significant roles in language learning. Less preference was given to Skype (1%), TikTok (6%), Instagram (6%), and Facebook (9%), suggesting a shift toward more interactive and AI-powered tools.

Research Question 1: What is the relationship between the Independent variables (social media usage, French club activities, and cultural immersion programs) and the dependent variables?

Table 2: Correlation Showing the Relationship between Social Media Usage, French Club Activities, and Cultural Immersion Programs on French Language Proficiency

Variables	Mean	S.D	df	r	p-value	Remarks
Social media, French club, and cultural immersion programs	38.20	6.21	98	0.841	0.000	Significant
French language proficiency	37.70	6.42				

p<0.05 (2-tailed)

Interpretation:
Table 2 reveals a strong and significant positive relationship between students' social media usage, participation in French club activities, cultural immersion programs, and their French language proficiency ($r = 0.841$; $p < 0.05$). This implies that the more students engage in these language-related activities, the more proficient they become in speaking, writing, and understanding French.

Research Question 2: What is the relative contribution of the Independent variables on the dependent variable?

Table 3: Correlation Showing the Relative Contribution of Social Media Usage, French Club Activities, and Cultural Immersion Programs

Variables	Mean	S.D	df	r	p-value	Remarks
Social media, French club, and cultural immersion programs	37.50	5.92	98	0.823	0.000	Significant
French language proficiency	37.00	6.14				

p<0.05 (2-tailed)

Interpretation:
Table 3 shows a positive and significant relationship between social media usage, French club activities, cultural immersion programs, and French language proficiency ($r = 0.823$; $p < 0.05$). This finding indicates that these three factors collectively make a strong contribution to improving students' language proficiency.

Research Question 3: What is the composite contribution of the Independent variables on the dependent variable?

Table 4: Correlation Showing the Composite Contribution of Social Media Usage, French Club Activities, and Cultural Immersion Programs on French Language Proficiency

Variables	Mean	S.D	df	r	p-value	Remarks
Combined social media, French club, and cultural immersion programs	39.00	5.78	98	0.931	0.000	Significant
French language proficiency	38.30	5.94				

p<0.05 (2-tailed)

Interpretation:
Table 4 reveals a very strong and significant positive relationship between the combined use of social media, French club activities, and cultural immersion programs and students' French language proficiency ($r = 0.931$; $p < 0.05$). This suggests that integrating the three approaches together produces a more comprehensive and effective learning outcome in French language acquisition.

Research Question 4: Which one of the Independent variables most predict the language proficiency of students?

Table 5: Correlation Showing the Most Predictive Independent Variable of French Language Proficiency

Variables	Mean	S.D	df	r	p-value	Remarks
Cultural immersion programs	38.10	6.05	98	0.849	0.000	Significant
French language proficiency	37.60	6.29				

p<0.05 (2-tailed)

Interpretation:
Table 5 shows that cultural immersion programs have the strongest and most significant relationship with French language proficiency ($r = 0.849$; $p < 0.05$). This implies that practical exposure through cultural immersion is the most predictive factor influencing students' mastery and usage of the French language compared to social media and French club activities.

Summary of Findings

Research Question	r-value	Relationship Strength	Remark
Relationship between variables	0.841	Strong	Significant
Relative contribution	0.823	Strong	Significant
Composite contribution	0.931	Very Strong	Significant
Most predictive variable	0.849	Strong	Significant

Interpretation

1. The study revealed a **strong and significant positive relationship** between social media usage, French club activities, and cultural immersion programs on students' French language proficiency.
2. Findings showed that **each of the three variables contributes meaningfully**, with social media, French club activities, and cultural immersion programs all enhancing language learning outcomes.

3. The **composite contribution** of these three approaches produced the **highest correlation**, indicating that their integration yields greater language proficiency.
4. Among the independent variables, **cultural immersion programs emerged as the strongest predictor** of French language proficiency among students.

Findings from table1 showed social media and digital tools are impactful; most respondents agreed platforms like WhatsApp, YouTube, ChatGPT, and Duolingo enhanced motivation, listening, fluency, and interaction with native speakers. Despite challenges like fast-paced speech and distractions, most acknowledged online learning improved fluency, writing skills, and self-evaluation. This indicates digital spaces are essential for modern language learning, especially French, offering real-time interaction and authentic cultural experiences. The second research question revealed a strong relationship between social media usage, French club activities, and cultural immersion programmes on students' French proficiency. A high correlation coefficient ($r = 0.841$; $p < 0.05$) indicates students engaging with French content on social media, participating in clubs, and cultural programmes show greater fluency, comprehension, and communication skills. This supports Bello and Ayelaagbe (2015), who asserted media exposure enhances linguistic acquisition and cultural understanding in Nigeria. It also aligns with Coulangeon (2018), emphasizing that club participation boosts academic achievement and skill mastery. These findings suggest diverse linguistic exposures play complementary roles in shaping communicative competence in French learning.The third research question examined the contribution of social media, French club activities, and cultural immersion programmes to French proficiency. The result ($r = 0.823$; $p < 0.05$) showed each factor significantly contributes, with social media and cultural immersion having slightly higher influence. This supports Benson, Anyalebechi, and Ariole (2017), who argued participation in language activities improves communication literacy and cultural adaptability. In a multimedia rich educational context, social media offers constant exposure to authentic French expressions, while French clubs provide platforms for peer interaction, reinforcing vocabulary and sentence construction. Thus, language proficiency thrives in immersive, complementary environments. The fourth research

question assessed the combined contribution of social media, French club activities, and cultural immersion programs to French learning. Results showed a very high positive correlation ($r = 0.931$; $p < 0.05$), indicating these variables create an effective framework for mastering French. This aligns with Botezatu et al. (2020), who found immersion-based learning significantly improves lexical production and comprehension. Similarly, Buchanan et al. (2021) noted cultural immersion promotes cognitive engagement and intercultural competence through practical language use. Thus, integrating digital tools, social collaboration, and experiential immersion enriches learning, ensuring linguistic knowledge is internalized through active cultural participation. The fifth research question identified the most predictive variable for French proficiency. Findings revealed cultural immersion programs had the strongest predictive power ($r = 0.849$; $p < 0.05$), suggesting direct cultural engagement is most effective for fluency. This aligns with Concordia Language Villages (2025), which highlights immersion as key for second language mastery, emphasizing learners develop competence surrounded by native speakers. This reflects Bourdieu's (1984) sociocultural theory, positing language acquisition is embedded in social context. Thus, students engaging in immersion gain linguistic skills, sociocultural awareness, confidence, and communicative competence. These results stress the importance of integrating immersion strategies with classroom instruction for comprehensive French proficiency.

Overall, findings confirmed that digital tools, peer engagement, and cultural experiences are essential for language acquisition. Students using these approaches demonstrated better French mastery than those relying solely on traditional methods. Conclusions: The study concluded social media, French club activities, and cultural immersion programs significantly enhance French proficiency. Social media exposes learners to authentic contexts, while clubs provide collaborative practice. Cultural immersion allows students to experience the language in its native setting, grasping cultural subtleties. Integrating these elements fosters fluency, cultural awareness, and communicative competence. The study emphasized modern technology and extracurricular activities are core components of French instruction. A holistic approach combining these tools offers the most effective strategy for achieving communicative competence.

Limitations

The study relied on self-reported data, which could be influenced by bias. The small sample of 100 students at one university restricts generalizability. Time constraints limited longitudinal observations or assessments of actual language performance. Future studies should adopt larger, multi-institutional samples, longitudinal designs, and objective proficiency assessments to strengthen the validity of findings.

Recommendations

Based on the findings, the following recommendations are made: (i) Integration of Social Media in Curriculum: Institutions should incorporate digital platforms such as YouTube, Instagram, and Duolingo into French language instruction to enhance learners' exposure to authentic language contexts. (ii) Promotion of French Clubs: Schools should strengthen French club activities by providing adequate resources for regular meetings, debates, and cultural exhibitions that encourage active language practice. (iii) Encouragement of Cultural Immersion Programmes: Universities should expand access to cultural immersion opportunities, including partnerships with the Nigeria French Language Village (NFLV) in Badagry and Francophone countries, to provide students with direct experiential engagement in the French language and culture.

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RE-SKILLING HUMAN RESOURCES FOR CONTRIBUTION TO THE FOURTH INDUSTRIAL REVOLUTION IN NIGERIAN UNIVERSITIES

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Abstract

The Fourth Industrial Revolution (4IR) is reshaping the global workforce through advancements in artificial intelligence, robotics, and digital technologies, among others. This paper examined the role of re-skilling human resources in contributing to the demands of 4IR in Nigerian universities. It clarified key concepts in re-skilling human resources and 4IR, reviewed relevant literature, explored global and Nigerian perspectives, and highlighted the evolution of 4IR, discussing the major benefits and challenges of re-skilling Nigerian university human resources for the 4IR. The study argued that without deliberate investment in continuous learning and adaptive skills, nations risk increasing unemployment. The paper concluded by proposing practical solutions to ensure human resources remain competitive and productive in the era of 4IR. Recommendations include revising curricula to include 4IR concepts, implementing continuous professional development programmes, revising the school library, improving the ICT infrastructure, adequate funding through legislation, continuous training, retraining, skilling, and reskilling on the use of digital technologies for effective attainment of university goals, and allowing collaboration for skill development.

Keywords: Fourth industrial revolution, Re-skilling, Human resources, Nigerian universities

Introduction

Human resources remain the life wire of any organization across the globe. Organizations like a university cannot achieve their vision and missions without human resources. This is why the function of human resources, particularly academic staff in universities, is crucial in achieving its stated goals. Human resource function refers to those tasks and duties performed in the university, and the functions comprise teaching, research, and community service. The HR in Nigerian universities is expected to develop a new skilled workforce that will meet the challenges in the education sector.

In the modern workplace, characterized by rapid technological advancements and ever-evolving job roles, the concept of re-skilling has gained prominence as a strategy for enhancing organizational agility (Gaur, 2020). It was estimated that by the year 2025, 85 million jobs may be replaced by a shift in the division of labour, while millions of new and more sophisticated jobs may emerge that will be more adapted to the new division of labour between humans, machines, and algorithms (World Economic Forum, 2020). It is very important for academic staff of any university to become more knowledgeable, skilled, and experienced to continue to thrive in the new normal. Universities should continually identify the need to reskill and encourage their human resources to develop new skills (Brasher, 2021). They must therefore value continuous personnel training and development if they want to remain sustainable and compete with their counterpart in the rest of the world. Kiers and Van Der Werff (2019) advised that educational institutions, industries, government, and the larger society should collaborate to maximize the efficiency of re-skilling of human resources during the Fourth Industrial Revolution (4IR).

The emergence of the Fourth Industrial Revolution (4IR), also known as Industry 4.0, has transformed the structure of human resources' work and the essential skills required in the economy in the modern day. Unlike previous revolutions, 4IR is characterized by the fusion of physical, digital, and biological systems, which demand human resources in the universities to possess not only technical competencies but also soft and adaptive skills in their day-to-day activities. The upsurge of industrial 4.0 has not only transformed the educational landscape but also revolutionized the way teaching and learning are taking place, and research is being conducted (Wordu &Nwanguma, 2024). For countries like Nigeria,

where the level of unemployment remains high, re-skilling human resources in Nigerian universities is paramount in achieving inclusive growth and sustainable development. The advanced deployment of Industry 4.0 and its application in the education industry is known as Education 4.0.

The 4IR is expected to reshape and restructure human resources in tertiary institutions, particularly in Nigerian universities, on how to perform their duty diligently with little effort and least cost required. These new technologies, including artificial intelligence, robotics, and digital technologies, among others, give the academic staff in the universities a different outlook about enhancing their operations to boost the delivery of teaching effectiveness, quality research and publication, impactful community service, and administrative service. However, the application of these technologies comes with several benefits and some risks. More importantly, the adoption of these technologies demands new skills for human resources for their operation and effective performance in Nigerian universities (Adepoju, Aigbavboa, Nwulu, & Onyia, 2022).

Conceptual Definition

Concept of 4IR: The term fourth Industrial Revolution (4IR), known as Industrial 4.0, was publicly introduced in 2011 at the Hannover Fair (Xu, Lu, Vogue-Heuser, & Wang, 2021). This is the era of the integration of digital technology, biotechnology, and artificial intelligence, among others. The 4IR is an era where smart technology is integrated with smart machines that communicate, diagnose, analyze, interpret, and make decisions without the help of humans (Moore, 2020). According to Schulze (2019), refers to the process of melting the barriers of the physical, technological, and biological spheres. Industrial 4.0 has caused a paradigm shift in the entire phases of human engagement. It has changed the ways human beings interact and communicate in society.

Re-skilling Human Resources: Re-skilling, the acquisition of entirely new skills to meet changing job demands, has become a critical component of workforce development. Re-skilling human resources refers to helping human resources (academic staff) to acquire new knowledge or skills to enable them to perform new jobs or enter new professions (Brinegar & Masino, 2021). Re-

skilling can help academic staff to grow as well as have a feeling of progress and satisfaction in their career path. In today's rapidly changing business environment, marked by technological advancements and evolving industry landscapes, the imperative for employees to acquire new skills has never been more pronounced. Sasmita and Kumar (2018) stated that organizations are increasingly recognizing the strategic imperative of investing in the development of their employees in upskilling and reskilling initiatives. This is not merely a response to current skill gaps but proactive measures to build a versatile and resilient workforce in the organization.

History of the Fourth Industrial Revolution

It is very germane to stress that the industrial revolution is a global transmission from one technology to another, for effective and efficient technology to provide reasonable solutions to the societal needs. The first industrial revolution was a period from the late-18th to mid-19th century, with the invention of steam and water to create new machines. This era brought rapid innovation in the areas of agriculture and manufacturing, which brought transformation to the economy, created a market for innovation and profit-making. The second industrial revolution, also known as the technological revolution, happened from the late-19th to early-20th century, an era that forced the use of electricity and gave rise to mass production of technologies. The main target of this era was the power of electricity and the engines that gave rise to light bulbs, automobiles, airplanes, telegraphs, and weapons, among others (Adetunla & Chowdhury, 2023).

The third industrial revolution was associated with the invention of information technology, computers, and the internet in the 1960s. It is also called the computer or digital revolution, where technology is the main drive of the system (Klaus, 2018). This era introduced the use of computers, the internet, automation, and the discovery of nuclear energy. The Fourth Industrial Revolution, same as Industrial 4.0 or Education 4.0, is the era of the Internet of Things (IoT), robotics, virtual reality (VR), and artificial intelligence (AI). Industrial 4.0 opened the digital world and provided a vista of opportunities to change the landscape of the educational system. Research, teaching, and learning are enhanced through the use of digital technology, and distance is no longer a barrier.

Skills Requirement for the Fourth Industrial Revolution

The Fourth Industrial Revolution (4IR) is presently changing the day-to-day activities of academic staff globally. This change requires a fundamental rethink to reequip academic staff with the necessary skills that would ensure their effective and efficient delivery of teaching, research, and community. Adetunla and Chowdhury (2023) defined skill as the application of the knowledge gained or developed with the ability to use it to satisfy the needs of society. The expected skills in the 4IR include training, technical know-how, managerial, and communication skills, which can serve as a basis and foundation. Adetunla & Chowdhury (2023) have enumerated professional digital skills needed by academic staff, ranging from basic computer skills, knowledge of technologies, library automation software usage, online database searching, online cataloguing experience, information retrieval, word processing, desktop publishing and webpage design and maintenance.

Bughin et al. (2018) categorized workplace skills in the 4IR into five groups: physical and manual skills, basic cognitive skills, higher cognitive skills, social and emotional skills, and technological skills. Also, Koya and Gopakumar (2018) elaborated on information technology skills which are expected from academic staff should possess. The skills include hardware skills, software skills, content management and development software skills, programming skills, reference management skills, and software security.

The World Economic Forum identified ten skills that are important for 4IR, and these skills are: emotional intelligence, cognitive flexibility, creativity, critical thinking, collaboration, negotiation, knowledge production, adaptation, communication skills, and the traditional role of university education in teaching and research (Verwey, 2022). Human resources are expected to have these required skills in alignment with 4IR in the area of artificial intelligence, robotics, smart technologies, and digital technologies for improving the teaching profession, research output, and community service in Nigerian universities. Re-skilling of human resources is crucial if they want to be relevant in the global universities.

Benefits of 4IR in Nigerian Universities

It is interesting to note that the core function of the university is anchored on tripartite functions of teaching, research, and community service. It is on this note that the benefits of industrial 4.0 to tertiary education will be discussed on the triple functions.

Research: It is one of the core functions of higher education institutions, particularly universities, to carry out research. Academic staff of Nigerian universities conduct quality research that would have an impact on national development using 4IR, while many students of higher institutions depend on the 4IR to write their projects (Oyedeji, 2025). This new technology encourages academic staff to seek new ideas and knowledge to enable them to supervise students who are very fond of 4IR. There are various smart machines and digital technologies that can be employed by a researcher that enhance academic writing. Khedkar (2023) stated that artificial intelligence helps to improve academic writing through editing and paraphrasing. AI-powered software helps academic staff and students of Nigerian universities to check accurate grammar and style suggestions. Examples of such software are Grammarly and PerfectIt, among others.

Another example of artificial intelligence is a search engine that a researcher can consult while writing academic papers. A search engine is a smart machine that is used to search for information online, and it is based on keywords or user behaviour. Examples of search engines are Google, Ask.com, Bing, among others. A study carried out by Malik et al (2023) affirmed that ChatGPT and AI-powered technology support researchers in content generation, research proposals, and abstracts, but quickly cautioned researchers to redefine the generated content. Furthermore, there are AI-powered technologies that can also help in analyzing data obtained from field work, prominent among them are the Statistical Package for Social Sciences (SPSS), Minitab, Stata, ATILAS, etc. Plagiarism Hunt, Plagiarism Checker, and Copyleak are equally software that are used to check plagiarism, while Zotero and Endnote are used for the management of references (Wordu & Nwanguma, 2024). In summarily, the use of artificial intelligence in academic writing has not only enhanced efficiency and productivity but also helped academic staff and students to manage time effectively.

Teaching: It is the main responsibility of academic staff in higher institutions of learning because it is the whole essence of education. The academic staff are expected to seek knowledge, preserve knowledge, and disseminate knowledge for the betterment of man and society. The 4IR has provided ample opportunity to improve the core function of academic staff in the university. With the support of digital technologies, many institutions in Nigeria have found themselves compelled to rapidly embrace online teaching during the widespread, pandemic-induced lockdowns. Gocen and Aydemir (2020), stated that the integration of artificial intelligence has helped to improve access to better teaching and learning opportunities and platforms for vulnerable, unserved, and isolated communities. It has encouraged personalized learning with individuals choosing the platform best suited and moving at their own pace and to their convenience. Oyedeji and Sodipe-Lawal (2023) stated that there are many online platforms for teaching and learning that academic staff and students can adopt for effective teaching and learning. These online platforms include StartMe, Neo, Classtime, Classwize, Ted-Ed, Coursera, Google Classroom, Future Learn, LanSchool, and Articulate 360, among others. However, the success of digital technologies largely depends on good internet connections, electronic gadgets, learning software, digital skills, availability, and access to technology. Artificial intelligence will take over the repetitive and low-value tasks and allow the academic staff to focus on more high-value tasks that require critical thinking, creativity, and empathy, if integrated into the pedagogy.

Community Service*:* This is the third core function of academic staff in Nigerian universities and focuses on serving the public with intellectual, professional, technical and executive value. The university disseminate existing and new information to the community and at times, to provide certain services to the community, such as medical services, enlightenment, and services, as well as the provision of student-teacher who help to impact knowledge in community schools through the fourth industrial revolution (Oyedeji, 2023). Some of the benefits the community derives from higher institutions of learning are collaboration with the community in research and providing solutions, concessions on admission of students and employment of staff, occupational skill training, and training high-level

manpower that will help in serving the community and others (Wordu & Nwanguma, 2024). The integration of digital tools in educational institutions is expected to improve communication between the community and the university. AI-powered machines can be used for language translation, recording minutes of the meeting, meeting procedures, and disseminating in real time to stakeholders.

Challenges of 4IR in Nigerian Universities

•Digital Skills and Competence: Low digital skills and competence are very rampant among staff in Nigerian universities, particularly in advanced digital skills which is required for the Fourth Industrial Revolution. Adetunla and Chowdhury (2023) found in their study that there was a low level of digital skills and competence to function in this era. They further stated that no available training or sign of preparation for the advanced digital skills required in the fourth industrial revolution. Adetunla et.al (2023) explained that the advanced digital skills to navigate in the 4IR were very low, and the main reason for this low level of advanced skills was the lack of training in the area of on-the-job training, in-house training, conferences, workshops, seminars, distance educational programmes, and study visits on the new technologies.

Ogunode, Babayo, Jegede and Abubakar (2021) and Ogunode and Ndayebom (2023) reported that Nigerian institutions lack the digital tools and facilities to enable full automation of technology in their pedagogy. Academic staff and students lack digital tools and knowledge that will enhance their teaching effectiveness and research publications. By implication, low digital skills and competence may undermine Nigerian universities, and Nigerian graduates may not only be unemployed in the labour market, but also not compete with international graduates.

Inadequate Funding: There is no doubt about the fact that without funding for human resources in the universities by the Federal Government of Nigeria, learning and teaching of new skills cannot be done. Wordu (2023) stated that funds and human resources are crucial in the achievement of a viable university education. Viable university education is education that can incorporate digital tools and smart machines in the pedagogical content. The level at which human resources will contribute to 4IR is likely to be low when

proper attention is not given to university staff to new skills that would make them compete with their colleagues in the advanced countries. According to Adetunla and Chowdhury (2023), Tertiary Education Trust Fund Programmes are largely unavailable to university staff for 4IR training. Dada, Atobauka, and Ogunode (2022) reported that inadequate funding has led to an insufficient supply of digital facilities in higher institutions of learning and subsequently undermined the realization of institutional goals.

Obsolete Curricula: The existing curricula of Nigerian universities do not equip human resources with the emerging technologies and skills needed for the 4IR. According to Akorede (2022), the most chronic frustrating educational development in Nigeria is the problem of outdated curricula and a conservative learning process. The researcher further explains that, if facts and figures are to be followed, the educational curricula presently being utilized in Nigeria are apparently far older than the country itself. These curricula are vivid remnants of the imperial educational system established by the colonial master sixty years ago and, to a large extent, are still in use, even though the original authors constantly revised theirs to suit contemporary demands. Aslam, Mushtaq, Noor, Maqbool, Khan, and Sarfra (2024) identified time restrictions, difficult curriculum content, issues with official curriculum documents, incompatibility of the curriculum with textbooks, a mismatch between curriculum materials and assessments, and a lack of access to detailed curriculum information as problems associated with curriculum implementation in Nigerian education. It is pertinent to state that for digital learning to be successful there is a need to scrap the old and obsolete curriculum where the institutional administrators have more interest in the memorization of facts and the award of the degree and shift to lifelong learning with an emphasis on the acquisition of digital skills and knowledge that will enable the recipient in the trajectory of the world of work. So, the use of the old curriculum bestowed by the colonial master is a disservice not only to the students but retard economic growth and development. It is enlightening to observe that technologies keep evolving and curricula keep changing to meet the demands of the market.

Internet Connectivity and Bandwidth: Poor internet connectivity and low bandwidth are other challenges of 4IR in Nigerian

universities. Oyedeji and Sodipe-Lawal (2023) observed that not all academic staff are ready to switch to the Fourth Industrial Revolution due to the absence of the skills required for digital technologies. Internet penetration has been steadily increasing, but access remains uneven, particularly in Nigerian universities. Connectivity can be unreliable, slow, and expensive (Nigerian Communications Commission, 2024). Many academic staff members struggle with limited bandwidth, which makes it difficult to access rich multimedia content, participate in live online sessions, or download large files. This digital divide exacerbates existing inequalities, as learners without reliable internet access are effectively excluded from online teaching and learning opportunities (World Bank, 2020).

Technology Acceptance and Adoption: Some of the academic staff find it difficult to accept and adopt the 4IR into teaching and learning, academic writing paper and dissemination of information to society. Muftahu (2020) laid credence to this that lecturers are not comfortable with the adoption of technology towards facilitating teaching and learning in the universities due to power failure and poor internet connectivity.

Conclusion

Re-skilling human resources is a necessity for effective contribution to the Fourth Industrial Revolution. Nigeria and other developing nations must strategically invest in human capital development, adopt global best practices, and create enabling environments for continuous teaching and learning. By doing so, the workforce will not only remain relevant but also drive innovation, productivity, and sustainable growth.

Recommendations

The following recommendations were made, based on the challenges of 4IR in Nigerian universities:

- Both human resources and universities need to commit to reskilling and make career development an essential phase of the future workforce. Great efforts should be taken to make these learning opportunities accessible, available, and affordable to the workforce.
- The federal government of Nigeria should provide adequate funds through legislation by ensuring that

university education shall budget of not less than 10% of the annual revenue. This will enable university education managers to procure the needed smart machines and digital technology.

- Technology is constantly changing, and the stakeholders in educational institutions should review the curricula to align with Industry 4.0 and the demand of the market. Lecturers and management need continuous training, retraining, skilling, and reskilling on the use of digital technologies for effective attainment of educational goals. Invest in and upgrade Federal Government of Nigeria should provide Information and Communication Technology (ICT) infrastructure within universities to support new training and digital learning.

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THE IMPACT OF PUBLIC DEBT ON INDUSTRIALIZATION IN WEST AFRICAN COUNTRIES

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Abstract
This study looked at how public debt affected industrialization in West African nations. The study specifically examined the effects on industrial output of total public debt, external public debt, and domestic public debt taking into account the region's particular economic structures and financial constraints. The analysis explores the extent to which these different types of public debt affect industrial development, measured through indicators such as manufacturing value added, industrial output, and infrastructure investment. Using panel data from a representative sample of African nations over the past two decades and panel GLS regression techniques. In addition to correlation analysis, descriptive statistics were used for preliminary analysis. The findings suggest that the connection between total debt and industrial production is not linear. Industrial output increases in lockstep with total debt until it hits a tipping point, beyond which an increase in total debt has a negative effect. These outcomes are similar to those found for the total debt. On the other hand, the results of the impact of external debt on industrial output suggest that there is a linear relationship between external debt and industrial output.

Keywords: *industrial production, panel regressions, industrialization, total debt, domestic debt, and external debt*

1.0 Introduction

Africa accounts for less than 3 per cent of global GDP and less than 1% of global manufacturing output. This reflects the continent's current industrial capacity and limited integration into global value chains (UNIDO, 2024). In 2014, Africa's MVA made up only 1.6 per cent of the world total, and since 1990, its growth has outpaced that of every other region (UNIDO, 2016). Furthermore, UNIDO (2016) reports that the participation of African economies in global value chains is quite low. Additionally, according to the UNIDO report, Africa's export value adds only 14percent whereas growing Asian nations contribute 27 percent and industrialized economies provide 31percent.

The united Nation projects Africa's economy to grow by 3.5 per cent in 2024, slightly up from 3.3 per cent in 2023. This growth outspaces the global average, which is expected to decline from 2.7 per cent in 2023 to 2.4 per cent in 2024. The African Development Bank also forecasts a 3.7 per cent growth rate for the continent in 2025, with 41 countries expected to experience stronger growth than in 2023(ADBG, 2024). The sluggish expansion of the "big five" countries of the continent South Africa, Nigeria, Algeria, Egypt, and Morocco contributes to the slower-than-expected growth. Compared to the average growth rate of 4.0 percent for the entire continent, the combined growth rate of these five African countries was only 3.1 percent. Growth is expected to pick up speed in 2020 and 2021, reaching 3.9 and 4.1 percent, respectively.

The GDP per capita in the industrial sector of Africa is $700 (Shs2.6m) on average, which is less than a third of the GDP per capita in Latin America ($2,500, Shs9.3m), and a fifth of the GDP per capita in East Asia $3,400 (Shs12.6m). Despite the fact that the agricultural sector does not create goods for industrialization, minerals and hides and skins are the main raw materials required from Africa, Ron (2017).

Fast industrial development is essential for West Africa to go from a static, subsistence-based economy to a dynamic, self-sufficient one (Gabriel, 2002). This would help the continent achieve its goals, which include raising real per capita income, creating more jobs, procuring more raw resources locally, and developing domestic industrial technologies. It is also anticipated that significant industrialization will create the linking effects that

are needed to maximise the use of current resources and promote overall economic growth.

Very few nations have achieved economic success without industrialization. Countries that could do so have only been in situations like great abundance of land or natural resources (UNIDO 2009).In the context of globalisation, industrialization is a force for social and economic transformation that is only growing stronger since it offers practically limitless opportunities for development, particularly for many low-income nations. It always has been essential to processes of continuous growth acceleration that make countries transition from "poor" to "rich."

In addition to being essential to the process of economic development, industrialization in West African nations would also foster growth by promoting primary exports and importing goods in place of export promotion initiatives (Kibbly, 1969). To encourage the expansion of industrial output, the majority of West African nations have implemented a number of alternative policies. The economies of West Africa remain underdeveloped despite a number of programs aimed at industrialization. Given the difficulties that African nations face, there has been a persistent effort in the literature to look at the reasons for West African deindustrialization. Providing enough cash to properly finance industrialization is one of the problems facing West African nations with industrialization-focused policies. Public debt is created when government programs and policies are financed by insufficient capital formation. Without appropriate and sufficient funding, industrialization cannot be truly realized or accomplished. Fiscal measures, capital formation, and public debt are some of the main sources of funding for industrialization.

The majority of African nations' public debt profiles are likewise cause for alarm. Sectoral analysis, such as the industrial sector, has gotten little to no attention in the growth analysis in the literature, despite the researchers' earnest efforts to demonstrate a substantial correlation connecting public debt and economic growth. One issue that hasn't gotten much attention yet is the connection between industrialization and state debt.

The golden-haired rule of public finance over the economic cycle states that borrowing should only be done by the government for investments, never for current spending. According to Keiko (2007), this rule safeguards investment spending while allowing

automatic stabilizers to function during the cycle without endangering long-term budgetary sustainability.

Many of the studies that have been done in the past on the subject of industrialization in Nigeria such as those by Lopes da Veiga(2016), Atta-Mensah, and Ibrahim (2024) have concentrated on how industrialization affects the country's economic growth. A few, such as Adebiyi (2004) and Uwem (2005), explained how industrialization related to other areas of the Nigerian economy. The manufacturing sector, which is a subsector of the industrial sector, was the exclusive focus of the few researchers, like Ogun (2004) and Dauda (2003), who based their investigations on factors of industrial production growth. This research took on significance because, despite playing essential role in the economic performance of every country, the affiliation between public debt and industrial expansion received little or no attention in the literature. For this reason, the influence of public debt on the industrialization of West African countries is the main subject of this research.

Though industrialization has been well-documented in numerous literatures to have a number of long-term benefits, including reduced unemployment, increased economic diversity, technology transfer, and improved welfare, West African nations have not adopted this policy. One of the main issues facing the sub-region is the generation of funds, with state debt being a particularly notable example. Without a question, the contentious discussion about the relationship between public debt and growth, especially for West African countries, has remained largely equivocal. Researchers have worked very hard to show that public debt and growth are positively correlated, but sectoral analysis such as the industrial sector—has gotten little to no attention in growth analyses published in the literature.

Debt ought to be utilised exclusively to fund government initiatives that enhance public capital development and foster robust and enduring economic expansion. More investigation into the debt-growth relationship and emphasis on the impact of public debt on industrial performance are necessary, given the paucity of empirical research on this topic.

Does public debt affect industrialization in West African nations? How does West African industrialization relate to the total amount of state debt? b.) Does domestic debt affect West African industrialization? c.) Does external debt affect West African

industrialization? The objective of the study is to examine how public debt affects industrialization in West African nations.

The study covers West African countries which include Guinea-Bissau, Cote d'Ivoire, Sierra Leone, Benin, Burkina Faso, Ghana, Guinea, Liberia, Nigeria, Guinea-Bissau, Mali, Niger, Senegal, Togo, Mauritania, Saint Helena, and Sou Tome and Principe. Due to the availability of data, this study will encompass the years 1980–2019.

2.0 Review of Literature

The ways in which public debt influences private investment are illustrated by four theoretical perspectives (Lau et al., 2019). First, according to the classical perspective, capital from the private sector may be transferred to the comparatively less productive public sector, which could explain the crowding-out effect of government borrowing on private sector investment (Salsman, 2017). The second point of view held by neoclassical economists is that government borrowing from banks increases the government's purchasing power and lets it contend with other industries for resources, or monies that are readily available. When there is full employment, government spending may take the place of private sector investment by increasing credit interest rates and price levels (Bernheim, 1989). Third, through multiplier effects, government spending may attract private sector investment, according to Keynesian economists (Salsman, 2017). Specifically, Friedman (1978) states that, if the interest rate is not sensitive to changes in investment or unemployment, it will encourage overall spending from both the public and private sectors. Fourth, the Ricardian equivalency points out that borrowing by the government cannot drive away private sector investment because both private investment and current interest rates will stay the same even in the scenario where citizens believe future tax increases by the government will be necessary to pay off its debt (Bernheim, 1987). The amount of public debt issued to cover future tax obligations will then be added to savings. T Excessive public debt can contribute to the public debt crisis and negatively affect the economy, as noted by Burriel et al. (2020).

The overall production of the economy's industrial enterprises, including mining, manufacturing, electricity, gas, steam, and air conditioning, is referred to as the industrial sector output (OECD, 2020). This indicator, which represents change in

the volume of production output, is often measured as an index based on a reference period. Stated differently, the output of the industrial sector which generally consists of mining, manufacturing, utilities, and, occasionally, construction is measured by industrial production. It is typically seen as a volume-based index. Hence, the annual variation in industrial production expressed as a percentage indicates the shift in the amount of industrial output relative to the year before. This means that since the production of capital goods and consumer durables is expected to decline during a downturn in the economy, annual variance in industrial production offers insight into the state of the economic cycle. Even though it only produces a small percentage of an economy's total production, the industrial sector is a leading indicator of GDP growth and overall economic performance because to its sensitivity to consumer demand and interest rates.

The impact of industrialization on economies has been analysed through a variety of theories; however, public debt and industrialization in West African countries have not been well-documented. The main theories of industrialization that will be covered in this study include the theory of structural changes, which was popularized by Lewis and Chennery.

According to Structural change theory, the theory explains the transition of an economy from traditional agriculture dominant to the industrial based economy. The structural change is explained by two prominent interrelated models in economy namely; Lewis model which was propagated by Lewis (1954) and the Chennery model propagated by Chennery (1950). The Lewis theory of unlimited supply is a classical model of structural change which is based on two sectors of the economy (modern and traditional sectors). According to Lewis, the modern sector is characterized with relatively high level of capital and small in size, while traditional sector has surplus labour in the agricultural sector with relatively low level of capital. The argument of Lewis is that the marginal productivity of the surplus labour in the rural agriculture sector is zero and by implication, reallocation of the surplus labour from the rural sector to the modern industrial sector would not pose any noticeable reduction in the agricultural sector productivity, rather industrial transformation would take place as the labour would be used to bring about a chain of productive reactions in the modern sector.

A review of the empirical literature

There is a dearth of empirical research on the connection between public debt and industrialization, particularly in Africa, but a wealth of literature on the factors that drive modernization. Oumou (2016) demonstrates that public debt has a threshold influence on industrialization in the WAEMU using a threshold effect panel (PSTR) model. Thus, he establishes the ideal debt amount for these nations. The threshold of 80% is the point at which any further debt will have a negative impact on the economies of the Union's member states. He employs the external debt-to-GDP ratio as an explanatory variable that varies depending on the regime as well as a transitional variable. Therefore, the regime states that debt has a negative and considerable effect on growth in WAEMU countries above this threshold. Below this point, however, debt has a positive and negligible impact on growth in WAEMU nations.

Sule (2017) looked into how foreign funding affected Nigerian industrialization between 1985 and 2016. The Dual Gap Model (1966) serves as the foundation for the study, and the Johansen Cointegration test and Error Correction Model under the VAR framework are used for data analysis. The study found that while foreign direct investment has a favourable influence on industrial output, external loans, foreign portfolio investments, remittances, and official development assistance had a negative impact on Nigeria's industrialization. Therefore, given the small amount allotted to the sector during the study period, the study recommended that the Nigerian government advocate for more official development assistance to the industrial sector and properly align foreign fund inflows to suit the sector.

Ugwu, Asogwa, and Ugwuanyi (2017) looked at how foreign capital affected Nigeria's industrial sector. They pointed out that foreign aid, foreign direct investment, and external debt constitute one of the main sources of investible resources in the majority of developing nations. Utilising the Ordinary Least Squares (OLS) technique on yearly time series data spanning from 1982 to 2013. The findings demonstrated that FDI has an inverse and negligible impact on manufacturing production in the short term, but foreign aid inflow and external debt had an inverse but considerable negative impact on manufacturing output. As a result, the report suggested that the government encourage investment in the business sector and guarantee responsible use of borrowed money.

Onyeiwu & Karonga (2013) state that a large number of studies on the industrial performance of African nations are case studies or descriptive analyses, but relatively few have well-developed models that explain industrialization as a function of other factors, such as growth. They base their empirical analysis on the Lucas (1988) model, which serves as a theoretical framework.

According to Patillo, Poirson, and Ricci (2004), low levels of public debt have a positive impact on economic growth, whereas high levels have a negative impact (Schclarek, 2005). However, Kumar and Woo (2010) found an inverse relationship between the two variables after controlling for other factors that influence growth.

Similarly, Ohwofasa et al. (2012), Sulaiman (2012), and Erhieyovwe&Onovwoakpoma (2013) all independently stated that foreign debt had a positive impact on economic growth, but Sulaiman's analysis found no evidence to support it. Ayad and Ayadi (2008) discovered varying indications of this non-linear correlation between the variables for two developing nations: they discovered that external debt had a positive influence on Nigeria until it reached a point where it turned negative, but they did not find any indication of this non-linearity for South Africa, where debt had a significant positive impact on the nation's economic output. This implies, they found a non-linear relationship between debt and growth in Nigeria but not in South Africa, which they suggested may be because of that country's superior debt management.

Kourtello et al. (2013) employed the augmented/threshold approach to find a mixed response to the relationship and no casual effect of public debt on economic growth. High levels of public debt and economic development under various regimes are examined using the Solow growth model and the panel regression approach. They contended that, in contrast to high-quality institutions, there is only a negative threshold effect of high public debt on economic growth in nations with low-democratic regimes. Additionally, they proposed that policymakers should abstain from enacting austerity measures that will have a detrimental effect on the stability of their economies and that the relationship between the two is significantly influenced by the calibre of the institutions that support the economy.

An Overview of the Found Gaps

While the majority of the papers on Africa did not cover all of the West African countries, and since policies vary from nation to nation, the conclusions drawn from one region may not apply to another, all of the previously reviewed papers added to the body of literature. Nevertheless, the results of the research may vary depending on the length of the investigation period; also, there are now relatively few and out-of-date publications discussing the effects of public debt on industrialization.

As a result, the literature reviewed above has certain research gaps. Firstly, none of the reviews addressed the impact of public debt on industrialization, both domestically and globally, which is the primary focus of this study. Instead, the reviews concentrated on the relationship between public debt and economic growth, ignoring sectorial performance, such as industrialization. Second, only national, developed, or developing countries were the subject of the literature analysis; none of the studies examined the effect of public debt on industrialization at the regional level, such as in West or North Africa, which is the primary topic of this study (West Africa).

The impact of both internal and external public debt, as well as the total amount of public debt, on industrialization in West African countries was examined in this study because, ultimately, it was found that many of the reviewed studies also focused on the relationship between external debt and economic growth, giving less thought to internal public debt and public debt overall.

3.0 Research Methodology

The theory of structural change, which has been contributed to a number of directions, would serve as the foundation for the theoretical framework for this investigation. Fisher (1935), Allan G.B. (1939), Colin Clark (1940), Nurske (1953), and Lewis (1954) made the first contributions to the theory. As per Allan, G.B. (1946), the three-sector model of economics divides economies into three activity sectors, namely primary extraction of raw materials, secondary manufacturing, and tertiary services. According to the model, the importance of an economy's primary, secondary, and tertiary sectors in terms of economic activity increases. The primary sector provides the majority of the national revenue in low-income countries, which are still in the early phases of development. In countries with middling national incomes and higher developed

states of development, the secondary sector generates most of the money. Most highly developed, high-income countries derive their economic production from the tertiary sector (Fisher, 1935; Allan G. B. 1939& 1946; and Colin Clark, 1940).

The idea of structural change has since been developed by a number of writers (Chennery, 1960; Chennery and Syrquin, 1975, Syrquin, 1980, Chenery and Syrquin 1986). The main argument of the theory of structural change is that a nation's structural shift from agriculture to the modern sector is influenced by a number of elements pertaining to economics, demography, and policy. The model states that changes in the level of capital stock per worker and per capita income are necessary for industrialization to occur. The population as a whole, human capital, or educational attainment, and trade openness or liberalisation policies are considered policy-related factors, whereas public debt is considered a demographic element.

The hypothesis is predicated on the claim that variations in per capita income represent the disparities in development stages between nations. Lower-developed nations are more likely to catch up to more developed nations and, as a result, follow long-term industrialization trends (Chennery&Syrquin, 1975). The population represents the home market, which is anticipated to have a favourable effect on industrialization because a sizable home market creates a scale economy that lowers manufacturing costs. In addition, the rate of urbanisation serves as a proxy for clustering or agglomeration, which is critical for driving up industrial output growth. Government policy-related elements, like debt policy, may have an impact on the degree of industrialization by creating a crowding out effect, depriving the private sectors that propel industrialization of the resources they need to increase production. The two main forces behind industrialization, according to Chennery's "pattern of industrial growth" (1960), are population and per capita income. He then looked at the factors that lead to industrialization using the equation below.

$SI = \alpha + \alpha$……1

$\ln(P) = \pi_{it} + \alpha$……2

$\ln(Y) = \pi_{it} + \alpha$.....3

$(Y2) = \pi_t + \pi_t = Z = \pi_t$

Chennery (1960) defined Z as the collection of control variables that includes urbanisation, openness policy, human capital, and physical capital.
SI is the proportion of industry in total output,
P is the total population, and
Y is the per capita income.

Model Specification
In line with the theoretical framework presented in the immediate preceding section, the level of industrialization (IND) depends on the set of economic factors represented by the per capital income and capital stock or gross fixed capital formation, demographic factors represented by population, human capital and urbanization, and set of policy-related factors including public debt and trade openness which measures trade liberalization policy. The functional relationship between industrialization and its determinants is thus given as:
IND = f (PCI, POP, GFCF, HC, PDB, TOP, URB,)
(3.2)

Where: IND: The percentage of industrial output in overall output is known as the Industrial Development Index, PCI is the per capita income measured in real term, POP is the population, GFCF means the gross fixed capital formation, HC mean human capital, PDB is public debt, DDBT is domestic debt, EXDBT is external debt, TOP is trade openness and, URB is the rate of urbanization. The model is therefore re-specified in econometric form as:

$INDi,t=\propto + \beta_1 PCIi,t + \beta_2 lnPOPi,t + \beta_3 GFCFi,t + \beta_4 HCi,t + \beta_5 PDBi,t + \beta_6 TOPi,t + \beta_7 URBi,t + \theta i + \varepsilon i,t$ .....(3.3)

The econometric model to be used for estimation to achieve the research objectives two and three is specified thus:
$INDi,t=\propto + \beta_1 PCIi,t + \beta_2 lnPOPi,t + \beta_3 GFCFi,t + \beta_4 HCi,t + \beta_5 DBi,t + \beta_6 EXDBi,t + \beta_7 TOPi,t + \beta_8 URBi,t + \theta i + \varepsilon i,t$
..... (3.4)
Where:θ = fixed effects by nation, S = the constant term; ε = the idiosyncratic error term
β represents the independent variables' coefficients, I = nation, t = year

4.0Analysis and Discussion of Results

Descriptive Analysis: Table 1 displays the findings of the summary statistical analysis. A measure of the asymmetry in a series' distribution around its mean is called skewness. A normal distribution often has 0% skewness. A long right tail is implied by positive skewness, whereas a long left tail is implied by negative skewness. All variables, with the exception of urbanization, which has a long left tail, have lengthy right tails, according to Table 1. Kurtosis calculates the series' distribution's peak or flatness. The distribution is classified as mesokurtic if the kurtosis is three; beyond three, it is classified as leptokurtic, and below three, as platykurtic. With the exception of Industrialization and Urbanization, which are mesokurtic, the tables demonstrate that all the variables are leptokurtic.

The Jarque-Bera test statistic is used to determine whether the series has a normal distribution. It calculates the variation between the series' skewness and kurtosis, which display variables with a normal distribution. With the exception of urbanisation, which is normally distributed, the Jarque-Bera results show that the series are not normally distributed.

With a standard deviation, minimum and maximum of 7.494572, 1.882058, and 48.39267 million naira, respectively, the average level of industrialization for the period under consideration is 20.88349 million naira, according to the results of the descriptive statistics. The estimated mean of domestic debt is 35.18062 million naira with a standard deviation of 78.49899 million naira. It equally has a minimum and maximum of 0.402581 and 915.9498 million naira respectively. The external debt has a mean and standard deviation of 78.48004 and 110.6209 respectively with minimum and maximum of 4.531357 and 2066.184 million naira respectively. The average total debt is estimated to be 113.6607 with a standard deviation of 141.1823. The minimum total debt is 12.82776 while the maximum total debt is estimated to be 2351.913 million naira. However, the result of Jarque-Bera normality test showed that, data of all variables in the model are not normally distributed with the probability values of 0.0000 which less that 0.05 significant level except for the urbanization which is normally distributed with the probability value of 0.224137 which is more than all significant level.

Table 1: Summary Statistics of the Variables

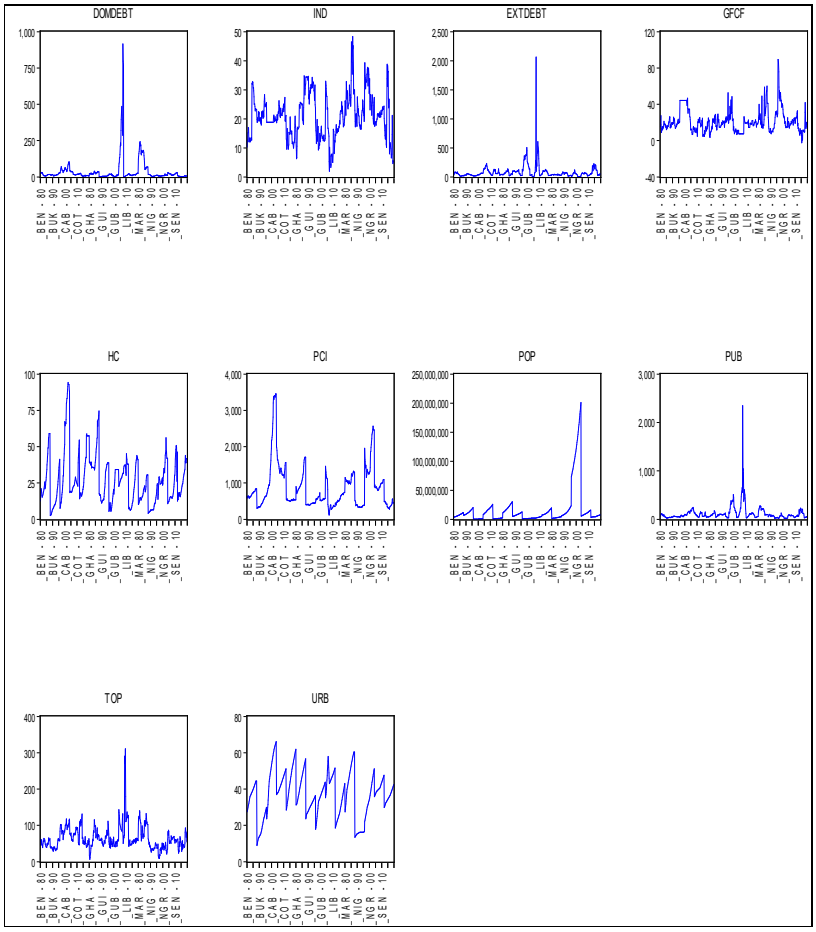
	IND	PUB	PCI	POP	HC	GFCF	TOP	URB	EXDEBT	DOMDEBT
Mean	20.88349	113.6607	838.6680	15.20641	28.02713	20.95211	66.19006	36.83324	78.48004	35.18062
Median	20.41478	78.57156	612.0472	7.001152	24.25389	18.72544	59.16432	37.28150	52.92221	15.17295
Maximum	48.39267	2351.913	3452.946	200.9636	94.24517	89.38613	311.3553	66.19500	2066.184	915.9498
Minimum	1.882058	12.82776	115.7941	0.286657	2.484340	-2.42435	6.320343	8.805000	4.531357	0.402581
Std. Dev.	7.494572	141.1823	600.8629	30.94046	17.35993	11.85134	31.78134	11.87891	110.6209	78.49899
Skewness	0.372899	8.120130	2.169532	3.929282	1.207869	1.807257	2.465822	-0.05152	10.12333	6.513689
Kurtosis	3.312786	108.9023	8.528398	18.57006	4.826586	8.388923	16.70923	2.680738	167.3895	57.87147
Jarque-Bera	17.38679	305151.4	1312.969	8086.223	243.8277	1119.297	5642.686	2.990992	729282.4	84550.71
Probability	0.000168	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.224137	0.000000	0.000000
Sum	13323.66	72515.50	535070.2	9701.689	17881.31	13367.45	42229.26	23499.50	50070.27	22445.23
Sum Sq. Dev.	35779.41	12696970	2.30E+08	609807.8	191970.9	89469.34	643404.1	89886.06	7794962.	3925252.
Observations	638	638	638	638	638	638	638	638	638	638

Source: Author's Computation, 2025

TREND ANALYSIS

The trend analysis illustrates how a variable varies over time in Tale 2 below. It can be used to examine the features of the data, especially to determine whether a trend is present. The trend's findings show that there isn't a trend in industrialization (IND), gross fixed capita formation(GFCF), Human Capita (HC), Per Capita Income, Total debt, per capita income, trade openness and Urbanization as the values goes up and down and do not follow a particular trend pattern. The trend also reveals that there was a few points lying away from the lines imply a distribution with outliers in Domestic debt (DOMDEBT), External debt (EXTDEBT) and Population (POP).

Table 2: TREND ANALYSIS



Source: Author's Computation, 2025

The results obtained from the correlation analysis are presented in Table 3 below. The estimated correlation coefficient of -0.228, -0.025, -0.274 indicate that public debt, domestic debt and external debt are moderately negatively correlated with industrialization (IND) while the estimated coefficient of 0.268, 0.309 and 0.294 indicate that per capita income(PCI), Gross Fixed Capita Formation(GCFC), Population (POP) are moderately and positively

correlated with Industrialization (IND). In addition, the estimated coefficient of -0.059, -0.046, -0.013 indicate that Human Capital (HC), Trade Openness (TOP), and Urbanization (URB) are moderately negatively related with IND.

Table 3: Correlation Matrix

Variables	IND	PUB	DOMDEBT	EXDEBT	PCI	GFCF	POP	HC	TOP	URB
IND	1.000	-0.228	-0.025	-0.274	0.268	0.309	0.294	-0.059	-0.046	-0.013
PUB	-0.228	1.000	0.625	0.833	-0.101	-0.128	-0.177	-0.074	0.273	0.119
DOMDEBT	-0.025	0.625	1.000	0.088	0.066	-0.042	-0.118	0.034	0.235	0.239
EXDEBT	-0.274	0.833	0.088	1.000	-0.176	-0.133	-0.142	-0.119	0.182	-0.018
PCI	0.268	-0.101	0.066	-0.176	1.000	0.400	0.421	0.558	0.137	0.539
GFCF	0.309	-0.128	-0.042	-0.133	0.400	1.000	0.198	0.159	0.148	0.111
POP	0.294	-0.177	-0.118	-0.142	0.421	0.198	1.000	0.112	-0.287	0.013
HC	-0.059	-0.074	0.034	-0.119	0.558	0.159	0.112	1.000	0.231	0.725
TOP	-0.046	0.273	0.235	0.182	0.137	0.148	-0.287	0.231	1.000	0.418
URB	-0.013	0.119	0.239	-0.018	0.539	0.111	0.013	0.725	0.418	1.000

Source: Author's Computation, 2025

Presentation of Panel Regression Results

The Generalized Least Square estimated panel regression results on the impact of debt on Industrialization are presented in Table 4 below. So far the Jaque-Bera normality test ascertained non-normal distribution of all variables data included in the model except urbanization, the study therefore employed the GLS regression analysis. The results were also obtained with the assumption of linear and non-linear relationship separately.

The estimated GLS panel regression results on the impact of total debt on IND are presented in Table 4. The results were obtained with the assumption of linear and non-linear relationship. The results of the linear model indicate that total debt has negative and significant impact on IND at all level of significance given the estimated coefficient and p value of -0.0102 and 2.94e-07 respectively. This implies that increase in total public debt leads to

significant reduction in the level of industrialization. Further analysis was conducted using non-linear panel GLS models and the results indicate that total debt has significant negative impact on IND while the square of the total debt has insignificant positive impact on IND. The implication of the results is that the impact of total public debt on industrialization is asymmetry or not non-linear. Hence, the result of the linear model is relied on.

The results for the impact of both domestic and external debt are presented in Table 4. From the results obtained with assumption of linear relationship between IND and domestic debt presented in the first column, it is revealed that domestic debt has positive but no significant impact on IND at all conventional level of significant given the estimated coefficient and p value of 0.000149 and 0.966 respectively. This implies that increase in domestic debt may have positive effect and improvement in industrialization but the development may not be noteworthy. However, the result of the non-linear regression shows that, domestic debt has significant positive impact on IND given the estimated coefficient and p value of 0.0210 and 0.0188 respectively while domestic debt square has significant negative impact on IND given its estimated coefficient and corresponding p value of -3.52e-05 and 0.00689 respectively. The implication of the results is that state domestic debt has inverted U shaped relationship with IND as the IND increases with public domestic debt up to a turning point where further increases in public domestic debt lead to reduction in IND. From the results therefore, domestic debt is beneficial for IND but government of various countries must exercise caution since increase in domestic debt beyond the inflection point will have negative consequence on the IND.

Furthermore, the GLS panel regression results for the impact of external debt on IND with the assumption of linearity and non-linearity are presented in Table 4. The results of the linear model with a coefficient of -0.0154 and p value of 3.20e-10 indicate that external debt has negative and significant impact on IND. This implies that the level of IND decreases with increase in external debt. The results of the non-linear model reveal that public external debt has insignificant negative impact on industrialization given its estimated coefficient and corresponding p value of -0.0230 and 3.01e-07 respectively while the square of debt has significant positive impact on industrialization as it recorded a coefficient of 6.08e-06 and p value of 0.0314. These suggest that there is

significant U shaped relationship between public external debt and industrialization in West Africa. At the lower level of external debt, the impact on industrialization is negative while it is positive at higher level of external debt. This may be as a result of low interest rate of the foreign debt.

Table 4: Estimated GLS Panel Regression Results for Total Public Debt

	(1)	(2)
VARIABLES	Linear	Non Linear
PUB	-0.0102***	-0.0144***
	(2.94e-07)	(0.000110)
PUBS		2.86e-06
		(0.181)
PCI	0.00284***	0.00294***
	(1.30e-05)	(7.32e-06)
GFCF	0.124***	0.122***
	(5.19e-07)	(8.71e-07)
POP	0.0410***	0.0391***
	(5.44e-05)	(0.000140)
HC	-0.136***	-0.144***
	(4.32e-09)	(1.65e-09)
TOP	0.00834	0.00992
	(0.403)	(0.323)
URB	0.0488	0.0558
	(0.182)	(0.130)
Constant	17.90***	18.14***
	(0)	(0)
Wald Chis	192.12	194.44***
Observations	638	638
Number of cid	16	16

pval in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Source: Author's Computation, 2025

Note: p-values in parenthesis; PUB is aggregate public debt; PUBS

is aggregate public debt square; PCI is per capita income; GFCF is gross fixed capital formation; POP is population; HC is human capita; TOP is trade openness; URB is urbanization.

For the control variables, the results show the linear and non-linear model for PCI, GFCF, POP, TOP, HC and URB in the Table 5 below. The result of the linear model indicates all have insignificant positive impact on industrialization with PCI coefficient of 0.00263, and probability value of 4.97, GFCF coefficient of 0.124 with probability value of 3.86, POP coefficient of 0.0430 with probability value of 1.91, TOP coefficient0.00896 with probability value of 0.361 and URB coefficient of 0.081 with probability value of 0.432 respectively except HC that has insignificant negative impact on industrialization with coefficient of -0.128 and p.value of 1.77. The implication of the results is that, industrialization increases as PCI, GFCF, POP, TOP and URB increases while IND decreases as HC increases.

Table 5 Estimated Panel Regression Results for Domestic Debt and External Debt

VARIABLES	(1) Linear	(2) Non Linear
DOMDEBT	0.000149	0.0210**
	(0.966)	(0.0188)
DMDS		-3.52e-05***
		(0.00689)
EXDEBT	-0.0154***	-0.0230***
	(3.20e-10)	(3.01e-07)
EXTDS		6.08e-06**
		(0.0314)
PCI	0.00263***	0.00208***
	(5.12e-05)	(0.00208)
GFCF	0.124***	0.119***
	(4.02e-07)	(8.53e-07)
POP	0.0430***	0.0463***
	(1.96e-05)	(6.17e-06)
HC	-0.128***	-0.119***
	(3.19e-08)	(9.01e-07)
TOP	0.00892	0.00434
	(0.367)	(0.666)
URB	0.0278	0.0194
	(0.449)	(0.597)

Constant	18.59***	19.48***
	(0)	(0)
Observations	638	638
Number of cid	16	16
Chi-square	208.7	231.4

pval in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Source: Author's Computation, 2025

Note: p-values in parenthesis; PUB is aggregate public debt; PUBS is aggregate public debt square; PCI is per capita income; GFCF is gross fixed capital formation; POP is population; HC is human capita; TOP is trade openness; URB is urbanisation.

Ayadi&Ayadi (2008) discovered conflicting evidence of this non-linear relationship between the variables for two emerging nations in their comparative study for South Africa and Nigeria. They discovered that external debt had a favourable effect on Nigeria up to a point at which it started to have a negative impact. However, there was no evidence of this kind of non-linearity for South Africa, where debt had a significant positive influence on economic production.

The findings shown in Table 5 demonstrate a significant U-shaped association between external debt and industrialization, suggesting that the influence is positive and significant at higher levels of public debt and negative and significant at lower levels. At the one percent significance level, it follows that the null hypothesis that is, the idea that external public debt has no discernible effect on industrialization is rejected.

5.0 Discussion of Findings

The results of the panel GLS presented in Table 4 reveal that total debt has significant negative impact on industrialization in West Africa. Based on the results of the linear model, total public debt is actually detrimental to industrialization and this might result from different channels. One of these is the crowding out effect of the public debt where borrowing by the government and its agencies crowd out private sectors and this reduces their ability to invest in local economy and thus lower level of industrialization. The findings in this study align with the theoretical and empirical submissions which state that debt is detrimental to growth and development

(Osuji and Ozurumba, 2013, Ezeabasili, Isu and Mojekwu, 2011, Olademi 2013, Solomon, 2016, Udofia and Akpama, 2016). Nonetheless, the findings are at odds with other prior empirical research that found an inverted U-shaped relationship between debt and IND, including studies conducted in Israel (Shahor, 2018), a sample of 152 countries (Seputience, 2018), Ohwofasa et al. (2012), Sulaiman (2012), and Erhieyovwe&Onovwoakpoma (2013), which claimed that external debt had a positive effect on economic growth.

Further analysis of the results show that public domestic debt has significant impact which is inverted U-shaped on industrialization in West Africa. This can be link to the crowding out of private sector as a result of government excessive domestic borrowing. The findings in this study partially contradict the theoretical and empirical submissions which states that debt is detrimental to growth and development (Osuji and Ozurumba, 2013, Ezeabasili, Isu and Mojekwu, 2011, Olademi 2013, Solomon, 2016, Udofia and Akpama, 2016)). The results are however align with previous empirical works that reported inverted U shaped relationship between debt and GDP such as in (Shahor, 2018), and in a sample of 152 countries (Butkus&Seputiene, 2018).

Also, the results of the panel GLS regression results presented in Table 5 revealed that public external debt has significant impact which is U-shaped on industrialization in West Africa. Linking these results with the results obtained from the domestic debt model one can infer that public debt is beneficial to industrialization only if it composed of higher external debt and relatively lower domestic debt. This result is consistent with the works of Omojolaibi, Okenesi and Mesagan(2016), Akanbi(2010), Giri and Mohapatra(2016), Hassan, Othman and Abd Karim(2011), and Erden and Holcombe(2005) but differs significantly with the conclusions of Hassan and Salim(2011), Magableh and Ajlouni(2016), Tchouassi and Ngangue(2014), Coutinho and Gallo(1996), Munthali(2012) and Brian, Oscar, Enowbi and Ngonidzashe(2010). As policy implications, this finding implies that more emphasis of governments of West African countries' expenditure should incure debt on infrastructures that help on capital formation instead of recurrent expenditures.

6.0 Conclusion and Recommendations

The nature of the relationship between public debt and industrialization in West African countries has not been conclusively shown by the study. Africa is still on the cusp of becoming industrialized. Since 1970, the manufacturing value added (MVA) to GDP ratios across the continent have been low. Africa's MVA only made up 1.6% of the world total in 2014, and since 1990, its growth has not kept up with that of any other region (UNIDO, 2016). Furthermore, few African economies are involved in global value chains, according to UNIDO (2016). The manufacturing sector in various countries has been the focus of numerous studies and analyses on this relationship; however, the impact of debt on industrialization in regional countries, such as those in West Africa, has received less attention due to a number of factors, including data scarcity. As a result, the analysis in this paper concentrated on West Africa and established how debt both external and domestic affects industrialization across the board in West African nations.

Panel regression analysis, correlation analysis, and descriptive statistics were all used in the study. Using both linear and nonlinear relationship assumptions, the study assessed panel regression results on the effect of debt on industrialization. Both the domestic debt and the total debt have substantial negative and non-significant positive effects on IND, respectively. The findings of the linear and non-linear models show that: • Domestic debt has a significant positive influence on IND while the square has a significant negative impact on IND.

In non-linear regression, PCI, TOP, and POP have substantial positive effects on IND whereas GFCF, HC, and URB have non-significant positive effects. • External debt has non-significant negative effects on IND while the square has significant positive effects on IND. The findings suggest that there is an inverse U-shaped association between the nation's overall debt, internal debt, and external debt and industrialization. Debt drives industrialization until it hits a tipping point, after which rising debt causes the IND to decline. According to the findings, overall debt both domestic and foreign benefits IND provided it is low and stays within a set limit among West African nations.

Therefore, the study's findings somewhat contradict the theoretical and empirical arguments (Osuji and Ozurumba, 2013, Ezeabasili, Isu and Mojekwu, 2011, Olademi 2013, Solomon, 2016,

Udofia and Akpama, 2016) that debt is harmful to growth and development. Nonetheless, the findings are consistent with earlier empirical research that found an inverted U-shaped link between GDP and debt in places like Israel (Shahor, 2018) and a sample of 152 nations (Butkus&Seputiene, 2018). Furthermore, the study's findings suggest that industrialization benefits from domestic debt. This research suggests the following:

The governments of West African nations can borrow or embark on public debt, either domestically or externally, until it becomes dangerous to the economy. This is due to the fact that borrowing too much will hinder industrialization. The governments of West African nations should use borrowed funds to finance capital projects or highly profitable investments rather than ongoing expenses. • The governments of West African nations should keep a careful eye on the public debt that the states incur so as not to go over what the nation can pay and to avoid negative effects when it gets excessive. This will help to service the debt through returns on investment.

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DEVELOPING EMPLOYABILITY SKILLS FOR THE FOURTH INDUSTRIAL REVOLUTION THROUGH TECHNICAL VOCATIONAL EDUCATION TRAINING IN SELECTED TECHNICAL COLLEGES IN OGUN STATE

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Abstract

This study examined the role of Technical and Vocational Education and Training (TVET) in developing employability skills required for the Fourth Industrial Revolution (4IR) among students in selected technical colleges in Ogun State, Nigeria. The emergence of 4IR technologies, including artificial intelligence, robotics, the Internet of Things, and digital automation, has transformed the nature of work and increased the demand for a workforce equipped with both technical and soft skills. Against this backdrop, the study explored the capacity of TVET programmes to prepare students for the evolving labour market. The paper reviewed the concept of TVET, the current state of TVET programmes in Nigeria, and the strengths and challenges associated with their implementation. Guided by the Human Capital Theory, the study highlighted the importance of education and training as investments that enhance productivity, employability, and economic development. Findings revealed that TVET remains a vital platform for equipping learners with practical competencies, entrepreneurial abilities, and self-reliance skills necessary for success in the 4IR era. The study further showed that government initiatives aimed at expanding vocational education have increased interest in skill acquisition among Nigerian youths. However, several challenges continue to hinder the effectiveness of TVET programmes, including inadequate funding, shortage of qualified instructors, obsolete equipment, poor infrastructure, weak industry collaboration, and negative societal perceptions of vocational education. The study concluded that TVET has a significant role in fostering employability skills and enhancing workforce readiness for emerging industries. It recommended the revision of TVET curricula to incorporate critical thinking, problem-solving,

collaboration, digital literacy, and other 4IR competencies; stronger partnerships between institutions and industries; continuous professional development for instructors; and increased government investment in technical education.

Keywords: Technical and Vocational Education and Training (TVET), Employability Skills, Fourth Industrial Revolution, Technical Colleges, Workforce Readiness.

Introduction

The Fourth Industrial Revolution (4IR) is transforming the world at an unprecedented rate, bringing about significant changes in the way we live, work, and interact with each other. The 4IR era is characterized by the fusion of physical, digital, and biological systems, and is marked by emerging technologies such as artificial intelligence, robotics, the Internet of Things (IoT), and blockchain (Schwab, 2016). These technologies are not only changing the nature of work but also creating new opportunities and challenges for individuals, businesses, and governments.

Education is seen as the key to achieving their ideal occupations, it is thus an aspiration that every young person should hold in high regard. One of the workforce development initiatives that is drawing interest from several nations worldwide is Technical and Vocational Education and Training (TVET) (Muhammad, 2012). Beyond general education, there are other aspects of the educational process that are included under the umbrella of TVET. It includes studying technology and associated disciplines in addition to gaining information, comprehension, and practical skills that are applicable to jobs in the social and economic spheres. The concept in question is explicated within the National Policy on Education as stipulated by the Federal Republic of Nigeria in the year 2013. One of the objectives of technical education is to ensure the provision of skilled labour in the field of applied science, as well as the availability of technology and commerce, specifically at the sub-professional level. This includes the imparting of training and essential skills to individuals, leading to the development of technicians, craftsmen, and other skilled workers who possess the qualities of entrepreneurship and self-sufficiency.

In this context, Technical and Vocational Education and Training (TVET) play a crucial role in equipping students with the skills required to thrive in the 4IR era. TVET is designed to provide

students with practical skills and knowledge in specific trades or occupations, and is widely recognized as a key driver of economic growth and development (UNESCO, 2018). However, the effectiveness of TVET programmes in preparing students for the 4IR job market is uncertain, and there is a need for research on the role of TVET in enhancing employability skills for the 4IR era. This study explores the role of TVET in enhancing employability skills for the 4IR era, with a focus on selected technical colleges in Ogun, Nigeria. The study investigated the current state of TVET programmes, its impact on employability skills, and the challenges faced by TVET institutions in preparing students for the 4IR job market.

The significance of this study lies in its potential to contribute to the development of strategies to enhance TVET programes and improve employability skills for students in Nigeria's technical colleges. This finding of this study will provide insights into the current state of TVET programmes, their strengths and weaknesses, and the challenges faced by TVET institutions in preparing students for the 4IR job market.

Literature Review

The Concept of TVET

TVET is a type of education that focuses on providing students with practical skills and knowledge in specific trades or occupations. TVET programmes are designed to equip students with the skills required for the workforce, and are widely recognized as a key driver of economic growth and development (UNESCO, 2018). TVET programmes are offered at various levels, including secondary, post-secondary, and tertiary levels, and cover a wide range of fields, including engineering, agriculture, business, and healthcare.

Vocational training provides a form of training that emphasizes the skills and knowledge required for a particular trade, craft or job function (in contrast to general education). Courses in technical vocational education and training (TVET) provide jobs-specific technical training, with hands-on instructions. Despite the increasing demand for workers with vocational and technical skills, the supply of this invaluable human resource has been unable to catch up with the demand in many developing countries. This problem has been partly attributed to the fact that it

is more costly to provide vocational and technical education compared to general education as well as low returns to vocational education (Hoeckel, 2008).

However, returns to academic qualifications are found to be significantly higher than the returns to vocational qualifications in at least in the United Kingdom (Blundell, et al., 2005). Other studies in different countries also find similar results of lower relative returns to vocational education as compared to academic qualification (Arora et al., 2018 for a review of the literature from other countries). In spite of the apparent superiority of general education in terms of costs and returns, Lewin (1997) provides compelling reasons for governments to focus and invest in technical and vocational education and training (TVET). First, through the impartation of skills and knowledge necessary for making the individual a productive member of society, TVET increases the relevance of schooling. In addition, TVET helps to reduce unemployment because of the provision of employable skills, especially to youth and those who cannot succeed under the general academic system. By improving the quality and skill level of the working population, TVET helps to increase economic development, increase the general standard of living and reduce poverty by giving the individuals who participate in access to higher-income occupations

The meaning and place of vocational education both at the primary, secondary, and tertiary levels have attracted several views, opinions and arguments over the years. One of such views is presented by Moodie (2002), who observed that the identity of vocational education is founded on four types of characteristics: teleological, epistemological, pragmatic and hierarchical; as such, no single characteristic is adequate to define vocational education across historical periods and jurisdictions. Despite this limitation, Colley et al. (2003), went ahead to define vocational education as training which emphasis is based on the acquisition of knowledge and technical skills, to foster behavioural competence in the workplace. Vocational education is also defined based on its specificity. Such definition like that presented by Davies and Ryan (2011), who Stated that vocational education is a type of education designed to prepare students for specific subjects and disciplines such as home economics, agriculture, commerce, and industry at the senior secondary or lower tertiary level. A similar definition is offered by Oni (2007), who defined vocational as, education which

provides the recipient with the basic knowledge and practical skills needed for entry into the workforce; adding that it nurtures skills necessary for agriculture, industrial, commercial and economic development.

The Nigerian National Policy on Education (2008), defined vocational education as the educational process which in addition to general education, involves the study of technologies and related sciences, and the acquisition of practical skills, attitudes, understanding and knowledge relating to occupations in various sector of economic and social life. The definitions of vocational education lay emphasis on practical activities, which leads to a specific type of job, that acknowledges the skills and contribution of every individual (Okocha, 2009; Sakellariou, 2006). The definitions of vocational education seem to suggest that vocational education is the best thing that could happen to an individual and economy at large. However, not every researcher agrees with this idea. Higham and Farnsworth (2012), noted that despite the usefulness of vocational education, it can also be institutionalized, haphazard and unorganized. Shavit and Muller (2000), also noted that working class students, use vocational education as a social reproductive mechanism which serves as a diversion to avoid higher education and its professions.

A good way to understand the concept of vocational education, is to understand the philosophies which surround the practice of vocational education. There are various philosophies which surrounds the concept of vocational education. Philosophy, in the opinion of Hornby (2000) is defined as a system of beliefs which results from a search of knowledge about the universe and the essence of life. Philosophy presents opinions of various individuals on an issue, in this case, the opinions of individuals concerning issues surrounding vocational education and training. According to Davies and Ryan (2011), the philosophy of vocational education was laid on the foundation of self-employment and self-reliance of individuals. Kennedy (2012), added that sociological influences, and societal recognition has made vocational education a subordinate discipline to other disciplines.

The current state of Technical and Vocational Education and Training (TVET) programmes in Nigeria

Nigeria's drive to expand vocational training has gathered strong momentum as more than 1.3 million young Nigerians have applied

for enrollment in the federal government's new Technical and Vocational Education and Training (TVET) programme. The initiative, led by the National Board for Technical Education (NBTE), aims to equip the country's youth with practical, job-ready skills to meet labor market demands. Professor Idris Muhammad Bugaje, Executive Secretary of NBTE, disclosed the figures in an interview with RFI Hausa Radio, noting the massive interest the scheme has generated across the country. "So far, about 1.3 million youths have applied, and 960,000 have been screened, 58,000 has lunched the first batch training already". According to him, the programme continues to expand as the implementation progresses. He explained that the TVET programme, launched by the Ministry of Education, focuses on providing technical and vocational training that prepares Nigerian youths for self-reliance and entrepreneurship. Nigeria is among the country with the largest youth population in the world with over 48%(UNO, 2026). Bugaje stated that about 70% of Nigerians are under the age of 30 which no other country has such a demographic so, there is need to shift from the traditional focus on academic qualifications toward more skill-based education. He argued that Nigeria's education system has long conditioned students to depend on government jobs that are no longer sufficient. The problem with formal (Western) education is that it conditions youth mind to believe you must get a government job whereas jobs are scarce for everyone. Therefore, youth must be taught skills that help them rely on themselves. Vocational learning goes beyond classrooms, pointing to informal training spaces such as local workshops and artisan hubs as vital contributors to economic growth. Other ministries are complementing the ministry efforts through specialized programmes such as the MTT initiative to train three million youth in digital skills, including content creation and artificial intelligence from Ministry of Communications also, Ministry of Work also introduce NASAP to train one million youth in construction-related trades like masonry, carpentry, tiling, and plaster of Paris (POP) so as to reduce unemployment rate in the county. Bugaje said "Right now in Nigeria, artisans from Benin and Togo are the ones doing our POP work, even in Abuja which is shameful meanwhile, our youths are idle, roaming neighborhoods with no jobs". He further said while the National Education Loan Fund (NELFund) is managing funding and certification processes, NBTE is committed

to monitoring centres and ensuring credible training and valid certifications.

Role of Technical, Vocational Education and Training in Human Capital Development

The importance of vocational education to an individual and the society at large cannot be overemphasized. Shavit and Muller (2000); Polat et al (2010), believed that vocational education enhances a students' chances of finding gainful employment. In addition to this, Colley et al. (2003), asserted that vocational education does not only increase the chances of gaining employment, it also equips the individual with the knowledge and technical skills as well as behavioural competence needed to increase the chances of employment and remain in employment. Apart from helping in getting the job and keeping the job, vocational education helps in creating the job which, as noted by Toner (2010), is achieved through innovation (technology diffusion), production, research and development.

Vocational education has received significant interest in the current decade amongst the international policy community, such that vocational education has been recognized as a key player in development (McGrath, 2012). Apart from its role in preparing student for different occupations, Hyslop (2001), added that it also plays crucial life in their social lives. Igbinedion and Ojeaga (2012), posited that vocational education addresses the issue of poverty and added that it increases opportunities for international competitiveness. Uwamaiye and Clark (2003), Stated that vocational education breeds professionalism because it exposes recipients to the specifics of a job and equips them with the skill required for the job.

Apart from work experience, Ajokporise (2010), added that recipients acquire procedural knowledge needed for skill acquisition. Vocational education has been described as the best tool to catch the attention of children. This, in the opinion of Saunders et al (2005), is because it takes advantage of their eagerness to learn, therefore, helping them to focus their talent on critical domestic 40 issues of development in a practical way. This is a move, Okocha (2009), describes as satisfying for children. Adults are also not left out in the benefits of vocational education; Okolocha (2009), Stated that vocational education can provide rehabilitation needed to update skills for technological

improvements. Lewin (1993) in Alam (2008), Stated that vocational education allows us to kill several birds with the same stone. Mustapha and Greenan (2002), explained that this is so, because it has become a tool for addressing political, social, and economic crises in a nation.

Vocational education has played very important roles in the national development strategies of countries. Ojimba (2012), explained that it is due to its impact on human capital development. From the analysis of Enyekit et al. (2011), The skills of a workforce are built upon the vehicle of vocational and technical education. This, in the opinion of Arthur-Mensah and Alargarja (2013), means that there is hope for a country which can produce self-reliant graduates with the required skills needed for sustainable human capital development; skills which are reliant upon the effective implementation of vocational and technical education. Wallenborn (2010), also noted that global, social, ecological and political development trends have shown the rationale for vocational education and human capital development.

Inayat et al. (2013) added that for a country to remain relevant in the global scheme of economic development, a country must be ready to provide a level playing ground for vocational education to thrive. For third world countries, Dike (2010) believed that a sustainable economically developed third world country cannot be achieved except human capital and technical knowledge is built and combined with social skills. Shavit and Muller (2000), noted that doing this will serve as a safety net for vocational and technical education to enhance the skills of the workforce. Governments are increasingly becoming aware of the importance of vocational and technical education to economic development; therefore, countries like Brunei have made vocational and technical education a vital part of its human capital approach to manpower development.

The Roles of Vocational/Technical Education in Promoting Economic Development

Employment opportunity: Vocational/technical institutions such as the Polytechnics, Monotechnics, Universities of Technology, Work schools and other skills acquisition centers are very indispensable. This is epitomized by the fact that they are sufficiently capable of providing practical vocational training and

skills to the masses. With that, they can independently create job opportunities for themselves and be economically self-valiant (Akpakpan, 2016). In a situation whereby economic opportunities are adequately created for the people national contacts are likely to be drastically minimized.

Stimulation of Technological and Industrial Development: The idea of technology here refers to the application of scientific knowledge to resolve practical human problems. On the other hand, industrial development denotes the establishment of more and more functional industries that can sufficiently and conveniently offer prosperous employment/job opportunities to the masses. Vocational/technical education aids in no small measure in boosting rapid technological and industrial development. A striking scientific example of this can be found in those advanced nations that admirably entrenched the culture of vocational and technical education culture. These comprise Britain, France, Germany, Italy, U.S.A, China, Japan etc. With the adoption of vocational/technical education in Nigeria, the country can competently produce engineering talents and promising students that can vigorously bring about socioeconomic and political development.

Reducing Dropout Rate: Dropouts are the persons that leave school or college before they finish their studies successfully. In a situation whereby those people continuously live without sustaining their livelihood, they can notoriously become social miscreants in society. Vocational/technical education here has a fundamental role to play because it can adequately assist in minimizing the dropout rate. In every society, there are some people that are not contented with general education and for that reason, they do engage in vocational/technical education where they can adequately sustain their livelihood and be comfortably self-reliant (Okorieocha, 2014)

Increasing Earning Capacity: It has been adequately discovered that vocational/technical education is significantly valuable in increasing the incomes of the people that have its skills because they are self-employed. By so doing, their standard of living can be improved substantially and also offer their generous contributions to national development. The issues of national conflicts can be peacefully resolved and boost economic

development when there is a continuous increase in earning capacity.

Strengths of TVET in Nigeria

1. Potential for Economic Growth: TVET can contribute significantly to Nigeria's economic development by providing individuals with relevant skills, enhancing employability, and reducing unemployment rates.
2. Practical Skills Development: TVET programmes focus on imparting practical skills, which can equip students with the competencies required by industries, making them job-ready.
3. Government Support: The Nigerian government has shown commitment to TVET development, with initiatives like the National Policy on Education and the establishment of the National Board for Technical Education (NBTE).

Weaknesses of TVET in Nigeria:

1. Inadequate Funding: TVET programmes face significant funding challenges, leading to inadequate infrastructure, equipment, and instructional materials.
2. Shortage of Qualified Instructors: Many TVET institutions lack well-trained and experienced instructors, which affects the quality of training.
3. Poor Infrastructure: TVET institutions often have poor infrastructure, including outdated equipment and inadequate facilities.
4. Lack of Industry Partnerships: TVET programmes often lack meaningful partnerships with industries, limiting students' exposure to real-world experiences and job opportunities.
5. Negative Perception: TVET is often viewed as a less desirable option compared to traditional academic education, which can affect enrollment and societal recognition.

6. Inadequate Quality Assurance: TVET programmes face challenges in maintaining quality standards, which can impact the employability of graduates.

Challenges Facing TVET Programmes

These challenges can impact the quality of TVET programmes, and limit their ability to equip students with the skills required for the 4IR job market. Some of the challenges or problems mitigating the training of technical education or vocational education are:

1) Funding: Universities in Nigeria are owned and funded by the Federal Government, State government and private individuals. Over the years, government subventions to universities have never been adequate but at the same time governments maintain the policy that universities should not charge fees it deemed adequate to complement the financial effort of the government. In Nigeria, the allocation to education as a share of the GDP is quite minimal. Till date, government funding of vocational and technical education programmes has not been impressive.
2) Facilities: Most technical education departments in Nigerian universities do not have laboratories or workshops space let alone usable equipment and facilities and where they exist, they are grossly inadequate, as the laboratories only have the items or equipment that were provided when the departments were established. It is however most surprising to know that most technical education departments still depend on engineering workshop and lecturers to teach technical education concepts in this 21st century.

   The available facilities, programme as at today are inadequate quantitatively and qualitatively and besides, they are obsolete. Oryem Oriya (2005) indicated that only 40% of institutions of Higher Education in Nigeria have laboratory or workshop space for technical education programmes. The others, 60% do not have laboratory or workshop space and this reflects the low quality of technology programmes in higher institutions. He further noted that these few universities that have laboratories, experience acute shortages of laboratory equipment and supplies. He concluded that this situation is partly

responsible for the reason why it has been increasingly difficult to run experiments effectively for students and made the teaching and research in science and technology difficult and therefore the country was producing insufficient and ill-prepared technical education graduates necessary for driving the technological and socio-economic development of Nigeria as a nation. The inadequacy in teaching, laboratory and workshop facilities has contributed to the diminution of the quality of technical education graduates in Nigeria. Ojimba (2012) categorized students into three, namely: verbalizers, visualizers and doers.

3) Brain Drain: In the context of this paper, brain drain refers to the movement of lecturers of technical education which are needed for the socio-economic and technological advancement of Nigeria from one university to other universities or to other professionals (including politicians) calling for better conditions of service.

Theoretical Framework (HUMAN CAPITAL THEORY)

Human capital theory posited that education and training are key drivers of economic growth and development (Becker, 1964). The theory suggested that investments in education and training could lead to increased productivity and earnings, and have positive impacts on economic growth and development.

Conclusion

This study concluded that TVET has a critical role to play in enhancing employability skills for the 4IR era. To achieve this, TVET programmes need to be revised to include 4IR-relevant skills, and industry partnerships need to be strengthened. It is recommended that policymakers and educators work together to develop a framework for TVET programmes that equips students with the skills required for the 4IR era.

Recommendations

1. Revise TVET curriculum: TVET curriculum should be revised to include 4IR-relevant skills, such as critical thinking, problem-solving, and collaboration.

2. Strengthen industry partnerships: Industry partnerships should be strengthened to provide students with practical experience and exposure to industry needs.
3. Provide training for instructors: Instructors should be provided with training and resources to develop their skills in teaching 4IR-relevant skills.
4. Increase funding: TVET programmes should be adequately funded to provide students with the necessary equipment and resources.

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