

NIGERIAN ONLINE JOURNAL OF EDUCATIONAL SCIENCES AND TECHNOLOGY

nojest.unilag.edu.ng

nojest@unilag.edu.ng

CAREER ADVANCEMENT AND FINANCIAL SECURITY: TACKLING SUSTAINABLE MILLENNIUM DEVELOPMENT GOAL ONE AMONG ACADEMIC STAFF IN NIGERIA

Kofoworola .B. ZACCHEAUS, Maruff .A. OLADEJO & Jacob. A. ADEYANJU

Department of Educational Management

Faculty of Education

University of Lagos

kzaccheaus@unilag.edu.ng

Abstract

The fundamental purpose of employment and career pursuits is to earn income to satisfy essential life needs, including food, shelter, clothing, overall well-being, and the realisation of personal aspirations. However, there seems to be persistent disequilibrium between academic staff career path and their financial security. The job of academic staff is meant to improve their lifestyle and financial security to promote Sustainable Development Goal One (SDG 1), which targets the need to overcome poverty everywhere. The presence of financial insecurity may pose a deterrent to the achievement of this goal among academic staff in Nigeria. This study therefore, investigates career advancement and financial security among academic staff in Universities in Lagos state. A mixed-method research design, specifically the exploratory sequential type, was adopted for this study. The population of the study consists of ten Universities in Lagos State, Nigeria. The population of academic staff is 3197 from all the universities in Lagos State, Nigeria. The sample size for this study was 411. It was obtained using Taro Yemane's sample size calculator. A Multistage Approach using purposive sampling techniques was used for selecting academic staff in the universities. A questionnaire titled the "Career Advancement and Financial Security of Academic Staff (CAPNFSAS)" was employed as the study's instrument. Cronbach's Alpha statistical tool will be used to determine the internal consistency of the research instrument. Reliability coefficients of 0.75 pre-test and 0.75 post-test were obtained for the ASCAQ. The data obtained from the field study were analysed using descriptive and inferential statistics. Research questions were answered with the mean and standard deviation. Inferential statistical tools, Pearson Product-Moment Correlation (PPMC) was used to test Hypotheses 1,2, and Linear Regression was used to test Hypothesis 3. All Hypotheses will be tested at the .05 level. The study discovered that promotion was significantly associated with financial security, also research was found to improve financial security, while recognition was found not to improve financial security and was significantly related among academic staff. However, it was recommended, among others, that there is a need to revisit capacity-building and career advancement training programs for timely promotion, grant-winning, and research writing to promote SDG 1 and reduce financial insecurity among academic staff in Nigeria.

Keywords: Career Advancement, Financial Security, Sustainable Development Goal One, Poverty, Promotion, Research Grant, And Recognition.

Introduction

The fundamental purpose of employment and career pursuits is to earn income to satisfy essential life needs, including food, shelter, clothing, overall well-being, and the realisation of personal aspirations. Accordingly, every profession is expected to generate sufficient income to support these fundamental requirements, including academic staff within universities. Universities serve as vital institutions for research and the development of human capital, a mission that is heavily dependent on the retention of qualified academic personnel committed to scholarly excellence. Despite this, there seems to be a disequilibrium between the responsibility shouldered by the academic staff and the income they receive. Where academic staff experience insufficient income to meet their basic needs, save for unforeseen contingencies, and

maintain resilience in the face of economic shocks, it can be termed as financial insecurity. A financially secure income caters to basic, emergency, and health needs, retirement plans, and guarantees future financial stability without reliance on loans or any fear of financial inadequacy. All these financial issues must be addressed to achieve Sustainable Development Goal One. However, the literature suggests that, financially, many academic staff nearing retirement lack the funds needed for a comfortable life (Prawitz et al., 2006, cited in Delafrooz & Paim, 2011).

The Sustainable Development Goal One (SDG 1) targets the need to overcome poverty everywhere. The presence of financial insecurity may pose a deterrent to the achievement of this goal among academic staff. Poverty is meant to be alleviated through employment. Being on a career path with good financial security may eliminate poverty, but this seems far from reality among academic staff. Financing for Sustainable Development Goal Report Five (2019) reported that, despite being employed in different careers, millions of workers still live in poverty due to low income. Based on the report, it seems that there is a huge gap between being employed and being financially secure through that employment. Salawu and Alfakoro (2023) affirmed that the lack of financial security among academic staff in Nigeria may have instigated innumerable adverse effects, ranging from protests, strikes, corruption, dismal performance, slow advancement, side work, and nonchalant attitude, among others, within the academic staff in Nigeria. Some of these protests and strikes are still ongoing. Lack of financial security from jobs might be a major contributor to more increase in negligence and lack of motivation. It may be true that academic staff in Nigeria are no longer satisfied with their jobs and income, as living standards and inflation continue to rise in the country. Nowadays, economic life is tougher; workers face higher food prices, energy costs, and health care expenses. Delafrooz and Paim (2011). They seem to have the status of being “employed,” yet their take-home pay makes them just a little better than people who are not fully employed.

This decline in financial security underlines the importance of career advancement, indicating how academic staff can progress financially through promotions, research work, and recognition. Career advancement refers to the progression of an individual's career via promotions, increased responsibilities, and improvements in job titles and salary. Career development entails navigating through different career stages and transitions. Building skills, experience, and certifications needed to thrive and advance in a career path is essential for career progression. Andresen et al. (2021) noted that promotions are largely attributable to differences in human capital. Employees must develop their capacity to achieve promotions. Academic staff can leverage promotions, leadership appointments, social mobility, and recognition associated with career advancement to enhance their financial well-being. Several factors have been identified as indicators of career advancement that can determine financial security, such as the promotion of academic staff from one level to a higher level in their careers.

It is instructive to note that promotion may come with the appointment of academic staff for leadership opportunities in an institution or in other parastatals of the country, increasing access to lead, supervise, and access to benefits connected to that leadership position. Promotional benefits range from an increase in salary increment, social status upliftment, bonuses, and professional development opportunities. Biemann and Braakmann (2013) asserted that careers develop pay off over time in terms of financial success, especially through promotions and salary increases. Also, Ojokoh and Akinola (2017) affirmed that the excellence of an academic staff member leads to promotion, added ranking, and financial value in return. Inversely, academic staff promotion has been observed to have financial implications resulting from the need for more research investment. Their promotion also involves high-index and international publications, which are not low-cost. The minimum quantum of publications required for a professorial promotion is six international publications and three international publications for associate professors (University of Lagos Authorship policy, 2022). However, it has been observed that most of these international publications and high-index journals have cost implications higher than those of local publications. A step higher in their career through promotion with a pay increase may be used to sub-charge some of these financial needs.

Likewise, the academic staff's onus is centred around teaching, research, and community development. Quality research work appears to attract grants, collaboration, and partnership from private companies, Non-Governmental Organisations (NGOs), and parastatals that may award contracts and seek research to be conducted for their products, services, innovations, or goals. NGOs, international organisations, and research agencies also seek ready research that has been conducted so they can invest or make decisions from the findings. Investing and skilling in R&D have globally been used not just for promotion at work (Ling, 2022) alone but also to solve problems and increase financial returns on research projects (Soltanischat & Alizadeh, 2019). Ojokoh and Akinola (2017) also noted that value returned from research collaborations done with international colleagues yields financial returns as benefits for the home universities, aside from adding to the university ranking. Fershtman and Gandal (2011) research showed that good research work can be monetised

or put on a patent. Consequently, a researcher known for quality research work may receive more readings, citations, and collaborations. Valued research data may require payment before granting access or permission to be used. Prominent academics who have reached such a rank in their research may benefit from the snowballing effect of the financial benefits that come with it.

Similarly, recognition is an important aspect of career advancement. Recognition means that staff are known in their field and beyond for their expertise and specialisation. To foster such recognition, the National Universities Commission (NUC) has mandated that publication and citation of University academic staff must now be seen on Scopus, Google Scholar, Semantic Scholar, Research Gate, and ORCID, to mention a few, and also that their institutional email be regularly used. Based on this agreement, Universities now compel their staff to carry out these registrations and upload all their research work online to gain more ranking. Recognition seems to be increasing with local and international conference attendance, team publication, collaboration, and online presence. While academic recognition can open doors to high-paying careers, achieving financial success is not solely determined by scholarly achievements. Networking, entrepreneurial skills, among others, play crucial roles in financial success (Geri, 2019). Recognition may allow investors and partners to see researchers or academics as experts, prominent, and active in their field. Local and international participation may be needed to attract benefits from recognition.

Empirical review

Adedapo, Abiri, and Adedapo (2024) studied the relationship between staff promotion and welfare and the job productivity of non-academic staff in public universities in Southwest, Nigeria. Their results revealed a significant relationship between staff promotion, welfare, and non-academic staff job productivity. Abdulkumini (2021) investigated the impact of Promotion on Academic Staff Development in the State Higher Educational Institutions of Borno State. The finding reveals that since 2015 to date, the Borno State government has offered paper promotion with no monetary increment to the salary of academic staff in the state's higher education. The study also reveals that there is a significant relationship between promotion and academic staff development. Rahim and Daud (2012) conducted a study to identify the relationship between reward and employee work. The study adopted 133 questionnaires were used for respondents consisting of permanent and contract workers. The results show that the reward system is an important aspect of motivating employees to encourage employees to achieve their goals. The study of Asaari, Desa and Subramaniam (2019) examined that reward and work motivation are very important for organisational workers, as this can be used to direct the staff towards achieving the goals of the organisation. The result concluded that there was a positive and significant relationship between rewards and motivation reward increase, the motivation of employees will also be increased, and they will long as the worker gets promoted to a higher level. Soltanisehat and Alizadeh (2019) researched Research and Development Investment and Productivity Growth in Firms with Different Levels of Technology. They found that Research and Development (R&D) with new technologies and innovation are contributors to economic growth. They observed that investing in research improves productivity, which in turn increases income. Results showed that R&D expenditures in high-tech and then in medium/high-tech industries have the most positive and significant effect on their economic growth. The visible hand of research performance assessment was studied by Hamann (2016) among universities in the United Kingdom. He discovered that research performance is measured by research quality. A quality research output attracts grants and funding for cooperating partners. Ojokoh and Akinola (2017) noted that value returned from research collaborations done with international colleagues yields financial returns as benefits for the home universities, aside from adding to the university ranking. Monetising and patenting research findings are avenues for increasing returns from research (Fershtman & Gandal, 2011), provided the research is of a quality and problem-solving. Consequently, a researcher known for quality research work receives more readings, citations, and collaborations.

Also, research by Rosita, Fazri, Musnaini, and Aira (2022) examines the remuneration and recognition in influencing the work engagement of lecturers. The research design used survey research with quantitative research, and a structured questionnaire for data collection. Lecturers who received remuneration (PNS) at Jambi University, the research. A sample consisted of 89 lecturers were sampled. The results showed that remuneration and recognition have a positive effect on work engagement. They reported that it is necessary to practice strong management in implementing remuneration so that it can be perceived as well as recognition, which is able to create prosperity and strong attachment in carrying out their duties as a lecturer. Asaari, Desa, and Subramaniam (2019) found that rewards from recognition increase financial rewards and visibility. Intrinsic rewards such as appreciation and recognition are important and have their own functions in stimulating employee attitudes and improving their performance. In essence, academic staff career advancement

emphasizes the importance of personal effort that can be geared toward financial freedom. Incidentally, educational managers, institutions, and even academic staff unions focus mostly on government assistance for financial upliftment out of poverty, which has yielded no results to date. It may be that career advancement could help in solving the financial situation among academic staff in Nigeria at present. It is against this background that the study examines career advancement (promotion, research, and recognition) and financial security among academic staff in public Universities in Lagos state, Nigeria.

Statement of the problem

Sustainable Development Goal One (SDG 1) targets the need to overcome poverty everywhere. The presence of financial insecurity may pose a deterrent to the achievement of this goal among academic staff in Nigeria. Salary and allowance controversy between the financier of public higher education (the government) and the academics seems to be unending. The government keeps trying its best on payment of academic staff incomes, but academics, on the other hand, feel the government has not done enough to meet their financial needs and standards to match up with professionals in other careers. Hence, there is a disequilibrium which had led to constant tensions, birthing unending issues in the university system. Academic staff retire at the age of 70, with 35 or more years of service to their institution, government, and their nation. On retirement, some professors in universities without accommodation spend extra days in the staff quarters so they can arrange shelter for themselves and their families; otherwise, they become displaced. The poor incomes received during the active service years could hardly achieve a good retirement plan since the majority of the incomes are spent on consumption. Microeconomic indices, especially inflation and unstable policies, have gradually eroded the disposable value of their income. To make ends meet, some academics come from far distances like Ikorodu, Mowe, and Ayobo areas, which have consequential effects on productivity, decline work enthusiasm, cause low work engagement, and health issues.

Poor lifestyle, inability to meet basic life needs, emergency needs like the situation of health issues leading to loss of life of some academic staff during the last (Academic Staff Union of Universities) ASUU strike in 2022 where their salaries were held back for eight months (Edema, Tolu-Kolawole & Oyekola, 2024) have resulted in more disengagement, government-academic Staff union court matters, and various protests. Even when there is no strike, an emergency need of academic staff could come up at any time, but their salaries mostly cannot cover it, leading to obtaining a loan or loss of life in the case of inability to secure loans and financial support. The inability to find a solution to the issues of financial security of academic staff may even account for the brain drain known as "Japa" in the profession. Academic staff now seek greener pastures in other countries where they can close the gap between their work and their pay to have a financially secure life. There also seems to be low morale among would-be academics who now have the fear of remaining poor for the rest of their lives, and others who will not even be willing to take up the teaching, lecturing, or academic profession after schooling. This study, therefore, will examine career advancement and financial insecurity among academic staff in public Universities in Lagos, Nigeria.

Theoretical Frameworks

The study is anchored on the Human Capital Theory and Income Trajectories theory.

Human Capital Theory (Becker, 1962)

Human Capital Theory was propounded by economist Gary Becker in 1962. Becker's pioneering work on human capital theory dates back to the 1960s and continues to influence discussions on education, skills advancement, labour economics, and workforce productivity. Human Capital Theory is an economic concept that views education, training, and skill advancement as investments in human capital that can lead to higher productivity, earnings, and economic growth. The theory posits that individuals can enhance their market value and earning potential by acquiring and developing valuable skills and knowledge, similar to how companies invest in physical capital (such as machinery and equipment) to increase productivity. The theory laid the foundation for understanding the economic value of human capital and the role of education and skill advancement in shaping individual success and economic outcomes. Academic staff can invest in their human capital by pursuing continuous professional development, attending workshops and conferences, engaging in peer collaboration, and acquiring new teaching strategies and methodologies. By investing in their professional growth, academic staff can enhance their teaching skills, adapt to changing educational trends, and increase their market value in the education sector. Academic staff who improve their human capital through ongoing professional development and skill-building activities can expect to see returns in the form of career advancement, higher job satisfaction, increased

opportunities for leadership roles, and potentially higher salaries. Enhanced human capital can also lead to improved student outcomes, better classroom management, and increased recognition within the educational community.

Income Trajectories Theory (Janet Dearing, Kathleen McCartney, Matthew C. Taylor, 2001)

Income trajectory has been primarily studied within the field of economics and labour market research to understand how individuals' earnings evolve over their working lives. While there is not a specific individual credited with propounding the concept of Income Trajectories, it has been a key area of research in the fields of labor economics, human capital theory, and income inequality. Scholars Janet Dearing, Kathleen McCartney, and Matthew C. Taylor have investigated various aspects of Income Trajectories, including wage growth, income mobility, earnings differentials across occupations and industries, and the impact of education, skills, and work experience on income trajectories. The concept of Income trajectory refers to the pattern of changes in an individual's income over time, including the factors that influence income growth, stability, and fluctuations throughout one's career. In line with the concept of career advancement and financial security of academic staff, the Income trajectory theory is particularly relevant to academic staff's career advancement skills and financial security, as it can shed light on the potential earnings trajectories of academic staff over their professional lives. Understanding the income patterns and factors influencing academic staff earnings can help inform decisions related to professional development, salary negotiations, retirement planning, and overall financial well-being in the field of education.

Research Hypotheses

The following null hypotheses were formulated and will be tested at a .05 level of significance.

1. Promotion has no significant relationship with the financial security of academic staff.
2. Research engagement has no significant relationship with the financial security of academic staff.
3. Recognition does not significantly predict the financial security of academic staff.

Methodology

A mixed-method research design, specifically the exploratory sequential type, was adopted for this study. The population of the study consists of ten Universities in Lagos State, Nigeria. The population of academic staff is 3197 from all the universities in Lagos State, Nigeria. The sample size for this study was 411. It was obtained using Taro Yemane's sample size calculator. A Multistage Approach using purposive sampling techniques was used for selecting academic staff in the universities. A questionnaire titled the "Career Advancement and Financial Security of Academic Staff (CAPNFSAS)" was employed as the study's instrument. Cronbach's Alpha statistical tool will be used to determine the internal consistency of the research instrument. Reliability coefficients of 0.75 pre-test and 0.75 post-test were obtained for the ASCAQ. The data obtained from the field study were analysed using descriptive and inferential statistics. Research questions were answered with the mean and standard deviation. Inferential statistical tools, Pearson Product-Moment Correlation (PPMC), were used to test Hypotheses 1,2, and Linear Regression was used to test Hypothesis 3. All Hypotheses will be tested at the .05 level.

Result

Test of Hypotheses

Research Hypothesis One

H₀₁: Promotion has no significant relationship with the financial security of academic staff.

Table 8: Relationship between Promotion and Financial Security of Academic Staff

Variables	Mean	S.D.	N	Df	R	p-value	Decision
Promotion	2.59	.449		411	409	.335**	.000
Financial security	2.52	.53					Reject H₀₁

Source: Researcher's Computation, 2025.

*Significant at the .05 level.

Analysis in Table 8 showed the result of Pearson Product-Moment Correlation in determining the significant relationship between promotion and financial security. The information in the table showed $r = .335^{**}$; $df = 409$ and a p -value of $.000 < .05$ level of significance. This implies that the null hypothesis was rejected. The correlation coefficient showed a low and positive significant relationship between promotion and financial security among academic staff in Universities in Lagos State, Nigeria.

Research Hypothesis Two

H_{02} : Research engagement has no significant relationship with the financial security of academic staff

Table 9: Relationship between Research Engagement and Financial Security of Academic Staff

Variables	Mean	S.D.	N	Df	R	p-value	Decision
Research Engagement	2.52	.53		411	409	.306 ^{**}	.000
Financial security	2.87	.55					Reject H_{02}

Source: Researcher's Computation, 2025.

*Significant at the .05 level.

Analysis in Table 9 showed the result of Pearson Product-Moment Correlation in determining the significant relationship between research engagement and financial security. The information in the table showed $r = .306^{**}$; $df = 409$ and a p -value of $.000 < .05$ level of significance. This implies that the null hypothesis was rejected. The correlation coefficient showed a low and positive significant relationship between research engagement and financial security among academic staff at Universities in Lagos State, Nigeria.

Research Hypothesis Three

H_{03} : There is no significant correlation between recognition and the financial security of academic staff

Table 10: Prediction of Recognition on Academic staff Financial Security

Model	Unstandardised		Standardised Coefficients Beta	T	Sig.	Decision
	Coefficients B	Std.Error				
Constant	2.264	.078		28.854	.000	Reject H_{03}
Recognition	.179	.036	.239	4.987	.000	

Dependent Variable: Financial Security

Model Summary: $R^2 = .057$ (Goodness-of-fit Index)

ANOVA: F -value = 24.871 (p -value = .000)

Source: Researcher's Computation, 2025. *Significant at the .05 level.

Table 10 shows the model summary result reveals goodness of fit index $R^2 = 0.057$ (57%); indicating model fit is significant at F -value = 24.871 ($p < 0.05$) significant level. Hence, the model is acceptable for further analysis. The result of the analysis revealed that recognition is significant at $t = 4.987$ ($p < 0.05$). Hence, the hypothesis is rejected at 5% significance level since $p = 0.000 < 0.05$; therefore, recognition has a direct significant correlation with the financial security of academic staff in universities in Lagos state, Nigeria. Consequently, based on the standardized Beta coefficient, there is a significant positive relationship between recognition and financial security at $r = .179$ ($p < 0.000$). Hence, a unit increase in recognition will financial security among academic staff in Universities in Lagos State, Nigeria.

Discussion of Findings

The findings from hypothesis one showed a positive and significant relationship between promotion and financial security among academic staff. This outcome, as shown in research hypothesis one on Table 8, agrees with the outcome of the study conducted by Adedapo, Abiri and Adedapo's (2024) that promotion increases staff welfare and productivity. This implies that, the awareness of a financial gain at the end of appraisal boosts the motivation of workers to be hardworking since it will bring an additional financial gain. This is against the findings of Abdulkumini (2021), which showed that despite the effort of employees to get promoted in Borno state, it comes with no financial increase but just a mere paper notification, as a result workers are not interested in working hard for promotion. This implies that when promotion of academic staff without an increment in their take-home pay is as good as nothing hence, have not financial value. Rahim

and Daud (2012) also support the findings of that study with results showing that the reward system is an important aspect of motivating employees to encourage employees to achieve their career goals. In the same vein, Asaari, Desa & Subramaniam (2019) agreed that reward and work motivation are very important for organisational workers. Hence, organisations must make attractive and effective reward policies and procedures to provide employee satisfaction and motivation. Sometimes employers are more focused on extrinsic rewards but intrinsic rewards. This result implies that the promotion of academic staff from one level to a higher level increases the financial income.

Research engagement is observed to have a significant relationship with financial security as indicated in the table 9 which showed the result from hypothesis two. This is in consistent with the research by Soltanisehat & Alizadeh's (2019) report that investing in skills towards developmental and problem-solving research increases financial returns from such research projects. This implies that with adequate research skills, academic staff could embark on developmental research and achieve financial benefits. It also supports the study of Ojokoh and Akinola (2017) that value returned from research collaborations with international colleagues yields financial returns as benefits for the home universities, aside from adding to the university ranking. This finding corroborates with Fershtman and Gandal's (2011) research that good research work can be monetized or put on patent for financial gains. Also, Hamann (2016) supported that a quality research output attracts grants and funding for cooperating partners.

The result from hypothesis three revealed that recognition has a direct, significant correlation with the financial security of academic staff. This implies that an increase in recognition will improve the financial security of academic staff. The finding is in line with the research by Rosita, Fazri, Musnaini, and Aira (2022), through recognition lectures can create prosperity and develop strong passion in carrying out their duties. Also, Asaari, Desa & Subramaniam (2019) found that rewards from recognition increase financial income and visibility. This implies that Intrinsic rewards, such as appreciation and recognition, are important and have their own functions in stimulating employee attitudes and improving their career performance.

Conclusion and Recommendations

Based on the findings, it could be concluded that improving financial security among academic staff is just about Union and government controversy. However, some personal steps can be taken by academic staff to tackle poverty to attain SDG 1. The following recommendations were therefore made:

1. One of the ways to promote SDG 1 and reduce financial insecurity among academic staff is to revisit capacity-building and career advancement training programs for academic staff. This training should empower academics on skills for timely promotion, grant winning, and research writing.
2. Emphasis should be placed on the importance of embarking on quality research and problem-solving findings that could attract grants, investors, and partnerships with private organizations. The result from such viable data can also be sold online before granting access.
3. NUC accreditation should not just be checked on if the university meet the standard on teaching and ranking. But also a check on the welfare and financial security of university lecturers.
4. The Government should, as a matter of urgency, increase its funding on academic research and take actions to improve institutional-industrial synergy to increase patronage of academic research from private stakeholders.
5. Pension fund administrators at the National Pension Commission (PenCom) can use the results from this research to plan new strategies to improve and advise on academic staff's retirement and investment planning.
6. Institutional managers and staff training centers should be trained on various career advancement to plan, train, orient, and participate in the financial well-being of their staff.
7. There should be improve staff welfare packages, and timely staff promotions to enhance job performance.
8. Academics should know how to patent and keep results and provide it to those who need them after payment.

References

Andresen, M., Lazarova M., Apospori E., Cotton R., Bosak. J., Dickmann. M., Kaše. R. & Smale A. (2021). Does international work experience pay off? The relationship between international work experience, employability and career success: A 30-country, multi-industry study. *Human Resource Management Journal*. 1–24. DOI: 10.1111/1748-8583.12423

Adedapo A.A., Abiri O.C. and Adedapo B.F. (2024) Promotion, Welfare and Non-Academic Staff Job Productivity in Universities in Southwest, Nigeria, *European Journal of Training and Development Studies*, 11(1). 19-2.

Adekoya, S. O. A. & Adetoro, J. A. (2007). *Fundamentals of statistics and research methodology*. Lagos: University of Lagos Press.

Asaari, Desa & Subramaniam (2019). Influence of Salary, Promotion, and Recognition toward Work Motivation among Government Trade Agency Employees. (2019). *International Journal of Business and Management*. (4)14.

Biemann, T., & Braakmann, N. (2013). The impact of international work experience on objective and subjective career success in early careers. *International Journal of Human Resource Management*, 24(18), 3438–3456.

Cho. S. H. (2009). Role of saving goals in savings behavior: Regulatory focus approach. American council on *consumer interests annual* (2)56. 72

Delafrooz. N., & Paim. P, H., (2011). Determinants of Saving Behavior and Financial Problems among Employees in Malaysia. *Australian Journal of Basic and Applied Sciences*, 5(7). 222-228.

Fershtman, C. & Gandal, N. (2011). Direct and indirect knowledge spillovers: the “social network” of open-source projects. *The RAND journal of economics*. 42 (1), 70-91 <Https://Doi.Org/10.2307/23046790>

Geri G.S. (2019). The effect of academic leadership and mentoring on the retention rates. *Canadian Journal of education*. 4(3).221-232.

Li, L. (2022). Reskilling and Upskilling the Future-ready Workforce for Industry 4.0 and Beyond. *Information Systems Frontiers*; signature

National Universities Commission (2019). *Nigerian university system statistical digest 2019*. Creative Commons Attribution International License. www.nuc.edu.ng.

National Universities Commission (2024), National Universities Commission Monday bulletin 26 February,9(19).

Ojokoh, B. A. & Akinola, A. (2017). Enhanced webometric ranking of the Nigerian public. *Journal of Education, Society and Behavioural Science*, 22(3), 1-16. <http://dx.doi.org/10.9734/JESBS/2017/36136>

Rosita. S, Fazri. A, Musnaini, Aira D.M. (2022). The Remuneration And Recognition In Influencing Work Engagement To Improve Lecturers' Workload. *Journal of Positive School Psychology*. (6)9.

Salawu, I.O. & Alfakoro, A. Y. (2023). Institutionalizing the effects of remuneration and welfare packages on employees' performance in public universities in Nigeria. *Quest journal of management and social sciences*, 5 (2), 7-10.

Soltanisehat, L. & Alizadeh, R. (2019). Research and Development Investment and Productivity Growth in Firms with Different Levels of Technology. *Iranian Economic Review* 23(4):795-818

Sustainable Development Goal (2019). The financing for sustainable development goals report. United Nations Department of Economic and Social Affairs Sustainable Development University of Lagos Authorship policy (2022); *Research management office*.

MOVING FROM TEACHER-CENTRED TO STUDENT-CENTRED MODE OF LEARNING: PRACTICAL GUIDE FOR EFFECTIVE MIGRATION

Chidimma ONUIGBO

Science Education, CIT department.

University of Benin.

drmochila9@gmail.com

Ajulufo Ifeyinwa

Educational Administration Department.

Chukwuemeka Odumegwu Ojukwu University, Anambra state.

Gosife19@gmail.com

Abstract

The teacher-centred learning approach (TCLA) is unarguably a convenient method of teaching, especially in learning environments with resource challenges. This is probably why it has proved tenacious over the years, albeit its connection to rote memorisation, passivity on the part of students and poor retention. Its direct link to poor academic achievement in different educational settings has led to the massive call for a paradigm shift towards more student-centred learning approaches. Student-centred learning approach (SCLA) requires massive investment of resources, effort and time but its advantages, according to empirical studies, make it worth the effort. This study compares both approaches, affirms the discrepancies between policy and practice and makes a case for the importance of transitioning from TCLA to SCLA. It also x-rays the drawbacks to the transition process with commensurate suggestions for tackling them. This study provides a comprehensive blueprint for assessing the readiness index of all educational stakeholders, suggests a step-by-step guide for effective migration and recommends the best approach to the transition process. Recommendations were made for the government to move beyond mere lip service and expedite actions towards achieving student student-centred learning environment. All educational stakeholders were also advised to utilise the blueprint and suggestions recommended by this study for easy and effective transition process.

KEYWORD: Teacher-centred learning approach, Student-centred learning approach, Grassroot, blended, Migration rubric

Introduction

Research into how students learn has increased exponentially as the field of psychology continues to understand how to make the learning process more efficient and individual-based. Different instructional strategies have been developed and adapted for varied learner needs while efforts have been made towards transforming these theories into practice in classrooms and across different regions. Tholibon, Nujid, Mokhtar, Rahim, Rashid, Saadon and Salam, (2022) affirm that there's a link between the instructional method used for classroom instructions and degrees of success attained by students. Hence, the recent affiliation to the usage of strategies that increase learner autonomy, as they have been known to create more critically thinking individuals (Donkoh, Amoakwah, 2024).

Albeit the international trend against its usage and its challenges, the conventional teacher-centred learning approach (TCLA) has proved tenacious over the years. The TCLA, according to Anyanwu, Iwuamadi, (2015) is the transfer of knowledge from a teacher to passive students who regurgitate this knowledge when necessary. Admittedly, it has several advantages, these advantages include suitability for large classrooms, ability to cover a large curriculum in less time and its usefulness in presenting new ideas to students (Nkebi, 2017). This approach is mostly popular in teaching and learning environments plagued by uncondusive learning environments, paucity of infrastructures and lack of resources in general. TCLA has contributed its fair share to the decadence experienced in the educational sector because it encourages students'

passivity and enthrones the teacher as an infallible owner of knowledge (Gumartifa, Syahri, Siroj, Nurrahmi, & Yusof, 2023). This absence of autonomy for students has been linked to decreased academic achievements (Nnorom & Uchegbu, 2017), retention and has contributed nothing to enhancing student's critical thinking abilities. Consequently, in recent years, the educational environment is seeing a growing advocacy for student-centred learning approach (SCLA) as a more effective approach to the teaching and learning process in comparison to TCLA. With the explosion of knowledge brought about by the influx of technology into classrooms, TCLA is loosening its hold and more attention is being given to the use of SCLA in a bid to develop deeper comprehension and increase knowledge retention (Yap, 2016).

Educational learning theories continually provide solid blueprints for the types of pedagogy utilized in classrooms, each with their corresponding advantages and drawbacks but the proponents of constructivism have repeatedly provided evidence to the efficacy of the theories that inculcate student centered learning strategies. SCLA has been touted to be transformative and through researches has been proved to enhance student engagement, foster deeper understanding, increase retention, improve critical thinking capabilities and attend to diverse learning needs (Eraikhuemen, David-Egbenusi & Onuigbo, 2024). A student-centered approach gives students considerable power over their learning. It not only improves academic outcomes but also prepares students for a world where adaptability, collaboration, and problem-solving are game changers (Tholibon, et al. 2022). In an increasingly complex global landscape, student-centred learning offers the flexibility, creativity, and critical thinking skills necessary for an efficient workforce and life beyond school.

The depth and robustness of learning is unarguably dependent on the quality of instruction provided (Amir, 2023). Nevertheless, a pedagogical shift from TCLA to student-centred learning is simply not a matter of teacher readiness; political dynamics and power structures within the educational system also play crucial roles in either facilitating or hindering the process. Policymakers and educational leaders are large and vocal about their dreams towards a sustainable and efficient learning environment. Schools and their administrators too claim to be abreast with the approach but in practice are hesitant to take bold steps toward comprehensive change (Anyanwu, Iwuamadi, 2015). Concerns about possible pushbacks, fear of change from conventional models, lack of resources and trained manpower and the lack of political will to drive such reforms at scale are plausible reasons for this discrepancy between theory and practice. It goes without saying that unless a strong leadership and a united commitment to prioritizing student-centred learning is in place, even the most well-meaning policies will remain fictions of imaginations, resulting in missed opportunities for students and educators alike. The type of leadership available will determine the success and the pace of the transition otherwise, power dynamics within the educational system will continue to favour the traditional, teacher-centred models.

This research aims to look into the factors that contribute to the discrepancy between policy advocacy and practical implementation. This study will provide insights into how educational stakeholders can move beyond rhetorical support to create sustainable, student-centred environments in schools. It will identify the drawbacks and provide actionable strategies that can bridge the gap between policy and practice, ultimately ensuring that the benefits of student-centred learning are realised in classrooms nationwide.

Teacher-centred approach vs. student-centred approach

The 2 major types of approaches are differentiated based on 3 distinct pillars; the nature of the intended objectives, the power balance between teacher and learner and the purpose of evaluation. Schreurs, Dumbraveanu, (2014) defines teacher teacher-centred learning approach as an approach where teachers thoughts alone dictates scope of learning and students are evaluated based on ability to reproduce learnt material verbatim. In TCLA, the teacher is the primary source of knowledge and directs learning, delivers content, and controls the pace and direction of the lesson. The learner receives information passively, follows instructions, and usually have limited input in the learning process. This teacher dominance gives little room for students to think; they only listen and take down notes because lectures usually occur at a fast pace. They are spoon fed lots of information within limited time frame and given no time to process knowledge according to their individual capacities. This hinders their thought process and makes them lose sight of the intended lesson objectives (Otukile-Mongwaketse, 2018). This rote memorization leading to poor achievement in classrooms (Atma, Azahra, Mustadi, & Adina, 2021) has promptly shifted international focus away from this approach towards the SCLA (Schreurs, Dumbraveanu, 2014). Standardized assessments are used to evaluate learners and is mostly centered on provision of correct answers unlike in SCLA where the emphasis is on fashioning and asking the right questions in order to elicit the right answers. Duratul, Masyitah, Hamizah, Jamilah, Siti, Azlinda, Dulina, Rudi, (2022) suggests that the reason for the unrelenting use of this approach by educators is usually because of unconducive environments which suggest that this approach is predominantly used in environments where finance and resources are major concerns. In consonance, Eraikhuemen et al. (2024) who carried out their research in Nigeria and posited that in certain educational climates,

especially in developing countries, this approach may not be eradicable in the foreseeable future. Attributing the tenacity of this approach to cultural influence, Matsuyama , Nakaya , Okazaki , Lebowitz , Leppink and van der Vleuten, (2019) also affirmed their sentiments by also reporting rampant use of this approach even in developed regions of East Asia, including China and Korea.

Arseven, Şahin and Kılıç, (2016), define SCLA as a learning model that gives the students the responsibility for identifying their learning needs and empowers them to scout for appropriate resources to solve their peculiar needs. In SCLA the teacher facilitates and guides learning, often acting as a mentor while the learner actively engages in the learning process, takes responsibility for their own learning, and participates in setting learning goals and evaluating their progress. Backed by the constructivist principles which was proposed by Piaget and Vygotsky, this approach encourages the construction of knowledge by the learners themselves. The needs and interests of the students are central and this has been known to develop critical thinking, problem-solving skills, and enables deeper understanding of the material, while attending to diverse individual learning needs (Rajnish, 2016). The educators are not left out of the benefits too, Woods and Copur-Gencturk (2024) after examining the role of student-centred versus teacher-centred pedagogical approaches towards self-directed learning through teaching found that teachers who practiced SCLA in their classrooms had a deeper understanding of instructional materials and learnt along with the students. They asserted that by providing a learning environment that encourages divergent thinking and giving assessments that had varied pathways to the right answers, the teachers themselves developed critical thinking abilities in the process.

Activities which prioritise the students' input in the classroom are mostly constructivist-based and are known as student-centred strategies. They are usually characterised by student's presentations and pairing of students into groups (Eduljee, Murphy, Laurie, Nina, and Karen Croteau, 2021). Examples of these are Collaborative activities, problem-solving, project-based learning, and inquiry-based methods like brainstorming, case study, demonstration, group assignment, group discussion, guided study, flipped class, field visit, interactive learning, individual assignment, learning by doing, peer-led team learning, peer learning, pair learning, pair discussion, project, panel discussion, oral presentation, poster presentation, role play, site visit, study tour, simulation game, question-answer method, and student teams-achievement division.

Understandably, with all the advantages attributed this model, there has been an onslaught of push for this technique. It has been given a larger than life image but according to (Komatsu, Rappleye, & Silova, 2021), it is not a magic bullet that will solve all challenges facing the educational sector and despite the massive popularity ascribed to it by international forums, it has its disadvantages and drawbacks and should not be ubiquitously applied especially in developing countries. In furtherance, according to their research, countries with greater individualism index were positively correlated with higher degrees of income gap and social imbalances which they argued was encouraged by the aura of individualism which may be the reason why collective efforts towards solving problems seems to be harder to come by as citizens. Natcha , Zheng and Nianci, (2023) also supported this assertion by saying that implementation of SCLA is at best "failable and unstable" without a commensurate update of objectives and assessment methods. Some factors pose considerable barriers to the inculcation of this strategy in classrooms, they include inadequate financial and human resources, nonexistent supporting policies, over the top class sizes, deficient infrastructures (Donkoh, Amoakwah,2024), poor teacher to student ratio and staff resentment (Awacorach, Jensen, Lassen, Ross, Zakaria and Olok, 2021). Additionally, albeit the lips stuck call for inculcation of SCLA, the purpose and process of assessment still largely favors the teacher centered learning in some places. In Nigerian tertiary institutions as an example, formative assessment is awarded only 30 percent of the available scores obtainable for a course and most often than not, these assessment are not given due considerations and only occur once every semester. More emphasis is rather given to the examination scores. In secondary schools, although 40 percent is awarded to formative assessments and are usually rigorous, much more emphasis is given to standardized scores from exam scores and feedbacks are solely geared towards cumulative standardized totals and not towards improving the final score.

Can a blend of both be feasible?

Due to individual peculiarities and differences in instructional contents, either of the approaches when used separately may or may not be entirely effective. Therefore, the onus lies on the teachers to decide what approach to use depending on the content and circumstances at play. A mix and match of both usually attends to the needs of the individuals usually found in a classroom environment. Eraikhuemen et al. (2024) argues that albeit the bad reputation ascribed to TCLA in recent times, it may never be eclipsed completely out of the educational horizon. The only plausible step may be a synergy or blend between both approaches. Komatsu, et al. (2021), while criticizing the larger than life aplomb given to SCLA argued that the TCLA was not the answer either and suggested that there may be a grey portion in between that can be exploited

for use especially in non-western learning environments. According to Murphy, et al. (2021); their foray into Preferences and Differences across Academic Majors; Teacher-Centered Versus Student-Centered Teaching, found out that students actually preferred a blend of both approaches. Where teachers transfer knowledge through direct instructions but also allow them to increase their involvement by collaborating with peers and voicing their opinions.

Drawbacks of the transitioning process and possible suggestions for redress

1. Lack of policy and implementation: In Regions where policies and rules that will guide the process is nonexistent or inefficient, this affects the drive for migration. Even in regions where policies exist, non-implementation of these policies and lack of quality assurance measures thwart the transition process (Ogunode, Ahaotu, 2020). In Nigeria, uncoordinated attempts at planning where implementation steps are not stipulated during the planning phase but are fashioned at a whim during the process mar the process before it even begins (Education Sector Analysis, 2021). Overpopulated classrooms which surpasses the stipulated class sizes are also direct impairment to the tenets of SCLA.
To combat this, governmental proposals of intent must be aligned to dedicated efforts towards the success of the transition. Policies to guide the process must be in place and should explicitly stipulate planning, implementation and evaluation measures before the on start of the process.
2. Resistance to Change: Considering the massive upheaval this pedagogical shift may cause, the phobia for change is expected from state administrators, Students, parents, and even teachers themselves as they may resist the shift from traditional methods to a student-centered approach due to unfamiliarity or the fear of the unknown. States may be hesitant due to the financial implication that is usually connected to changes of this magnitude. According to Duratul, et.al (2022), students are hesitant to this approach especially at the early usage because they find it hard to organize themselves in group activities without the aid of teachers or are too busy to invest time towards thinking while Onuigbo, (2025) opines that they may be too accustomed to the conventional method to care enough to figure out problems and construct their own knowledge.
This pushback can be ameliorated if effective channels of communications are provided. Communicating the benefits of the student-centered approach clearly, providing examples of successful implementations and prioritizing inclusiveness across all stakeholders in the transition process will help increase trust and support.
3. Resource issues: Designing and transitioning to student-centered learning requires massive investment into the planning and the implementation process. It is resource intense in respect to infrastructure and human resource, and puts a strain on states, teachers and schools. This strain is debilitating especially for those with limited budgets.
To ameliorate this, careful considerations about prospective impact and a mindful slow paced approach might yield more fruit than a full on charge. Implementing student-centered approaches in key subjects first, and expanding from there will likely prove to be forgiving yet more successful.
4. Time Constraints: Time allotted for instructions usually differ for students and teacher centered environments. Given the same amount of time, TCLA cover more content grounds than SCLA although content retention will be higher for SCLA. Adjustments in objectives and time management must be carried out to accommodate for activities in SCL environment.
To improve class time Tholibon, (2022) suggests implicit instructions/implementation and use of follow up with assessments to motivate them to be on task and on their toes. Lesson preparations which are always time intensive can also be improved if teachers are encouraged to collaborate and share lesson plans, materials, and ideas in order to reduce individual workloads. Inculcating digital tools and platforms can also help in creating resources.
5. Difficulty in aligning with existing curriculum standards: Student-centered approach are often large on exploratory, collaborative and experiential learning. These are inherently challenging to align with the rigid curriculum standards of TCLA .the standardized testing dependence of TCLA is also a challenge.
It may help to start with mild modifications on an already existing curriculum and objectives. Designing student-centered activities around an existing curriculum instead of an abrupt upheaval will make the transition a bit more seamless. Merging student-centered learning with some teacher-directed lessons will help ensure that key content and skills are covered at the initial stage.
6. Assessment Challenges: Traditional assessments usually do not effectively measure the outcomes of student-centered learning, which often focuses on critical thinking, collaboration, and problem-solving.
Carefully planned and designed rubrics that outline specific criteria for success in different tasks may be necessary. Introduction of alternative evaluation methods such as portfolios, presentations, peer reviews, and self-

assessments are imperative to the success of the process. Much more emphasis should be placed on formative assessments and its ability to provide ongoing feedback, as this helps students to understand their progress and identify areas for needed improvements.

7. Teacher Preparedness: Teachers may lack the training or disposition to implement student-centered strategies effectively. Shifting from being the primary source of knowledge to a facilitator of learning can be daunting for teachers accustomed to a teacher-centered model. They may not possess the necessary wherewithal to design and implement lessons that encourage student autonomy while ensuring alignment with learning objectives. Arming them with adequate resources and templates will increase their confidence in their ability. Professional development trainings targeted on various student-centered teaching strategies and mentorship programs where experienced educators offer coaching to less experienced ones will motivate them to try.
8. Classroom Management Issues: Unlike TCLA were students sit quietly and are content with just note taking, student-centred classrooms tend to be more dynamic, with students working in groups, moving around, and engaging in discussions. Without clear guidelines, this can lead to disorder or off-task behaviors which will in turn lead to frustration and decrease in learning achievements. Teachers should have and communicate clear classroom expectations and procedures for group work, discussions, and transitions before on start of class activities as this will help with time and class management .While still allowing flexibility for creativity and student autonomy, structured activities with clear roles and responsibilities for each student albeit little will help to keep the learning on task. Utilizing positive reinforcements and conflict resolution techniques also ensures a respectful and productive environment (Duratul et al., 2022).
9. Potential for unequal learning experiences: Students' varying abilities, learning styles, and levels of motivation can result in unequal learning outcomes. Some students may excel in a student-centered environment, while others may feel overwhelmed by the increased responsibility or lack the motivation to engage actively. Some socially adept students may dominate discussions or group work, while others struggle to participate. Teachers can tailor activities to meet diverse learning needs by offering varying levels of difficulty or multiple ways of engaging with instructional content. They can provide supports, such as guiding questions, checklists, and templates, to help less confident students succeed. Assigning roles to students in a group and being vocal about the importance of collaboration and group dependence for success ensures that everyone contribute meaningfully.

Rubric for assessing stakeholder readiness.

Pedagogical shifts of this magnitude is an encompassing process that requires that all arms of the educational sector be at tandem and all goals streamlined towards achieving the same objectives. It is pertinent that the readiness of stakeholders is gauged to ensure successful adoption. In order to set up an approach that is adaptable and appropriate for varied circumstances, extensive evaluations must be carried out before, during and post transition as this is crucial to the success of the process. From making policies to implementation and to quality assurance stage, stakeholders can be rated according to their level of readiness. A structured framework like one shown in Table 1 below can access the readiness of teachers, students, states and the community. Stage 1 represents the lowest level of engagement where there is virtually no commitment towards the process albeit pockets of interest while level 4 is the highest level where all strata of the sector are in the advanced level of engagement.

Category	Stage 1	Stage 2	Stage 3	Stage 4
State Readiness				
Policy Support	No policies	Policies are discussed but not implemented.	Policies exist but no enforcement	Policies are robust and consistently enforced.
Funding Allocation	None existent	Limited funding with unclear priorities.	Sufficient funding with clear guidelines	Sustained investment of resources.
Infrastructure Development	None existent Infrastructure	Basic infrastructure with limited flexibility.	Adequate infrastructure.	Adequate and scalable infrastructure.
Statewide Training Programs	No state-level programs.	Limited or one-time training opportunities.	Regular statewide training programs	Comprehensive and ongoing, training for educators.
Stakeholder Involvement	None existent	Infrequent stakeholders consultation	Regular discussions with Stakeholders.	Stakeholders are integral partners in the process
Educator Readiness				

Understanding of Concepts	Non-awareness of student-centered learning.	Basic awareness but poor practical understanding.	Maximum understanding of key concepts and their applications.	Educators are experts and can mentor others.
Classroom Management Skills	Teachers struggle to manage independent or group learning.	Teachers are hesitant but willing to attempt new methods.	Teachers manage student-centered activities effectively.	Teachers excel in guiding independent and collaborative learning.
Curriculum Adaptability	Curriculum is rigid, allowing no flexibility.	Teachers attempt minor adaptations but face challenges.	Teachers regularly adapt the curriculum to student needs.	Teachers can fully flexible, personalized curricula.
Skill in facilitation	Relies solely on conventional instruction.	Occasionally encourages student participation but maintains control.	Regularly shifts control to students and guides effectively.	Fully empowers students to lead learning with intermittent meaningful support.
Willingness to adapt	Teacher is hesitant or opposed to adopting new practices.	Teacher is willing but needs support.	Teacher actively seeks opportunities to learn and implement best practices.	Teacher champions the approach and supports others in adoption.
Assessment Practices	Only traditional tests and grades are used.	Some use of formative assessments or student input.	Balanced use of formative and summative assessments.	Holistic assessments are driven by student reflection and peer feedback.
Student Readiness				
Motivation to Learn	Students are passive and disinterested in learning.	Students engage when prompted but show limited initiative.	Students actively participate and take ownership of learning.	Students are highly motivated, self-directed learners.
Collaboration Skills	Students lack collaboration skills and resist group work.	Students engage in group work but require frequent intervention.	Students collaborate effectively with minimal guidance.	Students lead group activities and resolve conflicts independently.
Critical Thinking and Problem-Solving	Students rely heavily on memorization and teacher guidance.	Students show emerging critical thinking in structured settings.	Students regularly demonstrate critical thinking and problem-solving.	Students independently seek and solve complex, real-world problems.
Self-Management	Students cannot manage tasks without constant supervision.	Students manage tasks with occasional reminders.	Students self-manage most tasks effectively.	Students independently plan, manage, and execute tasks.
School Readiness				
Supportive leadership	Schools are unwilling to offer support.	They are aware of their roles but ill-equipped to engage.	Offer necessary guidance and support to the process	Offer maximum leadership support and are proactive in providing solutions
Infrastructure and resources	Inadequate infrastructures for learning	Meaningful expansion of infrastructures to accommodate change	Adequate infrastructure and resources to support SCL	Infrastructure fully supports innovative learning practices.
Professional development opportunities	No development opportunities are provided for teachers.	Sporadic PD opportunities or insufficiently tailored for SCL.	Adequate & relevant skills P.D.	Ongoing, personalized Trainings is embedded into school culture.
Community/Parent Readiness				
Awareness of Changes	Parents and community members are unaware of the shift.	Limited understanding of the approach and its benefits.	Parents understand and support the shift to student-centered learning.	Parents actively advocate for and participate in student-centered initiatives.
Engagement with Schools	Minimal interaction with schools or teachers.	Engagement occurs sporadically or for specific events.	Parents regularly engage in their child's learning process.	Parents and community members are partners in

				designing and implementing learning.
Support for Student Autonomy	Parents are uncomfortable with student independence.	Parents are hesitant but open to limited student autonomy.	Parents encourage their children's autonomy and decision-making.	Parents fully embrace and support student-centered principles.

Table 1: Rubric for assessing stages of readiness for transition from TCLA to SCLA across different educational stakeholder.

Keys Stage 1- Not Ready; Stage 2- Emerging Stage; Stage 3- Proficient; Stage 4- Advanced

Step by step actionable recommendations for effective migration.

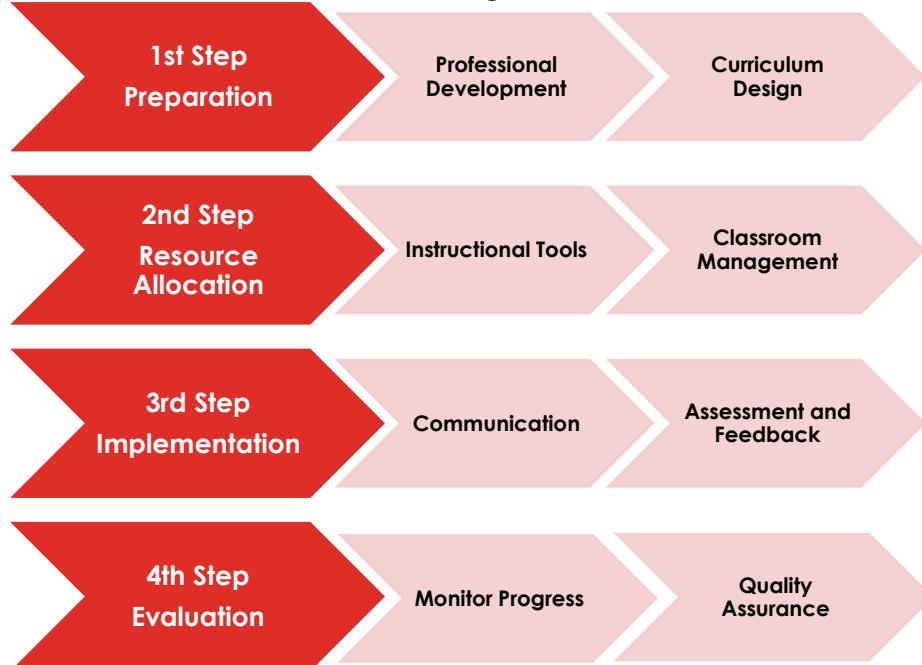


Fig 1: Steps towards student centered learning approach.

The shift in mindset from theoretical support to actual classroom practice requires not only new policies but the political will to prioritize this shift at all levels of the educational system. Every arm of the sector has responsibilities towards the success or failure of the process. The teachers must be confident in their abilities and be ready to relinquish power to a large extent in the classroom. They should be eager to offer learners maximum guidance and support (Amir, 2023) and be willing to unlearn and relearn new strategies. Be that as it may, change is a concept that waits for no one and scares everyone but owing to the massive evidence in support of SCLA, it is pertinent that efforts towards a seamless transition is prioritized. Blueprints must begin with

Stage 1 Clear implementation Plans

At this stage, it is expected that states must move beyond broad and sweeping policy declarations and create detailed, implementation strategies. These plans should include massive influx of funds and resources into the education sector for infrastructural and human developments; step-by-step guidelines for teachers; clear expectations of student outcomes and sustainable support systems. To ensure that the content delivered meets required evaluation and objective benchmarks, efforts must be made to align the curriculum to existent educational standards and assessment requirements. Detailed and

structured curriculum guides that outline key concepts, objectives, and step-by-step lesson plans is developed in order to support teachers in delivering consistent and focused instruction. Professional development programs must be aligned with these strategies to ensure that educators are well-equipped to transition into student-centered classrooms.

Stage 2 Professional development for Teachers

Teacher training colleges should be at the forefront of the transition process. The curriculum in use for training prospective teachers should imbibe SCLA before they enter the workforce. At this level, policymakers prioritize funding for teacher training programs that focus on practical skills for student-centered methodologies. These programs involve demonstration lessons where experienced educators showcase student-centered methods with practical exercises and examples that teachers can apply in their classrooms. Continuous, job-embedded professional development that goes beyond one-time workshops, with opportunities for collaborative planning, mentoring, and access to expert resources are provided for teachers to give them more opportunities for growth.

Stage 3 Foster a Culture of Leadership and Accountability:

Education leaders at the state levels foster a culture of leadership that prioritizes student-centered approaches. This is not just about top-down directives but involves empowering school administrators and teachers to take ownership of the change process. Teachers are assured and given ongoing support from school administrators. This ranges from regular check-ins, offering encouragements, and prompt tackle of challenges faced during the implementing of the new approach.

Stage 4 Ensure Equitable Access to Resources and Technology:

To successfully implement student-centered learning, all teachers and students must have access to necessary resources such as presentation soft wares, textbooks, worksheets and technologies. At this stage, stakeholders make efforts to provide targeted investments and seek strategic partnerships that bridge the digital divide and provide consistent access to digital learning platforms for the teachers and students. These essential educational tools, technology, and materials should be easy to access and integrate into class activities particularly in underfunded or underserved regions.

Stage 5 Promote Political Will and Stakeholder Engagement:

The successful implementation of student-centered learning requires political will at all levels of government. Policymakers at this stage must commit to championing the reforms, even in the face of oppositions. They make topnotch efforts to engage key stakeholders, including parents, local communities, and students while providing advocacy programs targeted at ensuring that all parties are invested in the transformation. This helps to shore up solidarity and widespread support for the shift.

Stage 6 Align assessment systems with student-centered practices:

Traditional assessment methods are reexamined and adapted to reflect the goals of student-centered learning environment. Curriculum planner and designers are charged with designing evaluation systems that measure processes and skills that emphasize student-centered learning such as problem-solving, critical thinking, and collaboration. Formative assessments, student portfolios, and project-based evaluations which better capture individual student growth and learning outcomes are inculcated and encouraged on a large scale.

Stage 7 Facilitate Community and Parental Involvement:

Building partnerships with the wider community and involving parents in the learning process is critical for the success of student-centered approaches. Schools are encouraged to foster stronger connections with families, providing them with the tools to support their child's learning at home. Community engagement initiatives are also engineered to help align student-centered goals with local needs, ensuring that the entire community is on board and supportive of the transition.

Stage 8 *Monitor and Adjust Strategies Based on Data:*

States continuously monitor the impact of student-centered learning initiatives. Locally, informal assessments in the form of quizzes, polls to gauge immediate student understanding are done at regular intervals and feedbacks garnered used to adjust instruction as appropriate. On a higher level, data on student outcomes, teacher satisfaction, and overall classroom experiences are collected at specified intervals. This data is utilized by policymakers and educators to make re-adjustments to the strategies. Strong accountability measures are also implemented to track progress, this includes regular monitoring and feedback loops that ensure the consistent application of student-centered practices across schools. Teachers are encouraged to reflect on their experiences and air them constructively during scheduled reflective meetings. Their opinions on what is working and what needs improvement are used by curriculum planners to make timely adjustments to the curriculum, training, strategies and resources.

Top-down, Grass root or Blended approach to the migration process?

The migration approach employed will be dependent on factors like educational cultures already at play, time frame and available resources. Due to differences in policies that guide educational systems, some regions may already have existing top down policies in place while others may benefit from a grass root approach or a blend of both approaches. Rapid, system-wide changes employ top-down approach while gradual, sustainable shifts are characteristic of grassroots approaches. Policy making and implementation have popularly been a top down process; policymakers, administrators, and educational experts are mostly the vanguards of such changes (Osias Kit Narciso, Jamirose, Jermilyn, 2023). A top down approach ensures uniformity of change and purpose across all parts because policies and guidelines are aligned across schools. With the large extent of state resources available; human and infrastructural, allocation of resources are easily facilitated and monitored. Schools and educators are more likely to adopt changes and overcome their phobia for change if widespread participation is enforced by a higher authority. The disadvantage of this method is possible kickback from other stakeholders who happen to be the implementers and may feel left out of the process. This may lead to lack luster engagement and may sabotage the entire process. For a seamless transition, this can be successfully managed with mindful and deliberate inclusive steps.

The grassroots approach present a direct opposite of the top down approach as the changes emanate from the classrooms. This approach is usually a resultant effect of several trial and failure processes which makes this approach more enduring, with more chances of success. Teachers and students feel more involved in the process and are often motivated and more inclined to be committed to its success even in the face of dire challenges. Teachers are considered implementers of the curriculum because they are in situ and frontal in the classrooms where the teaching and learning process occurs. They are often in tune with the students' needs and challenges of the class settings and usually possess more insights into the most effective solutions. Their inputs are pertinent in giving life to educational policies. Osias et.al. , (2023) reiterates that teachers are experts in their field and have earned the right to be part of discussions that effects students. It is unarguable then that approaches emanating from them will be more organic and inclusive even if it presents its own set of challenges. Nevertheless, this approach lacks the uniformity offered by a top down approach and often struggle with funding and expertise needed for significant changes. The expertise of involved members is also a possible drawback as it may make or mar the process.

Combining the strengths of both approaches often prove to more successful, a blended approach works on removing or at least reducing to the barest minimum the weak points eminent in both approaches while concurrently improving on their individual strengths. The state resources which includes policies, funding, and access to professional support can be utilized to establish a clear vision for student-centered learning. To increase commitment, leaderships can increase motivation and commitment by empowering teachers and schools to experiment with student-centered methods and give them adequate room for flexibility. Involving the grassroots in the decision-making processes also enables them to feel included. By combining both approaches, a more sustainable shift toward student-centered learning that is embraced by educators and supported by systemic leadership can be created.

Conclusion and recommendations

In conclusion, the transition to student-centered learning is a necessary evolution of our educational system and should be a priority for all educational stake holders, if students are to meet the demands of a rapidly changing world. Its potential to enhance student engagement, foster critical thinking, and address the diverse needs of learners is clear. However, acknowledging these advantages is only the first step. Real change requires mindful and strategic action. It is critical that we move beyond policy rhetoric and embrace a concerted effort to overcome the barriers preventing full implementation.

The future of education depends on our ability to provide students with autonomy over their learning, empower educators with the right tools and support they need, and create a dynamic, responsive system that caters to the needs of diverse learners. The journey toward educational reform is not without its challenges, but the long-term benefits far outweigh the challenges. With strong leadership, clear plans, and a firm commitment to student empowerment, an educational system that gives students opportunity to learn in engaging, personalized, and transformative ways and prepares them for the rigors of our time and of the future becomes possible.

From providing a comprehensive rubric for assessing readiness of the state/systems to proffering step by step guidelines for successful migration which when followed religiously will drastically reduce the strain that comes with the transition process. The following recommendations which have great implications for policy makers, educators, students and other educational bigwigs are that:

1. Government and other educational parastatals should invest in the future by reducing lip service and expediting action towards the inculcation of learning methodologies which prioritizes the needs of the learners.
2. Adequate resources; financial and human should be channeled towards the achievement of this monumental but necessary shift.
3. Stakeholders should utilize the blueprints and suggestions provided by this study for a stress less and efficient transition process and possibly adapt them to their peculiar circumstances.
4. All parties involved in the migration process should be aware of the variabilities in learning environments and be equally responsive in their adaptation process.

References

Amir, A. M., (2023). The Effect of Shifting to Student-Centered Learning: Implementing Student-Centered Reading. *Journal of Curriculum and Teaching*. Vol. 12(4). ISSN 1927-2677. E-ISSN 1927-2685.

Anyanwu , S.U, Iwuamadi , F. N., (2015) . Student-centered Teaching and Learning in Higher Education: Transition from theory to Practice in Nigeria International. *Journal of Education and Research*. Vol. 3(8)

Awacorach, J. Jensen, I., Lassen, I., Ross, D., Zakaria, H. L., Olok Tabo, G. (2021). Exploring Transition in Higher Education: Engagement and Challenges in Moving from Teacher-Centered to Student-Centered Learning. *Journal of Problem Based Learning in Higher Education*, JPBLHE: VOL. 9(2). Page 113-130 xx-xx 10.5278/ojs.jpblhe.v9i2.5262

Donkoh, S and Amoakwah, A., (2024). The Use and Challenges of Learner-Centered Pedagogy: Basic School Teachers' Perspective. *European Journal of Education and Pedagogy*. Vol 5(1). ISSN2736-4534

Education Sector Analysis (2021). Assessing the status of education in the federation and Oyo, Adamawa and Katsina States. ISBN: 978-92-803-1447-2

Eduljee, B., Murphy, L., (2020).Teacher-Centered Versus Student-Centered Teaching: Preferences and Differences across Academic Majors. *Journal of Effective Teaching in Higher Education*, Vol. 4(1) DOI: <https://doi.org/10.36021/jethe.v4i1.156>

Eraikhuemen, L., David-Egbenusi, N., Onuigbo, C. (2024). Effect Of Gallery Walk Instructional Strategy on Secondary School Students Academic Achievement in Taxonomy in Onitsha Metropolis of Anambra State. *South Eastern Journal of Research and Sustainable Development* Vol. 15(2).

Gumartifa, A., Syahri, I., Siroj, R. A., Nurrahmi, M., & Yusof, N. (2023). Perception of Teachers Regarding Problem-Based Learning and Traditional Method in the Classroom Learning Innovation Process. *Indonesian Journal on Learning and Advanced Education (IJOLAE)*, 5(2), 151-166. <http://dx.doi.org/10.3991/ijep.v4i3.3395>

Kilag, O. K., Marquita, J., & Laurente, J. (2023). Teacher-led curriculum development: Fostering innovation in education. *Excellencia: International Multi-disciplinary Journal of Education* (2994-9521), 1(4), 223-237.

Komatsu, H., Rappleye, J., & Silova, I. (2021). Student-centered learning and sustainability: Solution or problem?. *Comparative Education Review*, 65(1), 000-000.

Matsuyama Y, Nakaya M, Okazaki H, Lebowitz AJ, Leppink J, van der Vleuten C., (2019). Does changing from a teacher-centered to a learner-centered context promote self-regulated learning: A qualitative study in a Japanese undergraduate setting. *BMC Med Educ.* 19(1):152. DOI: 10.1186/s12909-019-1550-x. PMID: 31101111; PMCID: PMC6525356.

Murphy, Laurie, Nina B. Eduljee, and Croteau. (2021): "Teacher-centered versus student-centered teaching: Preferences and differences across academic majors". *Journal of Effective teaching in Higher Education*. Vol 4(1).pp 18-39.

Natcha, E., Zheng, L. and Nianci, L., (2024). Integrating Teacher-Centered and Student-Centered Approaches for Effective Online Teaching. *Asia Social Issues*. Vol.17 (2). E-ISSN: 2774-0315

Nkesi,W., Nmehielle,E. (2017). *International Journal of Education and Evaluation*.ISSN 2489-0073 Vol. 3(9)

Nnorom, N. R., &Uchegbu, J. C. (2017).Effect of mastery learning approach on senior secondary school students' achievement in biology in Imo. *African Journal of Education, Science and Technology*, 3(3), 100-105

Ogunode N.J., Ahaotu G. N.(2020).Challenges Facing the Implementation of Teacher-Students Ratio Policy in Nigerian Educational System and the Ways Forward. *International Journal on Integrated Education* 3(9):189-197. DOI:[10.31149/ijie.v3i9.619](https://doi.org/10.31149/ijie.v3i9.619)

Osias Kit T. K., Narciso, M. M., Jamirose, A. M., Jermilyn C. L. ,(2023).Teacher-Led Curriculum Development: Fostering Innovation in Education. *Excellencia: International Multi-Disciplinary Journal of Education*.Vol. 1(4) pp. 223. ISSN: 2994-9521

Otukile-Mongwaketse, M., (2018). Teacher centered dominated approaches: Their implications for today's inclusive classrooms. *International Journal of Psychology and Counselling*. Vol. 10(2), pp. 11-21. DOI: [10.5897/IJPC2016.0393](https://doi.org/10.5897/IJPC2016.0393)

Rajnish, A. (2016).The Nature of Educational Reform and Change: From Teacher-centered to Student-centered learning. *Educational Quest: An Int. J. of Education and Applied Social Sciences* Vol.7 (2).

Schreurs, J., Dumbraveanu, R. (2014).A Shift from Teacher Centered to Learner Centered Approach. *ijEP* .Volume 4, Issue 3. <http://dx.doi.org/10.3991/ijep.v4i3.3395>

Tholibon, D. A., Nujid, M. M., Mokhtar, H., Rahim, J. A., Rashid, S. S., Saadon, A., & Salam, R. (2022).The factors of students' involvement on student-centered learning method. *International Journal of Evaluation and Research in Education*, 11(4), 1637-1646.

Woods, P., Copur-Gencturk, Y., (2024). Examining the role of student-centered versus teacher-centered pedagogical. *Teaching and Teacher Education* 138 (2024)104415. <https://doi.org/10.1016/j.tate.2023.1044>

Yap, W. (2016).Transforming Conventional Teaching Classroom to Learner-Centred Teaching Classroom Using Multimedia-Mediated Learning Module. *International Journal of Information and Education Technology*, Vol. 6(2).

AN INVESTIGATION TO THE OPERATIONAL EFFICIENCY OF ELECTRICAL/ELECTRONICS PERSONNEL IN SELECTED INDUSTRIES IN IBADAN SOUTH-WEST, OYO STATE

Idowu Dare ADERINTO, O. O. OGUNDILE, & Adebawale Bimbola ADEKOYA
Industrial Technical Department Education,
Tai Solarin University of Education
aderintoid@tasued.edu.ng

Abstract

Amid increasing technological demands and competitive industrial standards, the competence and productivity of technical personnel have become critical to organisational success. Hence, this study investigates the operational efficiency of electrical/electronics personnel in selected industries in Ibadan South-West, Oyo State. Descriptive survey research design was adopted in this study. The population for the study comprised all 27 electrical/electronics personnel working in the selected registered manufacturing and service-based industries in Ibadan South-West Local Government Area, Oyo State. Due to the relatively manageable number of the participants, there was no sample for the study. A structured questionnaire which comprised 21 items rated on a 5-point Likert scale was used as instrument for data collection. The instrument was validated by experts in industrial technical education department, Tai Solarin University of Education. The reliability coefficient of the instrument was determined using Cronbach's Alpha and yielded a value of 0.84. Data were analysed using descriptive statistics of mean and standard deviation. Findings revealed that level of technical competence ($\bar{x}=3.15$) and operational efficiency ($\bar{x}=3.30$) among electrical and electronics personnel in selected industries in Ibadan South-West is moderate. Also, the study revealed that the availability of training and professional development for improving operational efficiency of electrical/electronics personnels in selected industries in Ibadan South-West is moderate ($\bar{x}=2.67$). It was concluded and recommended that as industries increasingly embrace automation, artificial intelligence, and green technologies, the capacity of their workforce to adapt and thrive hinges on higher-than-moderate levels of competence and efficiency. There, fostering a culture of continuous learning and operational excellence must become a policy and managerial priority to ensure personal growth of the personnel as well as enhancement of industrial productivity, innovation, and sustainable economic development in the region and beyond.

Keywords: Operational efficiency, electrical/electronic personnel, Industries,

Introduction

Technical proficiency and operational efficiency are becoming increasingly important in the changing global economy, particularly in developing nations like Nigeria where industrial expansion is crucial for long-term, sustainable development. The electrical and electronics sector which is a major part of Nigeria's industrial landscape, plays pivotal role in manufacturing, power generation, and technical development. The experts in this field are in charge of creating, maintaining, and debugging vital systems that drive industrial processes ranging from power supply installations to automation and electronic control systems. The efficiency of these workers has become a strategic concern for firms looking to maintain their competitiveness in both domestic and international markets at this time that productivity is closely tied to technology innovation and dependability.

Operational efficiency is the ability to carry out specified activities accurately, promptly, and efficiently while requiring the least amount of supervision. It also implies been able to adapt to changing technologies, meet with safety and quality

requirements, display problem-solving and decision-making competencies to boost organization output (Ogbuanya & Owodunni, 2015). According to Ezeokoli et al. (2021), operational efficiency is a multifaceted concept that is impacted by a number of variables, including motivation, management techniques, work environment, skill level, and availability of contemporary tools and equipment. One important factor influencing industrial growth is worker productivity, especially in fields like electrical and electronics engineering that demand specialized knowledge. The contributions of these technical experts are crucial to the long-term evolution of the Nigerian economy, which is striving toward industrialization and diversification.

According to Ojokuku and Adegbite (2014), on-the-job training and capacity-building programs are essential for enhancing the efficacy of technical personnel in Nigeria. They stated further that employees who had access to continuous technical training performed noticeably better and adapted more quickly to changes in equipment and processes. However, many organizations in the public and commercial sectors frequently lack or inconsistently administer this type of training. This phenomenon has been reported as a major barrier to technological advancement and industrial effectiveness in Nigeria (Asaju, Ashepo & (2025). Electrical and electronics personnel, by the nature of their responsibilities, require high levels of coordination, autonomy, and timely decision-making. Job morale tends to suffer when management does not empower employees or value their contributions, which negatively impact the output and overall operational efficiency. This emphasizes how important training and development initiatives are for closing skill disparities.

Operational efficiency also has an impact on Psychosocial and organizational elements, such as leadership styles, job satisfaction, incentives, communication flow, career advancement chances, and the physical work environment (Ogolo, 2023). In addition, poor lighting, insufficient ventilation, and inadequate maintenance practices are common in most Nigeria industries. These physical stressors can also cause poor performance, increased weariness, and Lack of concentration during operation (Onasanya, 2022). According to studies, employees who work in ergonomically sound settings with supportive management are more likely to be dedicated to their jobs and be more productive (Baba et al., 2021). Therefore, an adaptable workforce is necessary for electrical and electronics experts who are constantly exposed to new technologies, including smart grid systems, IoT-enabled gadgets, and programmable logic controllers.

Nonetheless, many Nigerian industries continue to underinvest in these kinds of capacity-building programs. This reflects in that many employers do not have established appraisal processes to monitor, evaluate, and improve employee performance. When performance reviews are conducted, they are frequently arbitrary, inconsistent, or unrelated to objectives for staff growth. This leads to a lack of accountability as well as an inability to recognise and address inefficiencies (Iwuanyanwu & Okoro, 2020). According to research conducted by Nwagbala and Okafor (2023), a sizable percentage of workers at electrical distribution companies had not received any kind of professional training in the preceding two years, which had an impact on their productivity and general performance.

Given the strategic role that electrical/electronics personnel play in sustaining industrial operations and innovations, it becomes essential to assess their level of job efficiency. Such assessment will not only help industry leaders but to understand the approach to use in improving personnel efficiency. Hence, this study investigates the operational efficiency of electrical/electronics personnel in selected industries in Ibadan South-West, Oyo State.

Statement of the Problem

The efficient functioning of industrial systems heavily relies on the competence and productivity of technical personnel, particularly those in electrical and electronics operations. These professionals are central to designing, installing, operating, and maintaining electrical infrastructure, control systems, and automated technologies supporting industrial activities. However, observations and preliminary studies indicate that many Electrical/Electronics personnel struggle with low productivity, skill deficiencies, lack of access to modern equipment, and minimal opportunities for upskilling. These inefficiencies have contributed to operational downtime, equipment failure, and increased costs of production, undermining organisational performance and competitiveness, especially within semi-urban industrial clusters. Despite the pivotal role these professionals play in ensuring operational reliability and safety, there is insufficient empirical data on the precise nature, scope, and causes of inefficiency among these personnel. This study, therefore, seeks to address this critical gap by systematically investigating the operational efficiency of Electrical/Electronics personnel in selected industries within Ibadan South-West Local Government.

Objectives of the Study

The primary objective of the study was to investigate the operational efficiency of Electrical/Electronics personnel in selected industries within Ibadan South-West Local Government. Specifically, the study sought to:

1. determine the level of technical competence among electrical and electronics personnel in selected industries within Ibadan South-West?
2. determine the level of operational efficiency among electrical and electronics personnel in selected industries within Ibadan South-West?
3. determine the level of training and professional development available for improving operational efficiency of electrical/electronics personnel in selected industries?

Research Questions

1. What is the level of technical competence among electrical and electronics personnel in selected industries within Ibadan South-West?
2. What is the level of operational efficiency among electrical and electronics personnel in selected industries within Ibadan South-West?
3. To what extent are the availability of training and professional development for improving operational efficiency of electrical/electronics personnel in selected industries?

Literature Reviewed

Concept of Operational Efficiency

Operational efficiency is the ability of an individual to effectively use time, skills, and resources to accomplish desired results with little waste or redundancy. In technical domains like electrical/electronics, it encompasses productivity, technical accuracy, compliance with safety standards, and effective time management (Robbins & Judge, 2019). Efficiency is closely linked with organizational performance, as high-efficiency employees contribute significantly to productivity, innovation, and competitiveness (Kreitner & Kinicki, 2013). Operational efficiency can be measured quantitatively “output per time unit, error rates, etc.) and qualitatively (skill proficiency, adherence to standards, problem-solving ability” (Amir, Qin & Muhammad, 2016). In technical settings, it often involves continuous process improvement and adaptation to technological advancements (ILO, 2020).

Electrical/Electronics Personnel in Industry

Electrical/Electronics personnel are professionals such as include engineers, technologists, technicians, and artisans involved in the design, installation, maintenance, testing, and troubleshooting of electrical/electronic systems (Bureau of Labor Statistics US, 2025). They play crucial roles in the automation, telecommunication, energy, and manufacturing sectors (Ikpe & Ekanem, 2024). These personnel are typically expected to possess core competencies such as circuit analysis, system diagnostics, equipment calibration, and compliance with regulatory standard. Productivity, workplace safety, product quality, and the bottom line of businesses that rely on electrical and electronic systems are all directly impacted by their effectiveness (Joy, Chikwe, & Chikezie, 2019). Besides, the performance and efficiency of these workers are significantly influenced by their technical knowledge, access to modern tools, and adherence to standard operating procedures. Rapid changes in automation, digitization, and smart technologies have redefined the competency requirements in this sector (Salau et al., 2020). Hence, training and development to perform optimal is essential for this professional.

Determinants of Job Efficiency in Technical Workplaces

Technical Training and Skill Development

One of the primary factors that determines an employee's efficiency is their technical proficiency. Research has indicated that skill gaps considerably impair performance in high-precision industries (ILO, 2020). Besides, continuous skill development is necessary for effective work. According to studies, businesses that regularly fund in-service training and retraining initiatives see improvements in output quality and less downtime (Herjuna et al, 2024). Additionally, technical training promotes adaptability to new tools and digital technologies. In Nigeria, gaps in training are common, particularly in SMEs. Many employees use antiquated knowledge, which makes it difficult to complete tasks effectively (Ajayi, Ajayi, & Ogunleye 2022). Additionally, academic credentials and professional certifications (such as NSE, COREN, and City & Guilds) have a good correlation with efficiency, particularly when it comes to complicated activities like load balancing and system troubleshooting (Belanich et al., 2019). According to Madu et al. (2023), graduates who participate in structured

industrial training, such as SIWES, during their academic program are more prepared for technical duties than those who do not.

Work Environment, Infrastructure and Motivation

A well-equipped and safe work environment significantly impacts efficiency. Adequate lighting, ventilation, safety installations, and modern tools reduce fatigue and error rates (ILO, 2020). Conversely, exposure to hazards, poor layout, and lack of materials can decrease morale and productivity. In technical workplaces, especially those with high-voltage equipment, the presence of noise and heat without mitigation measures negatively impacts concentration and efficiency (Almaskati et al., 2024). In a study by Richard, Raphael, and Filbert (2024), a high degree of motivation increases efficiency, decreases absenteeism, and improves focus. Technical staff productivity, growth prospects, and recognition were found to be strongly correlated. Both non-monetary rewards (such flexible scheduling and respect from superiors) and monetary incentives (like bonuses and performance-based pay) support long-term productivity levels (Vincent & Ayansola 2023). Burnout and errors are sometimes caused by an excessive workload and poorly planned shift schedules. To maintain high levels of efficiency, technical workers benefit from realistic deadlines, relaxation periods, and task balancing (Mohamad 2022).

Technology Integration and Management Style

The use of smart tools, including as PLC systems, automation software, AI diagnostics, and robotics, is growing in the contemporary electrical and electronics sectors. Employees that receive training on these technologies demonstrate improved accuracy and reduced turnaround times (Adib & Ashfakul, 2024). In Nigeria, there is still a skills gap, though, as many technicians are not conversant with Industry 4.0 equipment. Operational efficiency is decreased by this mismatch between the capacity of human resources and equipment. In addition, supportive supervision and leadership also improve accountability, teamwork, and communication. According to research by Ugwu, Chimaobi, and Nnadozie (2022), technical personnel's performance is positively impacted by participative management styles because they feel more engaged and dedicated. In contrast, poor supervisory practices, such as micromanagement or inconsistent feedback, often result in disengagement and inefficiencies.

Theoretical Review

Human Capital Theory

Human capital theory was primarily propounded by Theodore W. Schultz (1961). The theory posits that the knowledge, skills, experience, and competencies possessed by individuals significantly contribute to their productivity and economic value. Within the framework of operational efficiency, the theory emphasises investment in education, training, and health as key elements for enhancing employee performance and organisational growth. Applying this theory to the operational efficiency of electrical/electronics personnel provides valuable insights into how human capital development impacts operational performance in technical industries.

Methodology

This study adopted a descriptive survey research design. This design is suitable because it allows for the collection of detailed and quantifiable data related to workplace operational efficiency. The population for the study comprised all 27 electrical/electronics personnel working in the selected registered manufacturing and service-based industries in Ibadan South-West Local Government Area, Oyo State. This includes technicians, technologists, maintenance engineers, and supervisors involved in the installation, maintenance, and management of electrical/electronics systems. Due to the relatively manageable number of participants, there was no sample for the study. A structured questionnaire, which comprised 21 items rated on a 5-point Likert scale, was used as an instrument for data collection. The instrument was validated by experts in the Industrial Technical Education Department, Tai Solarin University of Education. The feedback was used to refine ambiguous items and ensure alignment with the study objectives. To ascertain internal consistency of the instrument, a pilot test was conducted with 10 electrical/electronics personnel from industries outside the study area. The reliability coefficient was calculated using Cronbach's Alpha and yielded a value of 0.84, indicating a high internal consistency. Data was collected with the support of a research assistant during agreed work hours. The data were analysed using descriptive statistics of mean and standard deviation.

Data Analysis and Results

Research Question 1: What is the level of technical competence among electrical and electronics personnel in selected industries in Ibadan South-West?

Table 1: Mean response on level of technical competence among electrical and electronics personnel in selected industries in Ibadan South-West?

S/N	Level of Technical Competence	Mean	St.D
1	Capable of troubleshooting issues without supervision.	3.46	.647
2	Demonstrating proficiency in operating industrial equipment.	3.19	.801
3	Expertise in interpreting schematics and diagrams effectively.	2.88	.993
4	Ability to comply with electrical safety standards and operational protocols.	3.15	.613
5	proficient in operating oscilloscopes and signal generators effectively.	2.92	.935
6	Ability to calibrate and maintain technical equipment as required.	3.08	.560
7	Skillful in use of multimeters and test benches.	3.38	.637
Average Mean		3.15	
4.50-5.00 (Very High), 3.50-4.49 (High), 2.50-3.49 (Moderate), 1.50-2.49 (Low), 1.00-1.49 (Very Low)			

The table presents the mean responses on the level of technical competence among electrical and electronics personnel in selected industries in Ibadan South-West. All the 7 items have their mean values ranging from 2.92 to 3.46. However, the table showed an average means of 3.15 which falls within 2.50 and 3.49 level of agreement adopted in this study. This implies that the level of technical competence among electrical and electronics personnel in selected industries in Ibadan South-West is moderate

Research Question 2: What is the level of operational efficiency among electrical and electronics personnel in selected industries in Ibadan South-West?

Table 2: Mean response on level of operational efficiency among electrical and electronics personnel in selected industries in Ibadan South-West

S/N	Level of Operational efficiency	Mean	St.D
1	Assigned tasks are generally completed within scheduled timeframes.	3.42	.758
2	Work quality consistently meets industry or organizational standards.	3.42	.578
3	Technical decisions made are usually accurate and productive.	3.19	.849
4	Initiative is often demonstrated to improve work processes.	3.27	.667
5	Work performance consistently meets or exceeds expectations	3.42	.758
6	Technical tasks are performed independently with minimal errors.	3.31	.679
7	Supervisors regularly provide positive feedback on task performance	3.08	.744
Average Mean		3.30	
4.50-5.00 (Very High), 3.50-4.49 (High), 2.50-3.49 (Moderate), 1.50-2.49 (Low), 1.00-1.49 (Very Low)			

The table presents the mean responses on the level of operational efficiency among electrical and electronics personnel in selected industries in Ibadan South-West. All the 7 items have their mean values ranging from 3.08 to 3.42. However, the table showed an average means of 3.15 which falls within mean range of 2.50 and 3.49 level of agreement adopted in this study. This therefore implies that the level of operational efficiency among electrical and electronics personnel in selected industries in Ibadan South-West is moderate

Research Question 3: To what extent are the availability of training and professional development for improving operational efficiency of electrical/electronics personnels in selected industries?

Table 3: Mean response on the extent of available of training and professional development for improving operational efficiency of electrical/electronics personnels in selected industries

S/N	Availability of training and professional development	Mean	St.D
1	My organization provides regular training opportunities related to my technical role	2.81	.939
2	There are mentorship programs available to help workers improve their job efficiency	2.69	1.050

3	Regular workshops and seminars are conducted to update personnel's on new technologies.	2.73	.919
4	There is a well-established apprenticeship program for fresh or new electrical/electronics personnel	2.69	.928
5	Online training and certification programs are encouraged for skill development.	2.54	.989
6	Electrical/electronics personnel receive structured feedback for performance improvement	2.81	.895
7	The organization supports personnel in obtaining industry-recognized certifications.	2.42	1.027
Average Mean		2.67	

4.50-5.00 (High Available), 3.50-4.49 (Available 2.50-3.49 (Moderately available), 1.50-2.49 (Rarely available Low), 1.00-1.49 (Not available)

The table presents the mean responses on the extent of available of training and professional development for improving operational efficiency of electrical/electronics personnels in selected industries. All the 7 items have their mean values ranging from 2.42 to 2.81. However, the table showed an average means of 2.67 which falls within mean range of 2.50 and 3.49 scale adopted in this study. This result therefore indicates that training and professional development for improving operational efficiency of electrical/electronics personnels in selected industries in Ibadan South-West Local Government is moderately available.

Discussion of Findings

The findings from this research highlight three critical dimensions of workforce capacity in the electrical and electronics sector within selected industries in Ibadan South-West Local Government: Each of these factors plays a vital role in shaping the productivity, innovation potential, and safety compliance of personnel in technologically driven industries. The findings of the study revealed that the level of technical competence among electrical and electronics personnel in selected industries in Ibadan South-West is moderate. This implies that although employees have some of the fundamental technical knowledge and abilities needed for their roles, there can be gaps in their level of competence in terms of mastery, breadth, and depth. According to Ezugu, Bala, and Muhammad (2023), technical competence is the capacity to use both theoretical and practical knowledge to carry out activities including electrical installations, troubleshooting, circuit design, instrumentation, maintenance, and system integration. This intermediate level of competency may result from a number of interconnected variables, such as gaps in pre-employment education and inadequate exposure to modern industrial technologies while working. Because of the speed at which technology is developing, studies have repeatedly highlighted the necessity of continuous skill improvement in engineering-related professions (Hassan, Dauda & Badawi, 2019). Employees may find it more difficult to achieve high technical proficiency if they are not exposed to sophisticated tools, computer-aided engineering programs, and automation technologies.

The results also showed that level of operational efficiency among electrical and electronics personnel in selected industries in Ibadan Southwest is moderate. According to Aldoghan et al. (2023), operational efficiency is the capacity of employees to carry out their duties with the highest possible productivity, the fewest possible errors, time effectiveness, and resource optimisation. Although employees can often carry out their duties, there are clear performance limitations that could impact production schedules, energy efficiency, equipment use, and maintenance management. This result is consistent with comparable studies by Taliang et al. (2023), who found that worker motivation, quality of supervision, sufficiency of tools and resources all had a significant impact on productivity in technical workplaces. This mediocre performance level in Ibadan South-West may be caused by limitations like outdated machinery, erratic power supplies, inadequate infrastructure, and a slow uptake of lean manufacturing practices. Also, Vallasamy, Muhadi, and Kumaran (2023), further noted that work-related stress, poor task allocation, and limited team coordination have been identified as operational hindrances.

Furthermore, findings revealed that training and professional development for improving operational efficiency of electrical/electronics personnel in selected industries in Ibadan South-West Local Government is moderately available. The moderate availability of training and professional development opportunities presents a mixed outcome. On one hand, it suggests that some form of capacity-building efforts exists in the studied industries, such as workshops, in-service

training, mentorship programs, or short-term technical courses. On the other hand, the limited access, frequency, or quality of these programs may not be sufficient to meet the evolving demands of the electrical and electronics fields (Odudu & Edidiong, 2024). Regular and structured training is a critical determinant of both technical competence and operational efficiency. According to Arulسامي et al. (2023), continuous professional development enhances employees' confidence, improves problem-solving capabilities, and fosters innovation. The moderate provision of training suggests that organizations might be constrained by funding, lack of collaboration with training institutes, or inadequate human resource planning.

Conclusion

The findings present a compelling case for urgent, yet strategic, interventions in the skill development ecosystem of electrical and electronics personnel in the studied region. As industries increasingly embrace automation, artificial intelligence, and green technologies, the capacity of their workforce to adapt and thrive hinges on higher-than-moderate levels of competence and efficiency. Fostering a culture of continuous learning and operational excellence must therefore become a policy and managerial priority to ensure personal growth of the personnel as well as enhancement of industrial productivity, innovation, and sustainable economic development in the region and beyond.

Recommendation

Given the study's results, the following suggestions are put forth:

1. Industries and relevant professional bodies such as COREN and NSE should enforce mandatory Continuous Professional Development (CPD) programs for all technical personnel. These programs should include hands-on training, workshops, certifications, and short courses focused on current trends in electrical and electronics technologies.
2. Industry 4.0 technology adoption should be encouraged by government and industry legislation, together with training initiatives to assist staff in adjusting to new tools like automation, IoT, and AI in industrial operations.
3. Institutions should adopt a performance and competence-based promotion policy. Linking advancement to measurable skill acquisition and job efficiency will motivate personnel to engage more actively in self-improvement and professional development.
4. Employers should be encouraged by the government to regularly train their technical staff through tax breaks or grants. Interventions in this area can lessen the financial strain on businesses and foster a culture of skill development.
5. Special programs should be designed for small- and medium-scale enterprises (SMEs) and informal industry players, who often lack the resources to independently fund training or efficiency-improvement initiatives for their personnel.

References

Adib, R. & Ashfakul. K. (2024). AI Revolutionizing Industries Worldwide: A Comprehensive Overview of Its Diverse Applications. *Hybrid Advances*. 7. 100277. 10.1016/j.hybadv.2024.100277.

Ajayi, P. O., Ajayi, O. M., Ogunleye, T. S. (2022) Determinants of Brain Drain among Health Workers in Public Teaching Hospitals in Ekiti State, Nigeria. *IIARD International Journal of Health and Pharmaceutical Research*. 7(1) 45-55

Aldoghan, M., & Kaliani, S., Veera, P., Kaliani, S. & Veera P. (2023). Organization operational efficiency and Innovativeness: Exploring the role of employees' task-based training, operational task commitment, operational engagement, and supervisor support. 11. 108-127. 10.46970/2022.29.1.7.

Almaskati, D., Kermanshachi, S., Pamidimukkala, A., Loganathan, K., & Yin, Z. (2024). A Review on Construction Safety: Hazards, Mitigation Strategies, and Impacted Sectors. *Buildings*, 14(2), 526. <https://doi.org/10.3390/buildings14020526>

Amir, I. Qin, S. Muhammad, A., S. (2016) Technical Efficiency and Its Determinants: An Empirical Study of Surgical Instruments Cluster of Pakistan. *Journal of Applied Business Research (JABR)* 32(2):647

Arulsamy, A., Singh, I., Kumar, S., Panchal, J. & Bajaj, K. (2023). Employee Training and Development Enhancing Employee Performance. *A Study*. 16. 406-416.

Asaju, K & Ashepo S., Y. (2025). Technology development and national development in Nigeria. *Journal of Emerging Technologies (JET)*5(1) ISSN: 2710-0189 (Print) | 2710-0197 (Online) Website: <https://journals.jozacpublishers.com/jet/>

Asogwa, U. C. (2017). Job rotation, motivation, demographic variables and job performance of career administrators in Universities in South East Nigeria Ph.D thesis, Department of Educational Foundation, faculty of Education University of Nigeria, Nsukka xii+169 pp.

Belanich, J., Fedele, E. & Dobbins, C., Morrison, J., Moses, F., & Madhavan, P. (2019). Impact of Professional Credentials on Employability. *Institute for Defense Analyses* 10.13140/RG.2.2.20406.96324.

Bureau of Labor Statistics, U.S. Department of Labor, (2025). *Occupational Outlook Handbook*, Electrical and Electronic Engineering Technologists and Technicians. at <https://www.bls.gov/ooh/architecture-and-engineering/electrical-and-electronics-engineering-technicians.htm>

Chinelo N. S. & Okafor I. P. (2023). An Assessment on Job Satisfaction and Employee Performance in Selected Enugu Electricity Distribution Company (EEDC), Enugu State. *International Journal of Research and Innovation in Social Science* 7(4), 891-902

Ezeokoli, F.O., Bert-Okonkwo, C.B.N., Okongwu, M.I., Fadumo, D.O., Ohaedeghasi, C.I. & Okoye, N.M. (2021) Factors Confronting the Present-Day Construction Practices in South-East, Nigeria: The Professionals' View. *Journal of Building Construction and Planning Research*, 9, 160-169. doi: 10.4236/jbcpr.2021.92011.

Ezugu L. C., Bala, A. A. & Muhammad Z. I. (2023). Technical Skills Improvement Needs of Electrical Installation and Maintenance Work Trade Teachers for Effective Teaching in Technical Colleges in Kano State. *International Journal of Multidisciplinary Research and Growth Evaluation*. 4(6) 425-431

Hassan M. A., Dauda, Y. A. & Badawi, H. M. (2019). Skills improvement need of woodwork teachers in technical colleges of Yobe State, Nigeria. *Insertions Journal of Innovative Information Systems and Technology Research*. 7(1):39-49.

Herjuna, S. A. S, Marhaeni., V. F., Alvira, M. & Putri. F. & Anastasya, F. (2024). Impact of Training and Development Programs on Employee Performance in the Manufacturing Sector. *Acta Psychology* 3(3), 140-151

Ikpe, A. & Ekanem, I. (2024). Integration of Intelligent Hydraulic Systems as Industry 4.0 Driving Trends: The Gateway to Industrial Automation in the Manufacturing Sectors. 11th International EL RUHA Congress of Social Sciences Iksad Institute.

International Labour Organization (2020) ILO Monitor: COVID-19 and the World of Work. Seventh Edition Updated Estimates and Analysis.

Joy, U. & Chikwe, G. & Chikezie, O. N. (2019). Workplace Safety as an Engineering Drive to Workers Productivity in Production Industries. *IDOSR Journal of Arts and Management* 4(1): 14-28

Kreitner, R., & Kinicki, A. (2013). *Organizational Behavior*. New York, NY: McGraw Hill/Irwin.

Madu, U., Omonijo, D. O., Anyaegbunam M. C., Adeleke, V. A., Nnatu, S. O., Ejoh, S., Oluwunmi, A. O., Olowookere, E. I. & Agubo, A. O. (2023). Influence of Students Industrial Work Experience Scheme (SIWES) on academic performance of library and information science students in library schools in Osun state, Nigeria. *Global Science Research Journal*.10(1). 1-11

Mohamad. S. (2022). The Impact of Work Environment on Employees Performance. *International Journal of Current Research in Science Engineering & Technology*. 03. 2582-5208.

Odudu, E., & Edidiong, I. S. (2024) Relevance of Electrical and Electronics Technology Education for Sustainable Workforce Development in Nigeria. *Journal of Association of Vocational and Technical Educators of Nigeria (Javten)*, 29(3).

Ogbuanya, T.C. & Owodunni, A.S. (2015). Effect of reflective inquiry instructional technique on students' academic achievement and ability level in electronic work trade in technical colleges. *Journal of Education and Practice*, 6(7), 4354. Retrieved from <https://files.eric.ed.gov/fulltext/EJ1083083.pdf>

Ogolo, B. N., & Azuonwu, G. (2023). Occupational hazards and safety practices among staff of Port Harcourt Electricity Distribution Company. Faculty of Natural and Applied Sciences *Journal of Scientific Innovations*, 4(2), 27–32. Retrieved from <https://fnasjournals.com/index.php/FNAS-JSI/article/view/174>

Ojokuku, R. M.A & Adegbite, T. A. (2014). The Impact of Capacity Building And Manpower Development on Staff Performance in Selected Organizations n Nigeria; *International Journal of Economics, Commerce and Management, United Kingdom* 2(5) 1 –9

Onasanya, I. O. (2022). Ergonomics of Workplace and Job Performance of Library Personnel in Private Secondary Schools in Ibadan Metropolis Nigeria. *Nigerian School Library Journal*, 21.

Richard, S., Raphael, M. & Filbert, M. (2024). Impact of recognition on employees' performance in the Manufacturing Industries in Tanzania: A Case of Tanga Cement Company. *International Journal of Scientific Research and Management (IJSRM)*. 12. 6059-6073. 10.18535/ijsrn/v12i03.em11.

Robbins, S.P. and Judge, T.A. (2018) *Essentials of Organizational Behavior*. 14th Edition, Pearson Education, Inc., London

Salau, O. P., Worlu, R. E. K., Osibanjo, A. O., Oludayo, O. A., & Falola, H. O. (2018). Survey data on work environments and productivity of academic staff of selected public universities in Nigeria. *Data in Brief*, 19, 1912–1917

Singer, S.J., Pfeffer, F., & Nikolov, M C. (2025) An absence of accountability: Evidence of employers' failure to measure and manage employee health benefits administration, *Social Science & Medicine*, 377,

Taliang, A., Rijal, S., Niswaty, R., Herman, H. & Arhas, S. (2023). Employee performance: The role of operational work tools toward productivity. *Journal of Governance and Regulation*. 12. 198-205. 10.22495/jgrv12i3siart1.

Ugwu, K., Chimaobi, I. & Nnadozie, N. (2020). Participatory Management and Employee Satisfaction (Revised)-1-1. 10.5281/zenodo.3948156.

Vallasamy, S. K. & Muhadi, S. & Kumaran S. (2023). Underlying Factors that Contributed to Job Stress in an Organisation. *Journal of Business and Social Sciences Research*. 13. 1239-1250. 10.6007/IJARBSS/v13-i5/16906.

Vincent, M. & Ayansola A. (2023). Impact of performance incentives on employees' performance in a university in KwaZulu-Natal. *SA Journal of Human Resource Management*. 21. 10.4102/sajhrm.v21i0.2114.

IMPACT OF DIGITAL FABRICATION AND MATHEMATICAL MODELLING ON ENTREPRENEURIAL COMPETENCIES IN SCIENCE AND MATHEMATICS EDUCATION

Zaharaddeen ALIYU, Faith JAMES, Usman KABIR

Department of Science Education,
Ahmadu Bello University, Zaria
zaliyu@abu.edu.ng

Usaini JAFAR
Jigawa State Ministry of Education
usainijafar@gmail.com

Abstract

This study investigated the impact of digital fabrication and mathematical modelling on the development of entrepreneurial competencies among senior secondary school students in science and mathematics education within the Zaria Education Zone, Nigeria. Anchored in Experiential Learning Theory and Constructivist pedagogy, the quasi-experimental design employed pre-test, post-test, control group methodology using 200 SSII students selected from four public secondary schools. The experimental group was exposed to project-based instruction involving digital design tools and mathematical modelling tasks, while the control group received conventional teaching. Data were collected using a validated Entrepreneurial Competency Rating Scale (ECRS) and a Performance-Based Innovation Task (PBIT), and analysed with ANCOVA and independent samples t-tests. The findings revealed statistically significant improvements in entrepreneurial problem-solving ($F(1,196)=48.13$, $p<.001$, $\eta^2=.197$) and creativity/innovation ($F(1,196)=52.89$, $p<.001$, $\eta^2=.213$) among students in the experimental group. No significant gender-based differences were observed, indicating inclusivity. The study concludes that integrating digital fabrication and modelling into STEM instruction fosters critical entrepreneurial skills necessary for innovation and job creation. It recommends curriculum reform, teacher training, and investment in maker-based infrastructure to scale this approach across Nigerian schools.

Keywords: Digital fabrication, mathematical modelling, entrepreneurial competencies, STEM education, project-based learning, innovation, gender inclusion, secondary school, Nigeria

Introduction

In the rapidly evolving landscape of 21st-century education, integrating entrepreneurship into science and mathematics instruction has become crucial for equipping students with the skills needed to navigate a complex, innovation-driven world. Digital fabrication, through technologies like 3D printing, laser cutting, and computer-aided design (CAD), empowers students to conceptualise, design, and create tangible solutions to real-world challenges (Aliyu et., 2025). Simultaneously, mathematical modelling fosters abstract reasoning and analytical thinking by enabling learners to represent and solve practical problems using mathematical frameworks. When combined, these instructional strategies present a powerful, transformative approach that aligns academic concepts with entrepreneurial application.

According to Blikstein (2018), digital fabrication shifts students from passive knowledge consumers to active creators, fostering innovation, problem-solving, and iterative design thinking. Stillman et al. (2017) similarly contend that mathematical modelling deepens conceptual understanding and encourages the meaningful application of mathematics across various contexts, including economic and technological enterprises. Embedding entrepreneurial learning into science and mathematics education through these strategies helps bridge the gap between theory and practice, cultivating a culture of creativity, resilience, and initiative. Lackéus (2015) emphasises that entrepreneurial competencies, such as creativity, opportunity recognition, financial literacy, and value creation, are most effectively developed through experiential and interdisciplinary pedagogies.

However, in the Nigerian education context, the integrative potential of digital fabrication and mathematical modelling for fostering entrepreneurial competencies remains largely unexplored. While there are emerging studies in related areas, these have generally approached the topics in silos. For instance, Onanuga and Saka (2022) found a low level of competence among STEM pre-service teachers in employing emerging digital technologies, highlighting a need to strengthen digital skills training. Similarly, Akpan, Itighise, and Umo (2024) reported that universities in Akwa Ibom State demonstrate only moderate digital technology competence and a low extent of integration in STEM teaching and learning. Yet, neither of these studies links digital tools to entrepreneurial learning or examines their combined effect with mathematical modelling strategies. Moreover, Inoma, Ibhadode, and Ibhadode (2020) examined the perception and deployment of 3D printing in Nigerian science and engineering programs, noting its potential to spur innovative teaching practices, yet they stopped short of investigating its impact on entrepreneurial mindsets. In the domain of mathematical modelling, Omobude (2014) explored how it enhances the perceived relevance of mathematics through real-life contexts, but did not extend this to include entrepreneurial competencies.

Thus, despite isolated inquiries into digital skills, emerging technologies, and problem-solving approaches, there remains a notable absence of research that cohesively examines how integrating digital fabrication and mathematical modelling can cultivate entrepreneurial competencies within Nigerian science and mathematics education (Aliyu et., 2025). This study addresses that gap, and is grounded in Kolb's (1984) experiential learning theory and constructivist pedagogical principles, which advocate for learning through active engagement, reflection, and real-world relevance. By empirically investigating how these innovative instructional strategies influence students' entrepreneurial mindset, such as creativity, opportunity recognition, and adaptability, this research aims to contribute to self-reliance, employability, and national development.

Objectives of the Study

The main objective of this study is to examine the impact of integrating digital fabrication and mathematical modelling into science and mathematics instruction on the development of entrepreneurial competencies among secondary school students in Nigeria. Specifically, the study seeks to:

1. Assess the effect of digital fabrication and mathematical modelling on students' ability to identify and solve real-world problems entrepreneurially.

2. Determine the influence of the integrated instructional approach on students' entrepreneurial creativity, innovation, and initiative.
3. Investigate the gender-based differences, if any, in the acquisition of entrepreneurial competencies through digital fabrication and mathematical modelling activities.

Research Questions

The study is guided by the following research questions:

1. What is the effect of digital fabrication and mathematical modelling on students' entrepreneurial problem-solving skills in science and mathematics?
2. How does the integration of digital fabrication and mathematical modelling affect students' creativity and innovation in entrepreneurial contexts?
3. Is there a significant gender-based difference in students' acquisition of entrepreneurial competencies when taught using digital fabrication and mathematical modelling strategies?

Null Hypotheses

The following null hypotheses were formulated and tested at the 0.05 level of significance:

H₀₁: There is no significant difference in entrepreneurial problem-solving skills between students taught using digital fabrication and mathematical modelling and those taught using conventional methods.

H₀₂: There is no significant difference in entrepreneurial creativity and innovation between students exposed to digital fabrication and mathematical modelling and those taught traditionally.

H₀₃: There is no significant gender-based difference in students' acquisition of entrepreneurial competencies through digital fabrication and mathematical modelling instruction.

Theoretical and Conceptual Framework

This study is grounded in Experiential Learning Theory (ELT) developed by Kolb (1984), which posits that knowledge is constructed through the transformation of experience. According to Kolb, meaningful learning occurs when learners engage in a cycle of concrete experience, reflective observation, abstract conceptualisation, and active experimentation. In the context of this study, digital fabrication offers concrete experiences through hands-on design and prototyping, while mathematical modelling facilitates abstract reasoning and problem-solving, thus completing the experiential learning cycle. This theoretical foundation aligns closely with the demands of entrepreneurship education, where learners must ideate, build, test, and refine real-world solutions. Additionally, the study draws from constructivist learning theory, which emphasises the active role of learners in constructing knowledge through exploration, collaboration, and contextual engagement (Vygotsky, 1978). Within this framework, integrating digital fabrication and mathematical modelling encourages learners to make meaning of scientific and mathematical principles by applying them to authentic, problem-driven tasks. Furthermore, the Entrepreneurial Competency Framework (Man, 2001) provides a practical lens for evaluating outcomes related to opportunity recognition, risk-taking, innovation, and value creation. These competencies are critical for students' ability to transition from passive knowledge receivers to active solution providers and potential job creators. The conceptual model underpinning this research posits that the intersection of hands-on digital creation and real-life mathematical application will enhance learners' entrepreneurial mindset, foster creativity, and promote long-term skill development applicable to the STEM economy.

Review of Related Literature

Recent research underscores the significance of integrating digital tools and real-world problem-solving in STEM education to cultivate entrepreneurial capacities. Blikstein (2018) argued that digital fabrication technologies such as 3D printing and CAD tools democratize innovation by allowing students to rapidly prototype and iterate designs, leading to increased ownership, creativity, and economic agency. In Nigeria, where access to conventional laboratory infrastructure may be limited, digital fabrication tools present a scalable alternative for promoting technological literacy and entrepreneurship (Okebukola, 2021). Similarly, mathematical modelling is recognized as a powerful pedagogical strategy that encourages students to represent and solve complex problems drawn from everyday life (Stillman et al., 2017). By engaging in modelling tasks, students develop analytical thinking, persistence, and innovation, all vital entrepreneurial attributes.

Lackéus (2015) emphasises that entrepreneurship education should go beyond business plans to include experiential learning, creativity, and value creation, which are achievable through integrated science-mathematics projects. Studies by Saavedra and Opfer (2012) and Beers (2011) confirm that project-based and inquiry-driven STEM instruction increases students' motivation, critical thinking, and readiness for the real world. In this context, digital fabrication serves not only as a technological platform but also as an entrepreneurial incubator where students can simulate product development and testing. Moreover, research by Martin and Brouwer (2021) found that combining mathematical modelling with engineering tasks enhances learners' innovation and entrepreneurship potential by promoting iterative design, experimentation, and critical reflection.

Gender-related research has also shown that engaging girls in maker-based and modelling activities significantly narrows participation gaps in STEM fields, especially when instruction is contextual, collaborative, and hands-on (UNESCO, 2018). In sub-Saharan African contexts, Oviawe (2017) and Nwachukwu (2020) have advocated for the integration of vocational and entrepreneurial skills into science and mathematics as a viable solution to youth unemployment and underutilization of STEM graduates. Overall, literature converges on the premise that the combined use of digital fabrication and mathematical modelling has the potential to foster entrepreneurial thinking, innovation, and sustainable skill development among science and mathematics learners.

Methodology

This study adopted a quasi-experimental research design using a pre-test, post-test control group approach to determine the impact of digital fabrication and mathematical modelling on students' entrepreneurial competencies in science and mathematics education. The design was chosen because it allows for comparison between experimental and control groups using intact classes without random assignment, which is both practical and appropriate in real classroom settings (Creswell & Creswell, 2018).

Population and Sampling

The population of the study consisted of all Senior Secondary School II (SSII) science students across twenty co-educational public secondary schools in the Zaria Education Zone, Kaduna State, Nigeria. From this population, four schools were selected using purposive and stratified random sampling. The purposive selection was guided by three criteria: (i) schools with functional science and mathematics teachers who had at least five years of teaching experience, (ii) schools with basic ICT facilities (computer laboratory and electricity supply) necessary for introducing digital fabrication activities, and (iii) schools with comparable student enrollment sizes to allow for balanced grouping. After this, stratified random sampling was used to ensure representation of gender and academic ability across the selected schools. Two schools were assigned to the experimental group and two to the control group. The final sample size comprised 200 students (100 in the experimental group and 100 in the control group).

Treatment Conditions

Students in the experimental group were taught selected science and mathematics topics (basic mechanics, algebraic problem-solving, and scientific modelling) using a project-based learning approach that integrated digital fabrication and mathematical modelling. They engaged in activities such as: Designing scientific prototypes using Tinkercad and other low-cost CAD tools, constructing physical models with affordable fabrication kits and recyclable materials and solving

contextualised real-life problems (e.g., calculating structural stability of a bridge model, designing a water filtration system, or estimating production costs of a prototype) through mathematical modelling.

The control group received instruction through traditional lecture-based methods. Lessons involved teacher-led explanations, use of chalkboard/marker board, guided note-taking, and textbook-based exercises. Students were primarily passive recipients of knowledge, with limited opportunities for hands-on or entrepreneurial engagement.

Instrumentation

Two instruments were used for data collection: the Entrepreneurial Competency Rating Scale (ECRS) and the Performance-Based Innovation Task (PBIT). Entrepreneurial Competency Rating Scale (ECRS): Developed by the researchers to measure entrepreneurial constructs such as creativity, opportunity recognition, financial literacy, innovation, and self-directedness. It consisted of 30 items structured on a 5-point Likert scale ranging from Strongly Disagree (1) to Strongly Agree (5). Performance-Based Innovation Task (PBIT): This required students to complete authentic, scenario-based tasks where they designed and modelled practical solutions. For example, one scenario involved creating a prototype of a low-cost bridge, requiring mathematical calculations for load capacity and material use, while another involved developing a simplified energy-saving device and estimating production costs. Students' outputs were assessed with a rubric that considered creativity, functionality, problem-solving, and entrepreneurial feasibility.

Validation and Reliability

The instruments were subjected to face and content validation by three experts—two in STEM education and one in educational measurement and evaluation. The experts commented on the clarity of items, relevance to entrepreneurial competencies, and alignment with study objectives. Based on their feedback, ambiguous items were rephrased, overlapping constructs were merged, and two items that were deemed redundant were removed from the ECRS. For the PBIT, the experts recommended refining scoring rubrics to include indicators of financial feasibility and innovation potential, which were incorporated.

A pilot test was conducted in a school not included in the main study. The Cronbach's alpha reliability coefficient for the ECRS was 0.84, indicating good internal consistency, while inter-rater reliability for the PBIT rubric (using two independent scorers) yielded a coefficient of 0.81, showing acceptable reliability.

Data Collection and Analysis

The study lasted for six weeks, encompassing instruction, project work, and assessment activities. Pre-test scores on entrepreneurial competencies were collected prior to the intervention to serve as covariates. Data were analysed using descriptive statistics (mean, standard deviation) and inferential statistics, specifically Analysis of Covariance (ANCOVA) to control for pre-test differences, and independent samples t-tests for post-test group comparisons.

Ethical Considerations

Ethical clearance was obtained from the Kaduna State Ministry of Education, and informed consent was secured from all participants and their guardians. Students' participation was voluntary, and confidentiality of responses was ensured.

Results and Data Analysis

To examine the effects of digital fabrication and mathematical modelling on entrepreneurial competencies, data were analysed using ANCOVA to control for pre-test differences. Below are the findings corresponding to the research hypotheses.

Hypothesis 1 (H_0): There is no significant difference in entrepreneurial problem-solving skills between students taught using digital fabrication and mathematical modelling and those taught using conventional methods.

Table 1: Descriptive Statistics and ANCOVA Result on Entrepreneurial Problem-Solving Skills

Group	N	Post-test Mean	SD	Adjusted Mean	SE	F(1,196)	p-value	Partial η^2
Experimental Group	100	77.85	6.14	77.62	0.45	48.13	<.001	0.197
Control Group	100	69.42	5.87	69.65	0.45			

Note. Adjusted means are estimated marginal means after controlling for pre-test differences. $p < 0.001$.

After controlling for pre-test scores, the ANCOVA results revealed a statistically significant difference in entrepreneurial problem-solving skills between the experimental and control groups, $F(1,196) = 48.13$, $p < .001$, with a large effect size (Partial $\eta^2 = 0.197$). Descriptive statistics further show that students in the experimental group ($M = 77.85$, $SD = 6.14$) outperformed those in the control group ($M = 69.42$, $SD = 5.87$). The magnitude of the effect size indicates that approximately 20% of the variance in entrepreneurial problem-solving skills can be attributed to the instructional approach. This represents a substantial educational impact (Cohen, 1988), confirming that the integration of digital fabrication and mathematical modelling is not only statistically significant but also practically meaningful. In practical terms, students exposed to these innovative strategies developed stronger problem-solving abilities that are crucial for identifying, analysing, and addressing real-world entrepreneurial challenges. For example, such students are more likely to apply mathematics to optimise production processes, design innovative solutions using digital tools, and evaluate the feasibility of their ideas. In contrast, students taught with traditional lecture-based methods lacked comparable opportunities for hands-on application, limiting the development of higher-order problem-solving competencies. Thus, the findings provide empirical support for embedding digital fabrication and mathematical modelling in Nigerian science and mathematics education as effective means of cultivating entrepreneurial skills needed for employability, innovation, and national development.

Hypothesis 2 (H_02): There is no significant difference in entrepreneurial creativity and innovation between students exposed to digital fabrication and mathematical modelling and those taught traditionally.

Table 2: Descriptive Statistics and ANCOVA Result on Creativity and Innovation Scores

Group	N	Post-test Mean	SD	Adjusted Mean	SE	F(1,196)	p-value	Partial η^2
Experimental Group	100	79.26	6.32	79.05	0.44	52.89	<.001	0.213
Control Group	100	70.14	5.76	70.35	0.44			

Note. Adjusted means are estimated marginal means after controlling for pre-test differences. $p < 0.001$.

After controlling for pre-test scores, the ANCOVA results revealed a statistically significant difference in entrepreneurial creativity and innovation between the experimental and control groups, $F(1,196) = 52.89$, $p < .001$, with a large effect size (Partial $\eta^2 = 0.213$). Descriptive statistics further show that students in the experimental group ($M = 79.26$, $SD = 6.32$) outperformed those in the control group ($M = 70.14$, $SD = 5.76$). The effect size indicates that approximately 21% of the variance in creativity and innovation scores can be explained by the instructional method. This is a substantial educational effect (Cohen, 1988), demonstrating that integrating digital fabrication and mathematical modelling produces meaningful improvements beyond what traditional teaching methods can achieve. Practically, this implies that students exposed to fabrication and modelling approaches developed enhanced capacity for creative thinking, idea generation, and innovative application of scientific and mathematical knowledge. For instance, these students were more capable of designing original prototypes, experimenting with novel solutions to community challenges, and applying mathematical models to test the feasibility of their ideas. By contrast, students in the lecture-based group had fewer opportunities to explore open-ended, creative problem spaces, limiting the growth of entrepreneurial innovation skills. These findings highlight the potential of digital fabrication and mathematical modelling as transformative pedagogical strategies in Nigerian classrooms,

particularly for fostering entrepreneurial competencies that are essential for self-reliance, start-up creation, and technological advancement.

Hypothesis 3 (H₀₃): There is no significant gender-based difference in students' acquisition of entrepreneurial competencies through digital fabrication and mathematical modelling instruction.

Table 3: Independent Samples t-Test on Gender-Based Differences in Entrepreneurial Competencies

Gender	N	Mean	SD	t	df	p
Male	51	82.34	6.87	1.09	98	.278
Female	49	81.01	7.14			

Note. Equal variances assumed.

The independent samples t-test showed that male students ($M = 82.34$, $SD = 6.87$) and female students ($M = 81.01$, $SD = 7.14$) did not differ significantly in their entrepreneurial competency scores, $t(98) = 1.09$, $p = .278$. This indicates that the digital fabrication and mathematical modelling intervention was equally effective across genders. The small mean difference (1.33 points) suggests minimal practical significance, implying that the program fosters equitable development of entrepreneurial competencies regardless of gender. This finding aligns with research emphasising the inclusiveness of technology-driven pedagogies in STEM education (e.g., UNESCO, 2021; Fakomogbon et al., 2023).

Discussion of Findings

The findings of this study strongly support the effectiveness of integrating digital fabrication and mathematical modelling in enhancing entrepreneurial competencies among secondary school science and mathematics students. The first hypothesis tested revealed a statistically significant difference in entrepreneurial problem-solving skills between students taught using digital fabrication and mathematical modelling and those taught using conventional methods. This aligns with Blikstein (2018), who emphasised that digital fabrication tools offer learners opportunities for tangible creation and iteration, thus encouraging innovative solutions to real-world problems. Similarly, the result supports Stillman et al. (2017), who reported that modelling tasks foster students' capacity to apply mathematical concepts in diverse entrepreneurial and scientific contexts. The substantial effect size (Partial $\eta^2 = 0.197$) found in this study indicates that the hands-on and applied nature of the experimental approach had a practical impact on learners' ability to analyze, design, and prototype entrepreneurial solutions.

The second hypothesis, which focused on creativity and innovation, also showed a significant difference favoring the experimental group. This corroborates the assertions of Lackéus (2015), who argued that entrepreneurial education, when designed as experiential and interdisciplinary, enhances innovation, creativity, and initiative in students. The integration of digital design software and modelling frameworks provided learners with an authentic context to apply STEM knowledge in the creation of entrepreneurial artefacts, as seen in Saavedra and Opfer (2012), who advocated for authentic problem-solving and real-world application in 21st-century learning models. The large effect size (Partial $\eta^2 = 0.213$) observed indicates the intervention's strong capacity to transform theoretical knowledge into tangible, creative outcomes.

Finally, the analysis of gender-based differences showed no statistically significant disparity in entrepreneurial competencies between male and female students who experienced the digital fabrication and modelling activities. This suggests the strategy is inclusive and effective across gender lines, affirming findings by UNESCO (2018), which emphasised that hands-on, technology-driven instruction can narrow gender gaps in STEM participation. Oviawe (2017) also supported the view that when entrepreneurial and technical content is made accessible through contextual and active engagement, both male and female learners can thrive equally. Hence, the study provides empirical evidence that integrating digital fabrication and mathematical modelling into science and mathematics education not only enhances core STEM skills but also nurtures essential entrepreneurial traits such as problem-solving, innovation, and opportunity

recognition. This aligns with global calls for education systems to prepare learners for future economic challenges by embedding entrepreneurial competencies within traditional academic frameworks.

Conclusion and Recommendations

This study has demonstrated that the integration of digital fabrication and mathematical modelling into science and mathematics education significantly enhances the entrepreneurial competencies of secondary school students. The experimental group, which engaged in hands-on, project-based learning using digital tools and real-world mathematical applications, outperformed the control group in entrepreneurial problem-solving, creativity, and innovation. Furthermore, the absence of significant gender-based differences suggests that this instructional approach is inclusive and effective for both male and female students. These findings validate the assertions of prior scholars (Blikstein, 2018; Stillman et al., 2017; Lackeus, 2015) who emphasised the role of experiential and applied learning in fostering innovation and entrepreneurial readiness among learners. In an era where STEM education must address not only academic excellence but also socio-economic empowerment, this study affirms that equipping students with entrepreneurial competencies through innovative strategies like digital fabrication and mathematical modelling is both timely and essential. By doing so, educators can prepare students not only to excel academically but also to become proactive problem-solvers, innovators, and potential job creators in a rapidly changing global economy.

Based on these findings, the following recommendations are made:

1. Curriculum Integration: The Federal and State Ministries of Education should revise science and mathematics curricula to include digital fabrication and mathematical modelling activities with entrepreneurial relevance.
2. Teacher Capacity Building: Intensive professional development workshops should be organised for science and mathematics teachers on the use of digital tools and project-based instructional strategies that support entrepreneurship.
3. Infrastructure Investment: Secondary schools should be equipped with basic digital fabrication kits (e.g., 3D printers, laptops with CAD software, and maker tools) to facilitate innovation-oriented STEM learning.
4. Gender-Inclusive Practices: Educators should be encouraged to use instructional approaches that are gender-sensitive and supportive of female participation in STEM-entrepreneurial learning contexts.
5. Further Research: More studies should be conducted across different regions of Nigeria to validate and expand on the findings of this study, including longitudinal research on the long-term impact of such interventions on students' career paths.

Limitations

The study did not explicitly state its limitations. One notable limitation is the relatively small sample size, which may affect the generalizability of the findings. While the results indicate positive effects of digital fabrication and mathematical modelling on entrepreneurial competencies, larger and more diverse samples across different institutions would strengthen external validity. Another limitation is the short duration of the intervention, which might not fully capture the long-term impact of the instructional strategies on entrepreneurial competencies. Future research should consider longitudinal designs to examine whether the observed improvements are sustained over time. Additionally, potential contextual and cultural factors that could influence students' entrepreneurial creativity and innovation were not addressed. Acknowledging these limitations provides a more balanced perspective and offers useful directions for future studies.

References

Aliyu, Z., Kabir, U., Muazu, M. J., & Abubakar, M. I. (2025). Gender-Based Analysis of Generative AI's Effectiveness in Enhancing Algebra Achievement in Senior Secondary Schools in Funtua Educational Zone, Katsina State. *Faculty of Natural and Applied Sciences Journal of Mathematics, and Science Education*, 6(2), 117-123.

Aliyu, Z., Tijjani, R. A., & Usman, M. H. (2025). Assessing the Role of Generative Artificial Intelligence in Enhancing Algebra Performance among Senior Secondary School Students in Funtua Educational Zone, Katsina State. *ATBU Journal of Science, Technology and Education*, 13(1), 131-138.

Beers, S. Z. (2011). *21st century skills: Preparing students for THEIR future*. National Education Association.

Blikstein, P. (2018). Pre-College Makerspaces: Implications for Education Researchers. *Teachers College Record*, 120(6), 1–44.

Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). SAGE Publications.

Kolb, D. A. (1984). *Experiential learning: Experience as the source of learning and development*. Prentice-Hall.

Lackéus, M. (2015). *Entrepreneurship in education: What, why, when, how*. OECD Publishing.

Man, T. W. Y. (2001). Entrepreneurial competencies and the performance of small and medium enterprises in the Hong Kong services sector. *Journal of Small Business Management*, 39(1), 49–65. <https://doi.org/10.1111/0447-2778.00005>

Martin, J., & Brouwer, N. (2021). Making and modelling: Integrating STEM through engineering design. *International Journal of STEM Education*, 8(1), 1–17. <https://doi.org/10.1186/s40594-021-00299-w>

Nwachukwu, C. E. (2020). Vocational and Technical Education for Sustainable Development in Nigeria. *Journal of Educational Research and Review*, 8(2), 14–20.

Okebukola, P. (2021). Repositioning STEM Education in Nigeria for Global Relevance. *African Journal of Educational Studies in Mathematics and Sciences*, 17(1), 1–16. <https://doi.org/10.4314/ajesms.v17i1.1>

Oviawe, J. I. (2017). Repositioning Nigerian vocational education and training (VET) for the 21st century: The role of ICT. *Journal of Education and Practice*, 8(8), 134–138.

Saavedra, A. R., & Opfer, V. D. (2012). Learning 21st-century skills requires 21st-century teaching. *Phi Delta Kappan*, 94(2), 8–13. <https://doi.org/10.1177/003172171209400203>

Stillman, G., Brown, J., & Galbraith, P. (2017). *Teaching mathematical modelling: Connecting to research and practice*. Springer. <https://doi.org/10.1007/978-3-319-62968-1>

UNESCO. (2018). *Cracking the code: Girls' and women's education in STEM*. UNESCO Publishing. <https://unesdoc.unesco.org/ark:/48223/pf0000253479>

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.

DEVELOPING ENTREPRENEURIAL LITERACY THROUGH CONTEXT-BASED SCIENCE AND MATHEMATICS TEACHING IN RURAL NIGERIAN SCHOOLS

Zaharaddeen ALIYU, Hannatu Mohammad LAWAL, Muhammad Bello ADAM

Department of Science Education,
Ahmadu Bello University, Zaria
zaliyu@abu.edu.ng

Sani Gwanji ADAMU
Department of Science Education,
Federal University Dutsinvla
gwanji20@gmail.com

Abstract

This study examined the impact of context-based science and mathematics instruction on entrepreneurial literacy among secondary school students in rural areas of Zaria Education Zone, Kaduna State, Nigeria. A quasi-experimental design involving pre-test, post-test control groups was employed. A total of 200 SSII students from four public rural secondary schools were sampled using multistage random sampling. Two schools received context-based instruction infused with real-life entrepreneurial scenarios, while two others served as control groups taught using conventional methods. The

Entrepreneurial Literacy Assessment Scale (ELAS) was used to collect data on students' entrepreneurial knowledge, attitudes, and skills. ANCOVA results showed a statistically significant difference in favor of the experimental group, $F(1, 197) = 45.14$, $p < .001$, with a large effect size ($\eta^2 = .189$), indicating that the context-based approach substantially improved entrepreneurial literacy. However, gender-based analysis revealed no significant difference between male and female students' scores, suggesting gender equity in learning outcomes. The study concludes that integrating context-based instruction into science and mathematics education enhances students' entrepreneurial thinking and real-world problem-solving capacity, especially in under-resourced rural settings. It recommends curriculum review, teacher training, and further research on scalable, inclusive entrepreneurial pedagogies in STEM education.

Keywords: Context-based instruction, Entrepreneurial literacy, Science and mathematics education, Rural schools, Gender, Nigeria, Secondary education

Introduction

In the evolving landscape of education and economic development, there is an urgent need to prepare students not only with academic knowledge but also with practical, entrepreneurial competencies that empower them to navigate real-life challenges (Aliyu et al., 2025). This is particularly relevant in rural Nigerian communities where formal employment opportunities are scarce and self-reliance is critical for survival and socio-economic mobility. Entrepreneurial literacy, which encompasses the knowledge, skills, attitudes, and values that enable individuals to identify opportunities, innovate, take initiative, and manage resources effectively, has emerged as a key 21st-century competence (Lackéus, 2015; Nwachukwu, 2020). Within this framework, three interrelated components are central: entrepreneurial knowledge (understanding concepts such as innovation, value creation, and financial planning), entrepreneurial attitudes (creativity, resilience, risk tolerance, and initiative), and entrepreneurial skills (problem-solving, opportunity recognition, teamwork, and resource management) (OECD, 2018; Fayolle, 2018).

Science and mathematics, by their very nature, are rooted in inquiry, critical thinking, and systematic problem-solving, foundations that align closely with entrepreneurial thinking (Aliyu et al., 2025). However, the conventional delivery of these subjects in Nigerian schools remains largely abstract, examination-driven, and disconnected from students' socio-economic realities, particularly in rural settings (Okebukola, 2021; Umeh & Eze, 2018). As a result, students often struggle to see the relevance of what they learn to the challenges and opportunities within their communities, leaving entrepreneurial potential untapped.

Context-based teaching has gained traction globally as an instructional strategy that situates learning within students' everyday experiences, making science and mathematics more relevant, engaging, and applicable (Gilbert, 2006; Bennett et al., 2007). In this approach, abstract concepts are introduced and taught through familiar situations or local issues such as agriculture, small-scale trade, environmental sustainability, and health practices—contexts that rural students can easily relate to and potentially transform into entrepreneurial opportunities. Through this pedagogical lens, learners are encouraged to apply scientific and mathematical knowledge in designing low-cost technologies, managing resources, conducting experiments tied to farming or commerce, and analyzing data for decision-making in real-world situations (Achor & Agbo-Egwu, 2015).

While a growing body of research emphasizes the integration of entrepreneurship into STEM education as a pathway to innovation, employability, and resilience (Oviawe, 2017; Blenker et al., 2014), much of this scholarship has been concentrated in urban or higher education contexts (Okolie et al., 2020; Okoye & Okwelle, 2021). Few empirical studies have systematically examined how context-based science and mathematics instruction can develop entrepreneurial literacy in rural Nigerian schools, despite the urgent need to address rural youth unemployment and underdevelopment. This gap is significant because rural learners face unique challenges—including limited access to resources, exposure to fewer entrepreneurial role models, and a curriculum that is often detached from their lived realities.

Therefore, this study investigates the effectiveness of context-based instruction in fostering entrepreneurial literacy among secondary school students in rural Nigeria. Specifically, it examines whether teaching science and mathematics through locally relevant contexts enhances students' entrepreneurial knowledge, attitudes, and skills (ELAS). Anchored in constructivist and experiential learning theories, this study contributes to the growing discourse on embedding

entrepreneurship into STEM education. By addressing an underexplored rural context, it offers insights into how context-based pedagogy can be leveraged to bridge educational inequality, promote self-reliance, and support sustainable community development.

Statement of the Problem

Despite the acknowledged importance of entrepreneurship in national development, most Nigerian secondary schools, particularly in rural areas, continue to deliver science and mathematics content in abstract, theory-driven formats that have little connection to the learners' environments or livelihoods. This disconnect leaves students ill-equipped to apply scientific and mathematical knowledge to real-world problems or develop innovative and entrepreneurial mindsets. The situation is more critical in rural settings where poverty, limited access to technology, and a lack of job opportunities heighten the need for practical, context-driven education that promotes self-reliance. While context-based instruction has been globally recognised for its potential to make learning more meaningful and relevant, its implementation in Nigerian classrooms, especially in rural areas, remains minimal and under-researched. Thus, there is a need to investigate whether teaching science and mathematics using locally relevant, context-based approaches can improve students' entrepreneurial literacy. This study, therefore, aims to address this gap by evaluating the impact of context-based science and mathematics instruction on the development of entrepreneurial knowledge, attitudes, and practical skills among secondary school students in rural Nigerian schools.

Objectives of the Study

The study aims to:

1. Determine the effect of context-based science and mathematics instruction on students' entrepreneurial literacy in rural Nigerian secondary schools.
2. Examine whether there are gender differences in the entrepreneurial literacy of students exposed to context-based instruction.

Research Questions

The study is guided by the following research questions:

1. What is the difference in entrepreneurial literacy between students taught science and mathematics using context-based instruction and those taught using conventional methods?
2. Is there a significant gender difference in the entrepreneurial literacy of students exposed to context-based instruction?

Null Hypotheses

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

H_{01} : There is no significant difference in entrepreneurial literacy between students taught science and mathematics using context-based instruction and those taught using conventional methods.

H_{02} : There is no significant gender difference in the entrepreneurial literacy of students taught using context-based instruction.

Theoretical Framework

This study is grounded in two complementary theories: Constructivist Learning Theory and Experiential Learning Theory (ELT).

Constructivist Learning Theory, advanced by scholars such as Piaget and Vygotsky, posits that learners actively construct knowledge through prior experiences and interactions with their environment (Vygotsky, 1978). In science and mathematics education, constructivism emphasises student-centred approaches that promote inquiry, problem-solving, and critical thinking, skills that are also foundational for entrepreneurial competence. When taught through context-based methods, science and mathematics become tools for exploring and addressing real-life challenges, enabling learners to build knowledge that is meaningful and transferable to entrepreneurial settings.

Experiential Learning Theory (Kolb, 1984) extends constructivist ideas by emphasising the cyclical nature of learning through experience. Kolb's four-stage model, concrete experience, reflective observation, abstract conceptualisation, and active experimentation, is particularly relevant to entrepreneurship education, where authentic problem-solving and hands-on practice are central. In this study, embedding instruction in local contexts (e.g., agricultural measurement problems or market-based budgeting tasks) provides students with direct experiences, opportunities for reflection, conceptual understanding, and application in entrepreneurial scenarios.

Taken together, these theories provide a strong foundation for the study. They suggest that context-based science and mathematics instruction can enhance entrepreneurial literacy by engaging learners in hands-on, locally relevant, and practical experiences that foster the knowledge, skills, and attitudes required for entrepreneurship.

Literature Review

Entrepreneurial literacy has emerged as a vital component of the global education agenda, recognised as a critical 21st-century skill that fosters innovation, financial independence, and socio-economic development. Lackéus (2015) defines entrepreneurial education as the process of equipping learners with the capacity to create value for others, solve authentic problems, and develop self-efficacy. In Nigeria, however, many science and mathematics classrooms remain rigidly exam-oriented and largely disconnected from students' lived realities (Okebukola, 2021; Oviawe, 2017).

Context-Based Teaching (CBT) has been identified as a transformative pedagogy that makes learning more meaningful by linking academic content with real-life applications. According to Gilbert (2006) and Bennett et al. (2007), this approach enhances students' engagement, interest, and retention of knowledge by situating abstract concepts within familiar situations. Achor and Agbo-Egwu (2015) demonstrated that rural students taught physics through community-related examples exhibited improved problem-solving skills and practical application abilities. Similarly, Nwachukwu (2020) found that embedding mathematics instruction in local contexts not only demystified the subject but also fostered entrepreneurial skills such as estimation, budgeting, and resource optimisation.

In terms of gender dynamics, several studies suggest that context-based and entrepreneurship-focused instruction can help reduce gender disparities in STEM education. For instance, UNESCO (2018) and Osioma and Nzewi (2018) argue that inclusive and practical teaching strategies in science and mathematics boost girls' interest and performance, particularly when connected to real-world social or economic activities. By showing learners how STEM knowledge can address everyday challenges, such as calculating profit margins in small-scale businesses or managing natural resources, entrepreneurial literacy becomes more concrete, relatable, and accessible to both genders.

Although existing literature highlights the effectiveness of context-based instruction and entrepreneurship education independently, there remains a scarcity of empirical studies that integrate both approaches within science and mathematics, particularly in rural Nigerian settings. This study, therefore seeks to bridge this gap by examining how context-based STEM instruction influences the development of entrepreneurial literacy (knowledge, skills, and attitudes) across gender.

Methodology

This study adopted a quasi-experimental pre-test, post-test control group design involving intact classes. The design was considered appropriate since random assignment of individual participants was not feasible in the natural school setting. The population of the study comprised all Senior Secondary II (SSII) students in public secondary schools located in rural communities within Zaria Education Zone, Kaduna State, Nigeria. The population was approximately 5,624 students across 18 rural-based senior secondary schools. The sample size consisted of 200 SSII students drawn from four co-educational public secondary schools through a multistage sampling procedure. At the first stage, purposive sampling was

used to select schools located in rural areas with comparable infrastructural conditions. At the second stage, two schools were randomly assigned to the experimental group and two to the control group, while intact classes from each selected school were used for the study. The experimental group received science and mathematics instruction using context-based teaching strategies that integrated real-life entrepreneurial scenarios such as agricultural estimations, market transactions, and environmental data interpretation. Instructional content was aligned with the Nigerian Senior Secondary School Curriculum but delivered through locally relevant experiences and problem-based learning approaches. The control group, however, was taught using traditional teacher-centred methods, focusing on textbook examples and rote learning.

The instrument for data collection was the Entrepreneurial Literacy Assessment Scale (ELAS), developed and validated by the researchers. The ELAS comprised three subscales:

- I. Entrepreneurial Knowledge (10 items)
- II. Entrepreneurial Attitudes (10 items)
- III. Entrepreneurial Skills (10 items)

The items were structured on a 4-point Likert scale. The instrument was subjected to face, content, and construct validity by experts in science education and entrepreneurship. A pilot test conducted with 30 students from a similar school outside the study zone yielded a Cronbach's alpha reliability coefficient of 0.83, indicating high internal consistency. Data collection was carried out in two phases: pre-test (to establish baseline equivalence between groups) and post-test (to measure the effect of the intervention) over a six-week instructional period. For data analysis, descriptive statistics (mean and standard deviation) were used for initial exploration, while inferential statistics were employed to test the hypotheses. Specifically, Analysis of Covariance (ANCOVA) was used to test for significant differences between the experimental and control groups while controlling for pre-test scores and an Independent samples t-test was used to determine gender differences in entrepreneurial literacy outcomes. All hypotheses were tested at the 0.05 level of significance using SPSS version 26.

Data Analysis and Interpretation

Research Question 1:

What is the difference in entrepreneurial literacy between students taught science and mathematics using context-based instruction and those taught using conventional methods?

Table 1: Mean and Standard Deviation of Students' Post-Test Entrepreneurial Literacy Scores by Group

Group	N	Mean Score	Std. Deviation
Experimental Group	100	72.84	6.35
Control Group	100	61.32	7.11

Table 1 shows that the students exposed to context-based instruction (experimental group) had a higher mean score ($M = 72.84$, $SD = 6.35$) compared to those taught with conventional methods ($M = 61.32$, $SD = 7.11$). This suggests a potential positive effect of the context-based instructional strategy on entrepreneurial literacy.

Hypothesis 1 (H_{01}):

There is no significant difference in entrepreneurial literacy between students taught science and mathematics using context-based instruction and those taught using conventional methods.

Table 2: ANCOVA Summary of Post-Test Entrepreneurial Literacy Scores Controlling for Pre-Test

Source	SS	df	MS	F	p-value	Partial η^2
Pre-test	442.75	1	442.75	6.53	.011*	.032
Group	3058.12	1	3058.12	45.14	.000***	.189
Error	13218.34	197	67.09			
Total	25278.61					

After controlling for the pre-test scores, the ANCOVA result in Table 2 reveals a statistically significant effect of instructional method on entrepreneurial literacy, $F(1, 197) = 45.14, p < .001$. The partial eta squared ($\eta^2 = .189$) indicates a large effect size. Therefore, the null hypothesis (H_01) is rejected. This means that context-based instruction had a significant positive impact on students' entrepreneurial literacy.

Research Question 2:

Is there a significant gender difference in the entrepreneurial literacy of students exposed to context-based instruction?

Table 3: Mean and Standard Deviation of Entrepreneurial Literacy Scores by Gender (Experimental Group Only)

Gender	N	Mean Score	Std. Deviation
Male	48	72.18	6.80
Female	52	73.44	6.05

Table 3 shows that female students had slightly higher entrepreneurial literacy scores ($M = 73.44$) than male students ($M = 72.18$), though the difference appears marginal.

Hypothesis 2 (H_02):

There is no significant gender difference in the entrepreneurial literacy of students taught using context-based instruction.

Table 4: Independent Samples t-Test on Gender and Entrepreneurial Literacy Scores

Gender	N	Mean	Std. Dev.	t	df	p-value
Male	48	72.18	6.80			
Female	52	73.44	6.05	-0.94	98	0.349

The independent samples t-test result shows no statistically significant difference in entrepreneurial literacy between male and female students taught using context-based instruction ($t = -0.94, p = 0.349$). Therefore, the null hypothesis (H_02) is retained. This implies that both male and female students benefited equally from the instructional intervention.

Discussion of Findings

The findings of this study reveal that the use of context-based science and mathematics instruction significantly enhances the entrepreneurial literacy of students in rural Nigerian secondary schools. This aligns with the assertions of Gilbert (2006), Bennett et al. (2007), and Achor & Agbo-Egwu (2015), who argue that embedding real-life contexts into instruction not only makes learning more relevant but also increases its practical application, especially in resource-constrained settings. The statistically significant difference in post-test scores between the experimental and control groups suggests that students who learn through real-world, entrepreneurial tasks are better positioned to acquire and apply entrepreneurial knowledge, attitudes, and skills.

The findings also support the theoretical underpinnings of Constructivist and Experiential Learning Theories. As Vygotsky (1978) and Kolb (1984) emphasized, learning becomes more meaningful when students are actively engaged in tasks that

mirror their environments. By using familiar contexts like local markets, small-scale farming, or family-based budgeting scenarios, students were able to construct knowledge that was both academically grounded and practically useful. This supports Nwachukwu (2020) and Osioma & Nzewi (2018), who advocated for a curriculum that fosters innovation and self-reliance through contextually meaningful STEM activities.

Interestingly, no significant gender differences were observed in entrepreneurial literacy outcomes, suggesting that context-based teaching strategies are inclusive and equitable. This supports studies by UNESCO (2018) and Umeh & Eze (2018), which emphasize the potential of context-based and entrepreneurial approaches to narrow gender gaps in STEM education. The use of shared, relatable experiences appeared to benefit both male and female students equally, providing a powerful argument for scaling such pedagogies in rural and underserved settings.

Recommendations

Based on the findings of this study, the following recommendations are made:

1. **Policy Integration:** The Nigerian Educational Research and Development Council (NERDC) should revise the science and mathematics curricula to explicitly integrate entrepreneurial competencies through context-based teaching strategies. For example, topics such as ratios and proportions in mathematics could be taught through local market price comparisons, while chemical reactions in science could be linked to small-scale soap or fertilizer production.
2. **Teacher Training:** Continuous professional development programs should be organized for science and mathematics teachers on the design and implementation of context-based instructional strategies. Training should include practical workshops on how to incorporate entrepreneurial projects—such as budgeting for school farming projects in mathematics or designing simple energy-saving devices in physics—into classroom teaching.
3. **Resource Development:** Educational stakeholders, including NGOs and local government education authorities, should support the development of instructional materials that reflect students' immediate environments and promote entrepreneurial learning. For instance, workbooks could include exercises on calculating profits from small trading businesses or experiments involving locally available raw materials like cassava, shea butter, or clay.
4. **Gender-Inclusive Pedagogy:** Since no gender differences were observed, educators are encouraged to apply these strategies across all-gender classrooms to ensure equity in entrepreneurial skills development. Teachers should consciously provide equal opportunities for both boys and girls to lead entrepreneurial group tasks such as managing class cooperatives or presenting innovative project solutions.
5. **Further Research:** Similar studies should be conducted across other regions and subjects (e.g., agricultural science, economics, and vocational studies) to further validate the effectiveness of context-based instruction in developing real-world competencies among diverse student populations..

Limitations of the Study

Despite the strengths of this study, several limitations should be acknowledged. First, the research was conducted within a specific geographical context, rural public secondary schools in Zaria Education Zone, Kaduna State—which may limit the generalizability of the findings to other regions with different socio-economic or cultural conditions. Second, the duration of the intervention was relatively short (six weeks), which may not have been sufficient to capture long-term effects of context-based teaching on entrepreneurial literacy. Third, the study relied primarily on self-report measures through the Entrepreneurial Literacy Assessment Scale (ELAS). While the instrument demonstrated strong reliability and validity, self-reported responses are subject to potential bias such as social desirability effects. Finally, the quasi-experimental design, which used intact classes rather than random assignment of individual students, may have introduced confounding variables beyond the control of the researchers. Future studies could extend the intervention over a longer period, incorporate additional objective measures of entrepreneurial competencies, and replicate the research across diverse educational and cultural settings to strengthen external validity and provide deeper insights.

References

Aliyu, Z., Tijjani, R. A., & Usman, M. H. (2025). Assessing the Role of Generative Artificial Intelligence in Enhancing Algebra Performance among Senior Secondary School Students in Funtua Educational Zone, Katsina State. ATBU Journal of Science, Technology and Education, 13(1), 131-138.

Aliyu, Z., Lawal H. M., & Sule Y. L. (2025). Entrepreneurship Education through STEM Based Projects: Enhancing Financial Literacy and Business Start-Up Skills among Pre-Service Science and Mathematics Teachers. *Journal of Science, Technology, and Education (JSTE)*; www.nsukjste.com/ 9(15), 198-207

Achor, E. E., & Agbo-Egwu, A. O. (2015). Effects of contextualized teaching on students' achievement and interest in measurement in physics. *Journal of Science Teachers Association of Nigeria (STAN)*, 50(1), 116–124.

Bennett, J., Lubben, F., & Hogarth, S. (2007). Bringing science to life: A synthesis of the research evidence on the effects of context-based and STS approaches to science teaching. *Science Education*, 91(3), 347–370. <https://doi.org/10.1002/sce.20186>

Gilbert, J. K. (2006). On the nature of “context” in chemical education. *International Journal of Science Education*, 28(9), 957–976. <https://doi.org/10.1080/09500690600702470>

Kolb, D. A. (1984). *Experiential learning: Experience as the source of learning and development*. Prentice Hall.

Lackéus, M. (2015). *Entrepreneurship in education: What, why, when, how*. OECD.

Nwachukwu, C. E. (2020). Context-based mathematics teaching for entrepreneurial skills development among secondary school students. *Journal of Mathematics Education*, 15(2), 58–67.

Okebukola, P. A. O. (2021). *Revitalising STEM education in Nigeria: Innovations and strategies*. Sterling Educational Publishers.

Osioma, U. I., & Nzewi, U. M. (2018). Gender equity in science education through context-based instruction. *Science Teachers Association of Nigeria (STAN) Conference Proceedings*, 123–132.

UNESCO. (2018). *Cracking the code: Girls' and women's education in science, technology, engineering and mathematics (STEM)*. UNESCO Publishing.

Umeh, M. O., & Eze, D. N. (2018). Repositioning science education for entrepreneurship and sustainable development in Nigeria. *Journal of Educational Research and Policies*, 13(1), 39–47.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.

LEVERAGING THE POTENTIAL OF VIDEO-BASED INSTRUCTIONAL PACKAGES ON PUPILS' ACHIEVEMENT AND RETENTION IN ARITHMETIC IN ONDO METROPOLIS

Oluremi Noah OYARINDE

Department of Science and Technology Education,
University of Ibadan, Nigeria

Joel Oluwadununsin KOMOLAFE

Department of Primary Education,
Adeyemi Federal University of Education, Ondo, Nigeria

Olaide Gbemisola KOMOLAFE

Department of Primary Education,
National Institute for Educational Planning and Administration, Ondo, Nigeria

Abstract

This study explores the potential of video-based instructional packages on pupils' achievement and retention in arithmetic in the Ondo metropolis. The study adopted a quasi-experimental design with pre-test and post-test control groups. Two primary schools were randomly selected to participate in the study, and one primary school was purposively selected for the experimental group, and the other was selected for the control group within the private schools in Ondo metropolis. A total sample of ninety-eight (98) primary II pupils from two private primary schools made up the study's population. Data were collected through the Arithmetic Achievement Test (AAT) and Video-Based Instructional Package (VBIP) developed by the researchers. The data were analysed using ANCOVA. The finding indicated no significant difference in pre-test scores between the two groups, confirming their equivalence at baseline. However, post-test scores revealed that the experimental group significantly outperformed the control group, demonstrating the effectiveness of the video-based instructional packages. Based on the findings of the study, it was recommended among others that primary school teachers should adopt a video-based instructional package as a pupil-driven instructional approach that gives pupils the ability to store, retain, and recall the learning experiences and improve academic achievement in primary schools.

Keywords: Arithmetic achievement, digital tools, primary education, retention and video-based instruction.

Introduction

The integration of digital technology into education has transformed traditional teaching methods and provided innovative approaches to enhance learning opportunities for all students. The rapid development in the field of technology in the 21st century affects our daily lives and education. Therefore, digital technologies are a very useful tool for educators and policymakers in the education sector because of their capacity to engage, motivate, and enhance learning among different categories of learners, especially at the primary education level. Primary education is the basic level of education given to children between the ages of 6 and 12 in Nigeria (Federal Ministry of Education, 2014). It is the foundation of all education levels and the bedrock of the entire educational system in Nigeria. Some of the objectives of primary education, as stated in the Nigerian National Policy on Education, are to inculcate permanent literacy, numeracy, and the ability to communicate effectively, and to lay a sound basis for scientific, critical, and reflective thinking, among others (FME, 2014). In pursuance of these objectives, various subject curricula have been designed, one of which is mathematics, which sets out to expose pupils to basic skills in arithmetic.

Arithmetic is a fundamental branch of mathematics that deals with numbers and the basic operations, such as addition, subtraction, multiplication, and division. It is the most elementary and oldest aspect of mathematics and is used in daily life for many purposes like measuring, counting, and computing (Purpura, Baroody, & Lonigan, 2013). Arithmetic is of paramount importance to mathematics for several reasons, serving as the foundation upon which the entire structure of mathematical concepts is built. It provides the basic operations addition, subtraction, multiplication, and division that are essential for all higher-level mathematical concepts. Without a solid understanding of these operations, it would be impossible to progress to more complex areas of mathematics. Learning arithmetic helps develop logical thinking and problem-solving skills. It encourages systematic thinking, precision, and attention to detail, which are essential qualities in all areas of mathematics and beyond. Its simplicity and ubiquity underscore its importance in both ancient and modern contexts. Arithmetic is usually the first mathematical skill that individuals learn, forming the basis for mathematical literacy. This foundational knowledge is critical for understanding and learning more advanced mathematical concepts taught in school and higher education (Uyen, Tong, & Lien, 2022). Many branches of mathematics, such as algebra, calculus, and number theory, rely heavily on arithmetic principles. Understanding the principles is necessary in order to solve equations, use functions, and look for mathematical patterns and relationships. In computer science, principles are fundamental to the creation of algorithms (Wong, 2017). For complex computations to be completed in a variety of domains, such as software development, data analysis, and cryptography, efficient algorithms for basic arithmetic operations are essential (Wong, 2017).

Despite the importance of arithmetic to all other aspects of mathematics, research findings have shown that the performance of pupils in mathematics has been on the decline in primary schools (Prather, 2012; Sari & Olkun, 2019). It cannot be denied that mathematics plays an important role in life, but the reality is that the majority of students find it very difficult to acquire the different mathematical skills and basic operations that are useful in their everyday lives. The reason for this may vary, but it could sometimes be related to the teaching method used by teachers (Chianson, Kurumeh, & Obida, 2010). In Nigerian primary education, teachers use the conventional method to teach mathematics. Mathematics at this level is

full of teacher-centred procedures that have to be mastered. In an attempt to find an immediate solution to the problems of mathematics at this level, primary school teachers need to improve their teaching methods to ensure that pupils are adequately engaged during the instructional process and to improve pupils' learning outcomes. The conventional way of teaching arithmetic has fallen short of providing an immediate learning environment, faster evaluations, and more engagement, which makes pupils passive with less interaction (Wong, 2017). In contrast, digital learning tools such as video-based instruction have the potential to go a long way in filling the gap in learning by allowing the pupils to use technological devices that would inevitably be part of their future professional practice.

Video-based instruction is one of the most diversified and distinct virtual learning mediums that captures and presents information more precisely (Oyarinde & Komolafe, 2019). It enables learners, especially primary pupils, to understand the contents more and retain information better. Video is one of the best methods to attract students to enjoy and understand the materials delivered at the mastery level (Reiss, Diestmann, Inkermann, Albers, & Vietor, 2017). Similarly, Furo (2015) opined that video-based instruction involves the use of an electronic approach that combines texts, audio, visuals, and images to offer learning experiences. According to Ogochukwu (2010), it is also defined as the fusion of various digital media, including texts, sounds, and images, presented to an audience in an integrated, multiple-sensory manner to facilitate learning. Several features of video-based learning promote meaningful learning opportunities that allow the pupils to activate, acquire, and apply knowledge in a meaningful way (Kumar, 2010). Studies have shown the influence of video-based instructions as a promising, transformative technology-supported approach on students' engagement and learning outcomes (Olatoye, 2017; Monday & Joel, 2017; Mendoza, Caranto & David, 2015; and Oyarinde, 2021).

Andor, Aneshie-Otakpa, Akobi, Agah, Okeke, Ube, & Iroanusi (2020) also conducted a study on the effect of video-aided instruction on primary school pupils' interest and memory development in arithmetic in Ogoja local government and revealed that video-aided instruction improves primary school pupils' interest and memory development in arithmetic. Gambari et al. (2016) also carried out a study on the effects of video-type instructional packages on the achievement of students in mathematics among senior secondary schools in Minna, Nigeria. The results revealed that there is a significant difference in the mean achievement score of students taught mathematics using Text Only (TO), Text Animation (TA), Text Narration (TN), and Text Animation Narration (TAN) video-type instructional packages. Moreover, Olatayo, Omiola, & Adedapo (2017) conducted a study on the effect of using video-mediated instruction as an advanced organiser on the cognitive achievement of students in mathematics and discovered that students exposed to video-mediated instruction as an advanced organiser performed better in their achievement than their counterparts. The authors found that the use of video-based instruction increased students' achievement in indices and logarithms aspects of mathematics. Other studies have also shown that video-based instructions led to great improvements in students' attendance to lessons, interest, motivation, and positive achievement in mathematics (Ogochukwu, 2010; Chaudari, 2013; Abragan & Hambre, 2017; and Oyarinde, 2021). Based on the previous studies, video-based instructions were effective in classroom activities. The effective ways of using video-based instruction to complement conventional teaching approaches would engage, increase the attention rate of pupils, and improve their academic achievement positively.

Apparently, achievement and retention in any academic pursuit are vital learning outcomes that show the degree to which learning has occurred. Retention is the ability to store what has been learned by an individual and be able to retain and recall the learning experiences. Any experience not retained cannot be recalled when the need arises. Therefore, retention is fundamental to academic achievement in arithmetic and mathematics generally. According to Amin and Malik (2014), factors affecting retention include rehearsal, exercise, testing, and reward. The scholars report that rehearsal entails repeated reception of the same content, events, and information through verbal or visual means. The use of text with images, coupled with frequent practice, could facilitate the retention rates of the pupils. Parrot (2019) identifies practice as one of the factors that could improve the ability of a child to recall what he or she has learned. The above postulation shows that the use of video-based instruction has potential in instructional delivery because it allows the pupils to view the contents over and over, and frequent practice on assigned tasks could improve retention, resulting in positive academic achievement.

However, with the growing trend of technology-assisted learning, it is observed that little effort has been made to improve the teaching and learning of arithmetic in Nigerian primary schools using technology, particularly video-based instructional packages. It seems the approach has not been extensively utilised in the teaching and learning of arithmetic. As a result, there is a need for learner-centred instructional methods that actively engage pupils in the use of technology for classroom activities. A video-based instructional package has the potential to fill this gap in instructional delivery, as it will directly

expose the pupils to the use of technology to engage them in classroom activities. Therefore, this paper examined the potential of video-based instructional packages on pupils' academic achievement and retention in arithmetic.

Purpose of the study

The purpose of this study is to investigate the potential of video-based instructional packages on pupils' achievement and retention in arithmetic. The study:

1. examined the potential of video-based instructional packages on the academic achievement of primary school pupils in arithmetic.
2. determined the potential of video-based instructional packages on the retention ability of primary school pupils in arithmetic.

Research Hypotheses

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

H₀₁: There is no significant difference in the academic achievement scores of pupils taught arithmetic using video-based instruction packages and their counterparts taught with conventional methods.

H₀₂: There is no significant difference in the retention ability of males and females pupils taught arithmetic using video-based instruction packages.

METHODOLOGY

The study adopted a pre-test, post-test, and control group quasi-experimental research design. The study population comprised all the primary II pupils in private schools in the Ondo metropolis of Ondo State for the 2023/2024 academic session. Primary II pupils were chosen because they were at the age where the foundation of arithmetic knowledge and skills is being laid. Two primary schools were randomly selected to participate in the study, and one primary school was purposively selected for the experimental group because they are boarding schools with well-equipped computer laboratories that are accessible to pupils, and the other was selected for the control group. Intact classes of ninety-eight (98) primary II pupils made up the study's population. Forty-eight (48) primary II pupils were assigned to the experimental and fifty (50) to control group. Two research instruments were used to obtain information from the participants: the Arithmetic Achievement Test (AAT) and the Video-Based Instructional Package (VBIP) developed by the researchers. The reliability coefficient of the instruments was obtained using a Cronbach's alpha for AAT; a value of 0.78 and a value of 0.84 were obtained. This was considered to be relatively high enough for the instrument to be used for the study. The researcher adopted these procedures to collect the information from the participants, first administering the instruments (Arithmetic Achievement Test (AAT) Questionnaire) as a pretest to the pupils, and their scores were recorded. The researcher then exposed the experimental group to the topics in arithmetic using a video-based instructional package for 5 weeks. The control group was also subject to the conventional method of teaching for the same number of weeks. The completed copies of the questionnaire were collected and analysed using ANCOVA.

Results

H₀₁: There is no significant difference in the mean achievement scores of pupils taught arithmetic using video-based instruction packages and their counterparts taught with conventional methods.

Table 1: Analysis of Covariance (ANCOVA) of Post-Achievement by Treatment and Retention.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	4273.552 ^a	4	2136.776	122.737	.000	.923
Intercept	888.775	1	888.775	392.575	.000	.729
Pre-Achievement	4517.686	1	4517.686	1995.478	.000	.932
Treatment	1433.065	1	1433.065	622.990	.000*	.814
Retention	.615	1	0.615	.272	.603	.002
Treatment x Retention	1.074	1	1.074	.474	.492	.003

Error	330.538	97	2.264
Total	41004.000	98	
Corrected Total	4927.470	97	
R Squared = .923 (Adjusted R Squared = .931), *p<.05			

Table 1 showed that there was a significant main effect of treatment on pupils' academic achievement in arithmetic. ($F_{(1,170)} = 622.99$; $p < 0.05$, partial $\eta^2 = 0.81$). The effect is 81.0%. This indicated that there was a significant difference in the pupils' post- academic achievement in arithmetic. Thus, hypothesis 1 was rejected. In order to determine the magnitude of the significant main effect across treatment groups, the estimated marginal means of the treatment groups was carried out and the result is presented in table 2.

Table 2. Estimated marginal means for post- academic achievement by treatment and control group

Treatment	Mean	Std. Error
Video-Based Package	18.60	.22
Conventional Method	11.13	.17

Table 2 indicated that in Video-Based Package (VBP) treatment group had the higher adjusted post-achievement mean score in arithmetic (=18.60), while the Conventional Method (CM) control group had the least adjusted post-achievement mean score (= 11.13). This order can be represented as VBP > CM. This shows that there was no significant difference between the retention ability of male and female pupils in arithmetic after the intervention ($F_{(1,170)} = 0.27$ $p > .05$). Therefore, hypothesis 2 was not rejected. This implies that the video-based instructional package will be of immense benefit to all pupils, regardless of their gender disparity.

Discussion of Findings

The results obtained from Hypothesis 1 reveal that there is a significant difference in the achievement scores of the pupils taught with the video-based instructional package and their counterparts taught with the conventional method of teaching. This implied that the video-based instructional package had a significant influence on pupils' achievement in arithmetic. In other words, this approach allows pupils to study at their own pace, promotes active learning, and makes the learning contents more accessible to them. Also, it allows pupils to spend more time on assigned tasks, and they are able to prepare and study the learning contents several times. The power of video to actively engage learners and stimulate their interest could have been responsible for this improvement in pupils' achievement after the experiment. The result is in support of findings by Gambari et al. (2016), Monday & Joel (2017), Olatayo, Omiola, & Adedapo (2017), Hambre (2017), and Oyarinde & Komolafe (2019). The findings of the study show that there is significant progress made by pupils in the process of learning the arithmetic aspect of mathematics using video-based instruction. This is in tandem with the finding of Andor et al. (2020), where the scholars observed that pupils progressed through video-based instruction faster and understood the concept in greater depth, and this stimulated their interest through the interactivity in the video package.

The results of the analyses obtained from Hypothesis 2 showed that there was no significant difference between the retention ability of male and female pupils in the experimental group after the intervention. This implies that both male and female participants have the ability to store, retain, and recall the learning experiences equally. In other words, the male and female participants benefited equally from the learning package. This is to show that the instructional package will be of immense benefit to all pupils, regardless of gender disparity. This finding aligns with the observation of Gumel & Galadima (2014), who revealed that gender has no significant effect on students' retention in geometry. The study discovered that the problem-solving approach is not sensitive to gender differences. The result was in line with the finding of Falode & Mohammed (2023), who reported no significant difference in the retention ability of male and female students in geography. Observation from this study revealed that incorporating class activities into the video package could have encouraged pupils to pay attention to the content during the instruction and improve their retention ability on arithmetic. This implies that a video-based instructional package is an effective learning delivery because it has contributed positively to the academic achievement of the pupils in primary schools.

Conclusion

Based on the findings of this study, it was proven that a video-based instructional package is more effective in enhancing pupils' levels of achievement in arithmetic than the conventional method. Also, the video-based instructional package

significantly improved pupils' retention ability on arithmetic learning because the media component of the video-based strategy engaged in instructional contents, which in turn led to improved academic achievement. The results revealed there is no significant gender implication in their retention ability; the interventions benefit both male and female pupils equally.

Recommendations

The recommendations made based on the findings from this study are:

- i. Primary school teachers should be adequately sensitised through workshops, seminars, and conferences on the use of video-based instruction for instructional delivery at the primary school level.
- ii. Primary school teachers should leverage the potential of video-based instruction to improve pupils' achievement in arithmetic at the primary school level.
- iii. Curriculum planners and developers in Nigerian primary education should emphasise the need to continuously use innovative strategies such as video-based instruction to improve instructional delivery.

REFERENCE

Abragan, F. Q. & Hambre, M. M. (2017). Video- assisted instruction and performance in science and health of grade 6 pupils at Naawan central school. *Journal of Education & Social Policy*, 7(1), 106-111.

Amin, H. U., & Malik, A. S. (2014). Memory retention and recall process. Retrieved from https://www.researchgate.net/publication/299456892_Memory_Retention_and_Recall_Process.

Andor, S.E.; Aneshie-Otakpa, V.O.; Akobi, T.O.; Agah, J.J.; Okeke, A.M.; Ube, M.O. & Iroanusi, C. (2020). Effect of Video-Aided Instruction on Primary School Pupils' Interest and Memory Development in Arithmetic in Ogoja Local Government Area, Cross River State. *Journal of the Nigerian Council of Educational Psychologists*, 14(1), 238-256.

Chaudari, P. (2013). Computer-assisted instruction: Development of instructional strategy for biology teaching. India: Irao University of Vanda.

Claessens, A., Duncan, G., & Engel, M. (2009). Kindergarten skills and fifthgrade achievement: Evidence from the ECLS-K. *Economics of Education Review*, 28(1), 415–427.

Falode, O. C., & Mohammed, I. A. (2023). Improving students' geography achievement using computer simulation and animation packages in flipped classroom settings. *Journal of Digital Educational Technology*, 3(2), 2-7 ep2303. <https://doi.org/10.30935/jdet/13106>.

Fuchs, L. S., Geary, D. C., Compton, D. L., Fuchs, D., Hamlett, C. L., Seethaler, P. M., et al (2010). Do different types of school mathematics development depend on different constellations of numerical versus general cognitive abilities? *Developmental Psychology*, 46(1), 1731– 1746.

Furo, P.T. (2015). Computer assisted instruction (CAI) and students' interest as determinant of SSII chemistry students' achievement in chemical equilibrium in Rivers State. *Journal of Applied Chemistry*, 8(8), 50-56.

Gambari, A. I., Shittu, A. T., Daramola, F. O., & Jimoh, M. A. (2016). Effects of video instructional packages on achievement of senior secondary school students in mathematics in Minna, Nigeria. *Journal of Science, Technology & Education*, 4(2), 179-196.

Gumel, A. B., & Galadima, H. (2014). Effect of gender-related differences in academic achievement and retention of senior secondary school students taught geometry using problem solving approach. *The Eurasia Proceeding of Educational and Social Sciences*, 1, 484-488.

Kumar D.D. (2010). Approaches to Interactive Video Anchors in Problem-based Science Learning. *J. Sci. Educ.*, 19(1), 13-19.

Monday A.B. And Joel O.L. (2017). Comparative Effect of Students Academic Performance in Learning Financial Accounting using Instructional Video. *International Journal of Advanced Academic Research | Arts, Humanities & Education*. 3(12).

Mendoza, G. L. L., Caranto, L. C. and David, J. J. T. (2015). Effectiveness of video presentation to students' learning. International Journal of Nursing Science, 5 (2),81-86. Retrieved from <http://article.sapub.org/10.5923.j.nursing.20150502.07.html>.

Ogochukwu, N. V. (2010). Enhancing students' interest in mathematics via multimedia presentation. African Journal of Mathematics and Computer Science Research, 3(7), 107-113.

Olatayo, S. O., Omiola, M. A., & Adedapo, I. Y. (2017). Effect of using video mediated instruction as an advanced organizer on the cognitive achievement of students in mathematics. International Journal of Educational Benchmark, 6(1), 123-131.

Olatoye, R.A. (2017). Effect of Teaching Using Charts, Real Specimens and Videos on Secondary School Students' Achievement in Mammalian Skeletal System Concepts. ENSAYOS, Revista dela Facultad de Educación de Albacete, 32(2). Enlace web: <http://www.revista.uclm.es/index.php/ensayos>.

Oyarinde, O. N. & Komolafe, O. G. (2019). Pre-Service Mathematics teachers' Attitude and Computer Skill toward the use of Video-Based Instruction as a delivery method in Algebra. *Journal of Studies in Education*, Ambrose Alli University, Ekpoma. 19(1), 113 -128.

Oyarinde, O. N. (2021). *Development and Utilisation of Two Modes of Video-Based Instructional Packages and Pre-Service Teachers' Learning Outcomes in Algebra in Southwestern, Nigeria*. Unpublished Ph.D. Thesis. Dept. of Science and Technology Education. University of Ibadan.xxi+224.

Parrot, N. (2019). Improving your pupils' retention and retrieval. Retrieved from <https://www.headteacher-update.com/best-practice-article/improving-your-pupils-retentionand-retrieval/222026/>.

Prather, R.W. (2012). Implicit Learning of Arithmetic Regularities Is Facilitated by Proximal Contrast. PLoS one 7(10), e48868. doi:10.1371/journal.pone.0048868.

Purpura, D. J., & Lonigan, C. J. (2013). Early numeracy skills: An examination of the structure of and relations among these skills in preschool. American Educational Research Journal, 50(1), 178–209.

Reiss, N., Diestmann, G., Inkermann, D., Albers, A. and Vietor, T. (2017). Understanding Design Methods-Using Explanatory Videos for Knowledge Transfer in Engineering Disciplines,60,518523. Retrieved 20/03/2018 <https://doi.org/10.1016/j.procir.2017.01.033>.

Sari M. & Olkun S. (2019). The relationship between place value understanding, arithmetic performance and mathematics achievement.

Uyen, B.P, Tong D.H & Lien N.B (2022). The effectiveness of experiential learning in teaching arithmetic and geometry in sixth grade. front. educ. 7:858631. doi: 10.3389/feduc.2022.858631.

Wong, T. T. (2017). The unique and shared contributions of arithmetic operation understanding and numerical magnitude representation to children's mathematics achievement, *Journal of Experimental Child Psychology*, 164, 68-86. doi:10.1016/j.jecp.2017.07.007.

STRATEGIC APPROACHES FOR ENHANCING INNOVATIVE INSTRUCTIONAL TECHNOLOGIES FOR TEACHING CLOTHING AND TEXTILES IN SOUTHWEST NIGERIA

OLUFUNKE. O OLUWALEYIMU

Department of Technology and Vocational Education

oluwaleyimu@noun.edu.ng

Abstract

The study examined strategic approaches for enhancing innovative instructional technologies for teaching clothing and textiles in southwest Nigeria. Survey research design was adopted for carrying out the study. Through multistage sampling technique, 78 Home economics lecturers were involved as respondents for the study. The instrument for data collection was a structured questionnaire face-validated by three experts who are Senior Lecturers in Home Economics Education.

The reliability of the questionnaire was achieved using Chronbach Alpha which yielded a reliability coefficient of 0.751. Data collected were analysed using mean and t-test statistics. The result showed that the respondents agreed to 10 technologies for improving clothing and textile instructions, 13 strategic measures for improving clothing and textile skills acquisition through technology education and 11 challenges confronting the use of technology education for clothing and textile skills acquisition. The findings of the study on hypotheses tested showed no significant difference in the mean ratings of Home economic lecturers in colleges of education and universities. Based on the findings and conclusion, the study recommended among others that there should be adequate funding and provision for modern and contemporary educational technology facilities in Nigerian schools and colleges.

Introduction

Home Economics is a broad field of study that embraces many areas such as food and nutrition Home management, tourism, child care and development, clothing and textiles and so on. Clothing is anything worn by human being to cover and beautify the body. In the opinion of Anyakoha and Eluwa (2008), clothing is any article placed on the body to protect, beautify or adorns it. Akubue and Chukwu (2016) noted that clothing include all types of dresses and their accessories such as hats, shoes, bangles, earrings, underclothes, hair-dos and even make-ups. Clothing is therefore derived from textiles. Akubue and Chukwu (2016) described textiles as any material formed by weaving, knitting, crocheting, pressing fibres together and even knotting. Textile is a flexible woven material that consists of a network of natural or synthetic fibres origin that have been twisted into yarn and constructed into cloths. Clothing and textiles are an area of study in Home Economics.

Clothing and textiles is one of the key Home Economics subjects in which entrepreneurial skills are needed to facilitate self-reliance. Igbo (2001) opined that clothing and textiles is a course that is taught at both basic secondary and tertiary institutions as well as in skill acquisition centres where an individual can be equipped with salable skills for self or paid employment on graduation. Iyere and Orumwense (2004) viewed clothing and textiles as covering basic techniques in wardrobe planning and garment making, clothing repair, maintenance, laundry, dyeing and dry cleaning of clothing items. In the opinion of Arubayi (2010), clothing and textiles is one of the three major areas of Home Economics taught in schools. The study of clothing and textiles is classified into garment construction, studying of fabrics, clothing care and maintenance, wardrobe planning and decorative processes. It is characteristically skill and activity oriented which when properly taught will equip the learner with saleable skills needed for self-reliance. Clothing and textile is an area of Vocational and technical education which enables learners to acquire the necessary skills, knowledge, abilities and attitudes required to function effectively for the development of self and the society, hence contributing to the economic advancement of the nation. Arubayi (2009) observed that the value of the quality of instruction in the teaching of clothing and textiles to national development and the economic empowerment of individuals is not in doubt. This is because clothing and textiles is a lucrative and an interesting aspect of Home Economics, which is of inestimable value to society.

The importance of adequately taught clothing and textiles lessons is of inestimable value to skill acquisition, economic enhancement and empowerment of the individual for self or paid employment. The teaching and learning of clothing and textiles entails various skills and techniques hence the need to apply information and communication technology to enhance effectiveness in the study. Olubiyi, Olaniyan and Odiaka (2015) pointed out that technology has revolutionised the way, ease, speed and time with which we conduct our activities as business transactions are conducted faster while teaching and learning become richer with the use of technologies. The use of technologies in education is fast revolutionizing the way people live and work in every aspect of human endeavor; and that the electronic world is characterized as an agent of change mainly driven by information and communication technology (ICTs). The use of technologies in learning, according to Amiaya and Ranor (2015) creates, fosters, delivers and facilitates learning. This is because, technologies in education have rapidly changed and revolutionized the nature, content and scope of instruction at all levels of education. The technologies that are employed in education are all forms of technologies that create, store, process and use information in its various forms (data, voice, image and multi-media presentations) to facilitate and support communication. They are broad-based technologies that use equipment, applications, methods and management that support the creation, storage, manipulation and communication of information for effective instructional delivery. Federal Ministry of Education (2010) described all technologies use in education as involving all equipment and tools (inclusive of conventional technologies of radio, video and television to the newer technologies of computers, hardware, firmware, mobile learning gadgets), as

well as the methods, practices, processes, procedures, concepts and principles that come into play in the conduct of the information and communication activities.

Innovative instructional technologies are modern facilities used for instructional delivery to foster quality teaching and learning. Khurshid and Ansari (2012) identified innovative instructional technologies to include the use of computer assisted instruction among others. These technologies make classroom instructions more interactive and can illustrate a concept through attractive animation, sound and demonstration (Sani, 2011). The use of innovative technologies or information and communication technologies (ICTs) is fast gaining prominence and becoming one of the most important elements defining the basic competencies in education system (Apreala, 2013). The increase in the use of technologies in education has facilitated the paradigm shift from traditional pedagogical methods to innovative technological-based teaching and learning methods imbedded in school educational programmes (Oketoobo, 2020). Educational technologies facilitate communication in teaching and learning process because they increase access to learning for students, stimulate a wide range of scientific phenomenon and generally motivate both teachers and students, develop problem solving capabilities and aid deeper understanding in learning experience.

Considering the relevance and significance of technologies in education, skills in the use of these technologies are also essential. Skill is the ability of an individual to perform an intellectual or physical task. Skills are practical activities which make one employable, self-reliant and relevant to the society. Skills are needed to solve problems and engender quality in any area of human endeavour. It was in line with this that this study examined strategic approaches for enhancing innovative instructional technologies for teaching clothing and textiles in southwest Nigeria.

Purpose of the Study

The broad purpose of the study was to examine strategic approaches for enhancing innovative instructional technologies for teaching clothing and textile in southwest Nigeria. Specifically, the study identified:

1. Innovative instructional technologies for teaching clothing and textile.
2. Strategic approaches for enhancing the teaching of clothing and textile through innovative instructional technologies.
3. Challenges confronting the use of innovative instructional technologies for teaching clothing and textiles.

Research Questions

1. What are innovative instructional technologies for teaching clothing and textiles?
2. What are strategic approaches for enhancing the teaching of clothing and textile through innovative instructional technologies?
3. What are challenges confronting the use of innovative instructional technologies for teaching clothing and textiles?

Hypotheses

H01: There is no significant difference in the mean ratings of Home economic lecturers in colleges of education and universities on innovative instructional technologies for teaching clothing and textiles.

H02: There is no significant difference in the mean ratings of Home economic lecturers in colleges of education and universities on strategic approaches for enhancing the teaching of clothing and textile through innovative instructional technologies.

H03: There is no significant difference in the mean ratings of Home economic lecturers in colleges of education and universities on the challenges confronting the use of innovative instructional technologies for teaching clothing and textiles.

Methodology

The study was carried out in southwest Nigeria comprising six states which are: Ekiti, Lagos, Ogun, Ondo, Osun and Oyo States. Three research questions were answered by the study while three null hypotheses were tested at 0.05 level of significance. Descriptive survey research design was adopted in carrying out the study. Described survey research design according to Nworgu (2015) is a method in which a group of people or items is studied by collecting and analyzing data from only a few people or items considered to be representative of the entire group. Rouse (2019) described survey research design as the process of data collection by asking individuals questions either in person, on paper, by phone or online using questionnaire through primary research which is the gathering of first-hand data from its source. The design is suitable for this study because it involved the collection of the required data and information on improving clothing and textile skills acquisition through effective technology education programme.

Multistage sampling technique was used to select the respondents for the study. The first stage involved random selected of two states (Lagos and Ogun) from the existing six states in southwest Nigeria. The second stage involved purposive selection of seven public tertiary institutions (Colleges of education and Universities) offering Home economics education programme in the two states. At the third stage of the sampling, all the 78 Home economics lecturers drawn from the nine tertiary institutions were sampled. Hence, the total sample for the study was 78 respondents from which data for the study were collected. The instrument for data collection for the study was a structured close-ended questionnaire designed by the researcher. The questionnaire was structured into four sections (A, B, C and D). Section A was developed to obtain personal data of the respondents such as names of schools, gender and highest educational qualification. Section B was structured to obtain the required data on innovative instructional technologies for teaching clothing and textile. Section C was developed to elicit data on strategic approaches for teaching clothing and textile using innovative instructional technologies while Section D was structured to generate data on challenges confronting the use of innovative instructional technologies usage for clothing and textile. Sections B, C and D of the questionnaire were structured into 4-point scale rating scale of Strongly Agreed (SA); Agreed (A); Disagreed (D) and Strongly Disagreed (SD) with corresponding rating values of 4, 3, 2, and 1 respectively. The instrument was face-validated by three experts who are Senior Lecturers in Home Economics Education. The reliability of the questionnaire was ascertained by trial testing 10 copies of the instrument on 10 Home economics lecturers in public tertiary institution in Oyo State. Data collected from the trial testing were analysed using Cronbach Alpha reliability method which yielded a reliability coefficient of 0.751 for the instrument.

Data for the study were collected by the researchers with the help of six research assistants to cover the seven schools. Due to close monitoring of the research assistants, the entire 78 copies of the questionnaire administered to the respondents were completely filled and returned representing the envisaged 100.0% rate of return. The data collected were analysed using mean and standard deviation for answering the research questions while the hypotheses were tested using t-test statistics. Cut-off point value of 2.50 on 4-point scale was used for interpreting the results. The cut-off point was computed thus:

$$\frac{4 + 3 + 2 + 1}{4} = \frac{10}{4} = 2.50 \text{ (cut-off point)}$$

Based on the obtained cut-off point value, any item with mean value of 2.50 and above was interpreted as “Agreed” while items with mean values less than 2.50 were interpreted as “Disagreed”. On the null hypotheses tested, the hypothesis of no significant difference was accepted for items whose t-calculated (t-cal) value was less than the t-table (t-tab) value of

1.96 at 0.05 level of significance while hypothesis of no significant difference was rejected for items whose t-calculated (t-cal) values was greater than the t-table (t-tab) value of 1.96 at 0.05 level of significance.

Results

Research Question One: What are innovative instructional technologies for teaching clothing and textile?

Table 1: Mean ratings of the respondents on innovative instructional technologies for teaching clothing and textiles (N = 78).

Innovative instructional technologies for teaching clothing and textiles include:			\bar{X}	SD	Rmks
SN					
1	Audio visual such as projectors for in clothing and textiles instructions.		3.72	0.57	Agreed
2	Engagement of mobile learning devices such as phones, ipad etc.		3.54	0.54	Agreed
3	Video conference in Home economics instruction.		3.61	0.69	Agreed
4	Computer programmes & software to complement home economics teaching		3.47	0.54	Agreed
5	Smart phones, Laptops MP3 players and E-book readers.		3.49	0.70	Agreed
6	Social medial platforms such as Facebook, Twitter, Whatsapp, and instagram for clothing and textiles instructional delivery.		3.53	0.81	Agreed
7	Computer Based Test (CBT) in clothing and textiles assessment		3.48	0.83	Agreed
8	Web Based Test (WBT) in clothing and textiles assessment		3.43	0.66	Agreed
9	AUTOCAD for clothing and textiles instruction		3.68	0.61	Agreed
10	Animation games for clothing and textile teaching and learning		3.53	0.53	Agreed
Pooled Mean			3.55	0.62	Agreed

Note: \bar{X} = Mean; SD = Standard Deviation.

The mean ratings of the respondents in Table 1 ranged from 3.43 to 3.72 which are all greater than the cut-off point value of 2.50 on 4-point rating scale. This indicates that the 10 items in the table are innovative instructional technologies for teaching clothing and textile instruction in tertiary institutions in southwest Nigeria. The standard deviation values ranged from 0.54 to 0.83 which indicates that the responses of the respondents are close to one another and the overall mean.

Hypothesis One

H01: There is no significant difference in the mean ratings of Home economics lecturers in colleges of education and universities on innovative instructional technologies for teaching clothing and textile.

Table 2: Result of t-test of statistics of significant difference between the mean ratings of Home Economics lecturers in Colleges of Education and Universities on innovative instructional technologies for teaching clothing and textiles

Variables	N	\bar{X}	SD	DF	Std. Error	t-cal	t-tab	Level of sig.	Rmks
COE Lecturers	47	3.52	0.57						

Uni. Lecturers	31	3.58	0.50
----------------	----	------	------

Note: NS = Not Significant at 0.05.

The data presented on the t-test statistics in Table 2 reveals that the t-calculated (t-cal) value of 0.31 is less than the t-critical (t-tab) value of 1.96 at 76 degree of freedom. This implies that there is no significant ($p < 0.05$) difference in the mean ratings of the responses of Home economic lecturers in colleges of education and universities on innovative instructional technologies for teaching clothing and textile in tertiary institutions in southwest Nigeria. Therefore, the null hypothesis of no significant ($p < 0.05$) difference in the mean ratings of the responses of the two groups of respondents is accepted for hypothesis one.

Research Question Two

What are strategic approaches for enhancing the teaching of clothing and textile through innovative instructional technologies?

Table 3: Mean ratings of the respondents on strategic approaches for enhancing the teaching of clothing and textile through innovative instructional technologies (N = 78).

SN	Strategic approaches for enhancing the teaching of clothing and textiles through innovative instructional technologies are:	\bar{X}	SD	Rmks
1	Adequate provision of fund by school management for procurement of educational technology devices	3.62	0.68	Agreed
2	Regular training of Home economics lecturers and technologists on effective use of modern technologies for instructions.	3.48	0.77	Agreed
3	Provision of steady electricity supply in Nigerian institutions for uninterrupted use of technologies for teaching and learning	3.70	0.72	Agreed
4	Public Private Partnership (PPP) for adequate provision of required learning technologies in schools.	3.58	0.65	Agreed
5	Site tertiary institutions in urban areas to increase the acquisition and use of modern technological devices to teaching and learning.	2.23	0.87	Disagreed
6	Mandatory use of modern technologies for Home economics instruction in schools	3.45	0.62	Agreed
7	Increased incentives to lecturers to own personal computers and other relevant modern learning facilities.	3.57	0.54	Agreed
8	Formulation of educational technology policies by government and school to enhance the use of technologies for teaching and learning.	3.39	0.62	Agreed
9	Donation of computers and other relevant instructional technological facilities to schools by stakeholders and NGOs	3.53	0.67	Agreed
10	Recruitment of ICT-inclined lecturers and technologists to handle Home economics instructions.	3.42	0.49	Agreed
11	Subsidizing the cost of learning technology gadgets for lecturers by the schools management	3.60	0.76	Agreed
12	Subsidizing the cost of learning technology gadgets for students by the schools management	3.51	0.48	Agreed
13	Increased emphasis on sponsoring of lecturers to attend technology related conferences and workshops.	3.54	0.60	Agreed
14	Developing good maintenance culture of educational technology devices by staff and school authorities.	3.48	0.51	Agreed
Pooled Mean		3.44	0.59	Agreed

Note: X = Mean; SD = Standard Deviation.

The mean ratings of the respondents on 13 out of the 14 items in Table 3 ranged from 3.39 to 3.70 which are all greater than the cut-off point value of 2.50 on 4-point rating scale. This indicates that the 13 identified items in the table are strategic approaches for enhancing the teaching of clothing and textile through innovative instructional technologies in tertiary institutions in southwest, Nigeria. Although, the mean value on item 5 in the table was 2.23 which is less than the cut-off point value of 2.50 on 4-point rating scale, indicating that item 5 is not part of the strategic approaches for enhancing the teaching of clothing and textile through innovative instructional technologies. The standard deviation values for the 14 items ranged from 0.48 to 0.87 which signifies that the responses of the respondents are close to one another and the overall mean.

Hypothesis Two

H02: There is no significant difference in the mean ratings of Home economic lecturers in colleges of education and universities on strategic approaches for enhancing the teaching of clothing and textile through innovative instructional technologies.

Table 4: Result of t-test of statistics of significant difference between the mean ratings of Home Economics lecturers in Colleges of Education and Universities on strategic approaches for enhancing the teaching of clothing and textile through innovative instructional technologies

Variables	N	\bar{X}	SD	DF	Std. Error	t-cal	t-tab	Level of sig.	Rmks
COE Lecturers	47	3.43	0.71						
Uni. Lecturers	31	3.45	0.63	76	0.022	0.29	1.96	0.05	NS

Note: NS = Not Significant at 0.05.

The data presented on the t-test statistics in Table 4 show that the t-calculated (t-cal) value of 0.29 is less than the t-critical (t-tab) value of 1.96 at 76 degree of freedom. This indicates that there is no significant ($p < 0.05$) difference in the mean ratings of the responses of Home economic lecturers in colleges of education and universities on strategic approaches for enhancing the teaching of clothing and textile through innovative instructional technologies in tertiary institutions in southwest Nigeria. Consequently, the null hypothesis of no significant ($p < 0.05$) difference in the mean ratings of the responses of the two groups of respondents is upheld on hypothesis two.

Research Question Three: What are challenges confronting the use of innovative instructional technologies for teaching clothing and textiles?

Table 5: Mean ratings of the respondents on challenges confronting the use of innovative instructional technologies for teaching clothing and textiles (N = 78).

SN	Challenges confronting the use of innovative instructional technologies for teaching clothing and textiles include:	\bar{X}	SD	Rmks
1	High cost of procurement and maintenance of technologies in education.	3.33	0.66	Agreed
2	Poor internet connectivity as a major limitation in the use of online technologies in education.	3.58	0.64	Agreed
3	Unstable power supply result in interrupted use of instructional technologies and devices.	3.32	0.52	Agreed
4	Inadequate classroom spaces to accommodate technological devices	2.20	0.82	Disagreed
5	Difficulty in the use of educational technologies in Home economics	3.60	0.76	Agreed
6	The fear of theft of modern instructional technologies and information lost.	3.49	0.50	Agreed
7	Techno-phobia or fear of new technologies by some lecturers is a challenge in educational technology.	3.62	0.66	Agreed
8	General poor maintenance culture of educational technologies and devices.	3.70	0.69	Agreed
9	Fragility of most educational technological devices is a challenge	3.43	0.52	Agreed
10	Poor attitude and disposition of students towards learning with educational technologies	1.72	0.85	Disagreed
11	The challenges of poor battery life span of technological devices affect their uses for teaching and learning.	3.57	0.73	Agreed
12	Poor funding of public schools resulting to inadequacy of needed technologies in education	3.53	0.73	Agreed
13	Inadequate incentives to Home economics lecturers to acquire needed modern technologies for service delivery.	3.62	0.68	Agreed
Pooled Mean		3.29	0.67	Agreed

Note: \bar{X} = Mean; SD = Standard Deviation.

The mean ratings of the respondents on 11 out of the 13 items in Table 5 ranged from 3.32 to 3.70 which are all greater than the cut-off point value of 2.50 on 4-point rating scale. This implies that the 11 identified items in the table are challenges confronting the use of innovative instructional technologies for teaching clothing and textiles in tertiary institutions in southwest Nigeria. On the other hand, the mean values on items 4 and 10 in the table are 2.20 and 1.72 respectively which are in each case less than the cut-off point value of 2.50 on 4-point rating scale. This indicates that items 4 and 10 do not constitute challenges confronting the use of innovative instructional technologies for teaching clothing and textiles. The standard deviation values for the 13 items ranged from 0.50 to 0.85 which indicates that the responses of the respondents are close to one another and the overall mean.

Hypothesis Three

H0₃: There is no significant difference in the mean ratings of Home economic lecturers in colleges of education and universities on the challenges confronting the use of innovative instructional technologies for teaching clothing and textiles.

Table 6: Result of t-test of statistics of significant difference between the mean ratings of Home Economics lecturers in Colleges of Education and Universities on the challenges confronting the use of innovative instructional technologies for teaching clothing and textiles.

Variables	N	\bar{X}	SD	DF	Std. Error	t-cal	t-tab	Level of sig.	Rmks
COE Lecturers	47	3.32	0.64						
Uni. Lecturers	31	3.27	0.73	76	0.030	0.42	1.96	0.05	NS

Note: NS = Not Significant at 0.05.

The data presented on the t-test statistics in Table 6 reveal that the t-calculated (t-cal) value of 0.42 is less than the t-critical (t-tab) value of 1.96 at 76 degree of freedom. This indicates that there is no significant ($p < 0.05$) difference in the mean ratings of the responses of Home economic lecturers in colleges of education and universities on the challenges confronting the use of innovative instructional technologies for teaching clothing and textiles in tertiary institutions in southwest Nigeria. Hence, the null hypothesis of no significant ($p < 0.05$) difference in the mean ratings of the responses of the two groups of respondents is accepted on hypothesis three.

Discussion of Findings

The study identified innovative instructional technologies for teaching clothing and textiles to include: audio visual such as projectors, engagement of mobile learning devices such as phones, ipad etc, video conference, computer programmes and software to complement home economics teaching, smart phones, Laptops MP3 players and E-book readers, Computer Based Test (CBT) in clothing and textiles assessment and AUTOCAD for clothing and textiles instruction among others. This finding corroborated that of Nendum-Ogbede (2016) who identified modern technologies to facilitate teaching and learning to include: projectors, e-mail, smart boards, mimeo boards, teleconferencing, video conferencing, e-book reader and streaming videos.

This study identified strategic approaches for enhancing the teaching of clothing and textile through innovative instructional technologies to include: adequate provision of fund by school management for procurement of educational technology devices, regular training of Home economics lecturers and technologists on effective use of modern technologies for instructions, provision of steady electricity supply in Nigerian institutions for uninterrupted use of technologies for teaching and learning, Public Private Partnership (PPP) for adequate provision of required learning technologies in schools, mandatory use of modern technologies for Home economics instruction in schools, increased incentives to lecturers to own personal computers and other relevant modern learning facilities, formulation of educational technology policies by government and school to enhance the use of technologies for teaching and learning and recruitment of ICT-inclined lecturers and technologists to handle Home economics instructions among others. The findings conformed with the result of Okoro (2013) who identified adequate funding of ICT facilities, provision of adequate ICT equipment by school authorities, provision of adequate ICT facilities, provision of adequate electricity supply, proper implementation of ICT policies, employment of adequate qualified ICT teachers, reduction in cost of ICT facilities, reduction in cost of

ICT equipment and sponsoring of lecturers to attend workshops/seminars as strategies for enhance use of ICT facilities for teaching. Similarly, the findings of the study agreed with that of Onojetah (2019) who identified adequate provision of fund by school management, organizing regular workshops/seminars for training lecturers and technologists on effective use of learning technologies, and proper implementation of ICT policies by school authorities as measures for promoting the use educational and mobile learning technologies.

This study identified the challenges confronting the use of innovative instructional technologies for teaching clothing and textile to include: high cost of procurement and maintenance of technologies in education, poor internet connectivity as a major limitation in the use of online technologies in education, unstable power supply result in interrupted use of instructional technologies and devices, inadequate classroom spaces to accommodate technological devices, difficulty in the use of educational technologies in Home economics, the fear of theft of modern instructional technologies and information lost, techno-phobia or fear of new technologies by some lecturers is a challenge in educational technology and general poor maintenance culture of educational technologies and devices. The findings agreed with the findings of Amiaya and Ranor (2015) who identified the challenges to the use of modern learning technologies in education as: connectivity and battery life span are common phenomena, accessibility and cost barriers for end users are common, durability and obsolescence of the handheld devices, subject of mobility in the content of mobile learning is a challenge.

Conclusion

The strategic role of innovative technologies in instructional delivery is paramount. Hence, this study examined strategic approaches for enhancing innovative instructional technologies for teaching clothing and textile in southwest Nigeria. Through the data collected and analysed, the study identified 10 innovative instructional technologies for teaching clothing and textile, 13 strategic approaches for enhancing the teaching of clothing and textile through innovative instructional technologies and 11 challenges confronting the use of innovative instructional technologies for clothing and textile instruction. The findings of the study on hypotheses tested showed no significant difference in the mean ratings of Home economic lecturers in colleges of education and universities.

Recommendations

Based on the findings and conclusion, the study recommended that:

- i. There should be adequate funding and provision for modern and contemporary educational technology facilities in Nigerian schools and colleges.
- ii. There should be continuous training and retraining of Home economics lecturers for effective use of learning technologies for quality instructional delivery in Nigerian tertiary institutions.
- iii. The current epileptic power supply to Nigerian schools should be addressed to guarantee effective use of technologies for educational purposes.

References

Akubue, B. N and Chukwu, L. N. (2016). Uses of Information and Communication Technology in Teaching and learning of Clothing and Textiles in Ebonyi State University. *British Journal of Education*, 4 (8): 44 – 51.

Amiaya, A. O and Ranor, C. L. (2015). Challenges and Benefits of Mobile learning Adoption in OTM Programme in Delta State Polytechnics. *American International Journal of Contemporary Research*, 5 (4): 85 – 91.

Anyakaha, E. U and Eluwa, M. (2008). Home Management for secondary schools and colleges, African first publishers Ltd.

Apreala, I. (2013). Challenges in Using Information and Communication Technology (ICT) for Teaching and Learning Financial Accounting in Tertiary Institutions in Rivers and Bayelsa States. *Unpublished Masters Project* submitted to Department of Vocational Teachers Education, University of Nigeria, Nsukka.

Arubayi, D. O. (2010). Students' Appraisal of the Quality of Instruction in Clothing and Textiles in Tertiary Institutions in Delta State. *An International Multi-Disciplinary Journal, Ethiopia*, 4 (3): 195 – 205.

Arubayi, D.O (2009) "Appraising Instructional Materials and Evaluation Strategies in the Teaching of Clothing and Textiles, *Studies on Home and Community Science, India*, 3(1): 25 – 28.

Federal Ministry of Education (2010). *National Policy on Information and Communication Technologies (ICT) in Education*. Abuja: FME.

Igbo, C. A. (2001). Employment opportunities in Textiles Industry for Senior Secondary graduates. E.U. Anyakoha (Ed). *Research Imperative and challenges for Home Economics in Nigeria*. (145 – 154), Nsukka: Home Economics Research Association of Nigeria.

Iyere, F. O and Orumwense, F. A (2004). Home Economics Education: Vocation for Self Reliance. *Journal of Knowledge Review*: 8 (1): 104 - 106.

Khurshid, F and Ansari, U (2012). Effects of Innovative Teaching Strategies on Students' Performance. *Global Journal of Human Social Science Linguistics & Education*, 12 (10): 47 – 54.

Nedum-Ogbede, P. O. (2016). New Technologies in Business Education: Challenges and the Way Forward. *Nigerian Journal of Business Education (NIGJBED)*, 3 (2): 104 – 111.

Nworgu, B. G. (2015). Educational Research: Basic issues and methodology (3rd ed.) Nsukka: University trust publishers.

Oketoobo, E. A. (2020). The Significance of Basic Information and Communication Technology (ICT) Aptitudes of Agricultural Science Teachers for Career Guidance of Secondary School Students in Oyo State, Nigeria. Department of Agricultural and Home Economics Education, Michael Okpara University of Agriculture Umudike, Abia State, Nigeria.

Okoro, J. (2013). Strategies for Enhancing the Teaching of ICT in Business Education Programmes as Perceived by Business Education Lecturers in Universities in South South Nigeria. *International Education Studies*, 6 (10): 78 – 89.

Olubiyi, I. A., Olaniyan, A. J and Odiaka, N. (2015). The Role of Technology in the Advancement of Legal Education and Practice in Nigeria. Retrieved 20th May, 2020 from <https://www.researchgate.net/publication/280566346>

Onojeta, S. O. (2019). The Significance and Challenges of Effective Utilization of Mobile Learning Technologies in Business Education Instruction in Edo State, Nigeria. Unpublished Manuscript, Department of Vocational Education (Business Education), Delta State University, Abraka.

Rouse, M. (2019). Survey Research. Retrieved 11th March, 2020 from <https://www.whatis.techtarget.com>

Sani, I. D. (2011). Effects of Computer Assisted Concept Mapping and Digital Video Instruction on Students Achievement in Chemistry. An Unpublished Ph.D Thesis submitted to the Department of Arts Education, University of Nigeria, Nsukka.

FANS-MEDIA FACTORS INFLUENCE ON FOOTBALL CLUBS PERFORMANCE AT THE NIGERIA NATIONAL LEAGUE

Ayobami A. OKUNDARE, Isaac A. OYEWUNMI, Saidi DAUDA & S. ALIU

Department of Human Kinetics and Health Education,
Olabisi Onabanjo University Ago-Iwoye, Ogun State, Nigeria
daudaaliu15@gmail.com

ABSTRACT

Fans-media interactions have positively impacted European Football leagues and football clubs performance. However, Nigeria football leagues have not been significantly impacted by fans-media relations due to improper handling of social media fans interaction by Nigeria National league football clubs (NNL). This study investigates how fans-media factors influence on football clubs performance at Nigerian National League (NNL). Specifically, it aims to understand how fans engage with these clubs across different social media platforms and to determine the impact of this engagement on club performance. Survey research design was adopted in this study. The study sample comprised of One Thousand One Hundred and Ninety-Nine participants, drawn randomly across five (5) clubs (Gateway united FC, Crown FC, Ekiti United, Vandrezzer FC, and Osun united FC). They were the Football Clubs that participated in NNL for the 2020-2021. Data were collected using Sport Spectator Identification Scale ($r=0.84$). Data were analysed using descriptive statistics of mean percentage and standard deviation and inferential statistics of regression analysis. The study found that YouTube, Facebook and Snapchat are the most significantly social media platforms among NNL football fans during the 2020-2021 NNL football clubs league season. The study also found a significant level of trust in the fans-media relations between the supporters and the NNL football clubs. In addition, there is a significant influence of fans-media composite on performance of the NNL football clubs during the 2020-2021 league season. The study concluded that fans-media factors significantly influence Nigerian National League (NNL) football clubs' performance. Based on these findings, it was recommended that Nigerian National League (NNL) football clubs should prioritise and invest in fans-engagement strategies across various social-media platforms.

Key Words: Nigerian National League, Football Clubs, Fan-Media Factors, Social Media, Fan Engagement.

Introduction

The performance of football clubs, particularly in the Nigerian National League (NNL), encompasses various dimensions such as on-field success, financial stability, fan engagement, and overall club management. Performance is not only about winning matches but also about sustaining a club's reputation, generating revenue, and maintaining a loyal fan base. Ogunleye (2018) and Eze (2019) argue that a football club's performance is a holistic measure that includes competitive success, operational efficiency and the ability to engage with stakeholders, particularly fans and the media. Fan engagement and media coverage, collectively referred to as the "FAN-MEDIA" factor, is increasingly recognized as a critical determinant of football club performance in the NNL. Fan engagement refers to the emotional and transactional relationship between the football club and its supporters. This engagement is vital as it drives ticket sales, merchandise purchases, and overall club visibility. Media coverage, on the other hand, amplifies the club's presence beyond the stadium, reaching a wider audience through various platforms such as television, radio, and social media.

Okeke (2020) and Udeh (2021) highlight that fan loyalty and media attention can significantly enhance a club's performance by increasing its marketability and attractiveness to sponsors. When fans are deeply engaged, they are more likely to attend matches, purchase club merchandise, and participate in club activities, which in turn boost the club's financial performance. Similarly, positive media coverage can enhance the club's image, attract new fans, and provide a

platform for the club to communicate with its stakeholders effectively. The importance of the FAN-MEDIA factor in the NNL is further underscored by research from Nwosu (2018), who found that clubs with strong fan bases and robust media strategies tend to perform better both on and off the field. Nwosu argues that fan engagement leads to a positive feedback loop where increased fan support drives better performance, which in turn attracts more media attention, further boosting fan engagement. This cycle is crucial for sustaining long-term success in the competitive environment of the NNL.

Moreso, Adebayo (2019) stated that media coverage can significantly influence a club's performance by shaping public perception and enhancing the club's brand value. Media outlets play a pivotal role in amplifying the club's achievements, thus attracting more fans and potential sponsors. Adebayo (2109) further indicates that clubs that invest in media relations and fan engagement strategies tend to outperform those that do not, as these factors contribute to creating a positive and vibrant club culture. Furthermore, Ojo and Adeola (2020) emphasize the role of social media as a modern tool for enhancing fan engagement and media presence. They argue that social media platforms provide an accessible and cost-effective way for clubs to interact with fans, share updates, and build a global fan base. This digital interaction not only strengthens the relationship between the club and its supporters but also provides valuable data that can be used to tailor marketing strategies and improve fan experience, thus positively impacting club performance.

In the Nigerian context, the FAN-MEDIA factors are particularly important due to the passionate nature of football fans and the growing influence of media in sports. Okafor (2019) and Nwachukwu (2020) note that Nigerian football fans are highly invested in clubs, and support can make a significant difference in a club's success. The media, on its part, plays a crucial role in shaping narratives around clubs, influencing public opinion, and driving the popularity of the sport in the country. Adeyemi (2021) suggests that the performance of NNL clubs is often directly linked to the level of fan engagement and media coverage they receive. Clubs with a large and active fan base tend to have more consistent performances, as the support from fans provides a psychological boost to players and creates a formidable home advantage. Adeyemi also notes that media coverage can either positively or negatively impact a club's performance depending on the nature of the coverage, highlighting the need for clubs to actively manage their media relations. The findings of Eze and Nnamdi (2020) further highlight the symbiotic relationship between fans and media in influencing club performance. They argue that while fans drive media content through their engagement and interactions, the media, in turn, amplifies fan voices and promotes club activities. This mutually reinforcing relationship is crucial for building a strong club identity and achieving sustained success.

The advent of the Internet fundamentally altered how people consume information. People with Internet access can quickly browse millions of websites for relevant news and information without having to pay for a newspaper subscription or watch television news. The Internet is also simple to use; all one needs to do is enter a few phrases into a search engine and click the search button to get hundreds of results that might be of interest. The exponential expansion and popularity of the Internet are most likely due to this feature's usability. Thus, staying connected with their preferred football team has become easier for fans with the help of modern communication tools. Football teams are now creating branded content to engage with fans. This process may involve creating promotional videos, participating in Facebook Live sessions, or documenting the behind-the-scenes of events. Many clubs showcase scintillating examples of their work on YouTube. Fan-media interaction has become a popular trend among sports clubs.

Statement of the Problem

Fans media interaction have positively impacted Football leagues and football club's performance especially in European football. Nigeria football leagues have not been significantly impacted by fans media relation due to improper handling of social-media fans interaction by Nigeria National League Football Clubs (NNL). NNL football clubs have failed to generate required income through live streaming of their football matches via-social-media. Adequate funds could be generate by NNL football clubs through live matches live streaming or various social-media platforms. However, NNL football clubs have not been generating funds through social-platforms. European football clubs generate large percentage of income for the football clubs and used social-media fans interaction feedbacks as a tool for their football clubs, NNL clubs have failed to use fans social-media interaction as communication avenue for feedback response that can improve their football clubs performance in different competition usually don't update their website and social-media frequently for proper information dissemination among football club and fans which can lead to improvement in football club performance at various competitions.

Research Questions

The following research questions were raised and answered in this study

1. What is the ranking of social media outlets used by NNL football clubs' fans?
2. What is the commitment of NNL Football clubs of human resources to manage fan-media during the 2020-2021 league season?

Methodology

The study adopted survey research design. Sample size consists of one thousand five hundred (1500) respondents. The population for this study comprised five football clubs from Nigerian National League (NNL) during the 2020/2021 league season in South West and their fans. Gateway United FC (Ogun), Crown FC (Oyo), Ekiti United FC (Ekiti), Vandrezzer FC (Lagos) and Osun United FC (Osun). Sport Spectator Identification Scale (SSIS) developed by Wann and Branscombe (1993) and a self-developed questionnaire tagged Football Club Fan-Media Operations Assessment Instrument to examine the clubs' fan-media practices and their performance were the instruments used for this study. The descriptive statistics of simple frequencies (f), percentages (%) and mean (\bar{x}) were used to analyze the demographic characteristics of the respondents. In testing the stated research questions, the inferential statistics and multiple regression analysis were used.

RESULTS

Research Question One: What is the ranking of social media outlets used by NNL football clubs' fans?

Table 1. Spearman Correlation showing the ranking of social media outlets used by NNL football clubs' fans

S/N	Social Media Outlet	Ranking	Correlation	Remark
1	Twitter	4 th	0.196*	P < 0.05
2	Facebook	5 th	0.112*	P < 0.05
3	Instagram	3 rd	0.205*	P < 0.05
4	YouTube	1 st	0.498*	P < 0.05
5	Snapchat	2 nd	0.264*	P < 0.05

Table 1 present the result of Spearman's Rank correlation analysis showing whether NNL football clubs' fans would not rank any of the social media outlets of: Twitter, Snapchat, YouTube, Facebook and Instagram significantly higher than the others for their fan-media relationship during the 2020-2021 league season. Findings above indicate a significant outcome. This outcome implies that YouTube was rank highest with correlation ($r = 0.498$), this was followed by Snapchat with correlation ($r = 0.264$). Similarly, Instagram was rank 3rd with correlation ($r = 0.205$), and twitter was rank 4th with correlation ($r = 0.196$), while Facebook was rank lowest with correlation ($r = 0.112$). These findings underscore the importance for NNL football clubs to strategically allocate resources and tailor content across various social media platforms based on fan preferences and engagement patterns. While YouTube and Snapchat appear to be particularly influential for fan-media relationships, clubs should not disregard the potential impact of platforms like Instagram and Twitter, while reassessing the effectiveness of Facebook in reaching and engaging with their fan base. Adaptation to evolving social media trends and preferences is essential for maintaining a strong fan base and maximizing fan engagement in the digital age.

Research Question Two: What is the commitment of NNL Football clubs human resources to manage fan-media during the 2020-2021 league season?

Table 4.7: Descriptive Analysis on the commitment of NNL Football clubs human resources to manage fan-media during the 2020-2021 league season

	Statements	SA	A	D	SD	Mean	SD
1	.NNL football clubs with dedicated human resources for fan-media relations are more likely to establish and maintain a positive and engaged fan community	.519 (43.1%)	559 (46.6%)	123 (10.3%)	0 (0.0%)	3.33	0.65
2	.Allocating a specialized team to manage fan-media relationships is important for NNL football clubs to effectively handle the diverse demands and expectations of their fan base	.518 (43.2%)	479 (39.9%)	202 (16.8%)	0 (0.0%)	3.26	0.73
3	.Investing in human resources for fan-media relations is unnecessary, as effective communication foster a strong connection between clubs and fans	.354 (29.5%)	483 (40.3%)	204 (17.0%)	158 (13.2%)	2.86	0.99
4	.Having social media specialists within the human resources allocated to fan-media relations is crucial for NNL football clubs to navigate and leverage the evolving landscape of online platforms	.439 (36.6%)	601 (50.1%)	159 (13.3%)	0 (0.0%)	3.23	0.67
5	.Regular training and development programs for the human resources management of fan-media relationships are essential to stay updated with the latest trends and best practices	445 (37.1%)	672 (56.0%)	41 (3.4%)	41 (3.4%)	3.27	0.69
6	.Allocating minimal resources to fan-media relations is unacceptable for NNL football clubs, as it may lead to missed opportunities for engagement and community building	.163 (13.6%)	510 (42.5%)	444 (37.0%)	82 (6.8%)	2.66	0.88
7	.Having a designated spokesperson or liaison within the human resources team enhances communication and transparency between NNL football clubs and their fan base	.635 (53.0%)	482 (40.2%)	82 (6.8%)	0 (0.0%)	3.46	0.62
8	.Regularly evaluating the performance and effectiveness of the human resources dedicated to fan-media relations is crucial for NNL football clubs to adapt and optimize their strategies	.445 (37.1%)	632 (52.7%)	81 (6.8%)	41 (3.4%)	3.24	0.72

Criteria Mean =2.50 ; Average Mean = 3.16

Table 2 present the descriptive statistics showing whether NNL football clubs would commit significant human resources to manage fan-media relations during the 2020-2021 league season. Findings above indicated that NNL football clubs commit significant human resources to manage their fan-media relationship during the 2020-2021 league season. This is because, the criteria mean of 2.50 is lesser than the average mean of 3.16. However, the respondents perceived the commitment of NNL football clubs in terms of human resources to manage their fan-media relationship during the 2020-2021 league season highest on the statement that says “Having a designated spokesperson or liaison within the human resources team enhances communication and transparency between NNL football clubs and their fan base”(Mean = 3.46). This was followed by the statements that says “NNL football clubs with dedicated human resources for fan-media relations

are more likely to establish and maintain a positive and engaged fan community" (Mean = 3.33), then by "Allocating a specialized team to manage fan-media relationships is important for NNL football clubs to effectively handle the diverse demands and expectations of their fan base" (Mean = 2.66). However, it was perceived lowest on the statement that says" Allocating minimal resources to fan-media relations is unacceptable for NNL football clubs, as it may lead to missed opportunities for engagement and community building" (Mean = 2.66), then by "Investing in human resources for fan-media relations is unnecessary, as effective communication foster a strong connection between clubs and fans"(Mean = 2.86). In a nut shell, findings above showed that NNL football clubs committed significant human resources to manage their fan-media relationship during the 2020-2021 league season.

Discussion of Findings

Findings suggest that fans of NNL (Nigerian National League) football clubs had a distinct preference for certain social media platforms over others when it came to engaging with fan-media content during the 2020-2021 league season. Recent observations suggest that platforms like YouTube and Snapchat wield significant influence in nurturing fan-media relationships. Research by Smith and Jones (2020) found that football clubs experienced a positive correlation between their YouTube presence and fan engagement metrics, indicating the platform's effectiveness in cultivating a loyal fan following. Similarly, Snapchat's real-time and ephemeral nature presents unique opportunities for clubs to connect with fans on a more personal level. The platform's interactive features and behind-the-scenes content provide fans with exclusive glimpses into the inner workings of their favorite clubs, fostering a sense of intimacy and belonging. Johnson and Brown (2021) noted a notable surge in fan interaction and brand affinity among football clubs that actively leveraged Snapchat as part of their social media strategy, however, while YouTube and Snapchat emerge as frontrunners in fan engagement, football clubs must not overlook the potential of platforms like Instagram and Twitter. Instagram's visually-driven interface and Twitter's real-time updates remain integral components of the social media landscape, catering to diverse audience preferences and communication styles. Kantar (2023) report highlighted the continued relevance of Instagram and Twitter in facilitating fan interaction and brand advocacy for sports organizations. Additionally, as Facebook's user demographics shift and organic reach declines, football clubs face the challenge of optimizing their Facebook presence to maintain relevance among specific segments of their fan base. While the platform may no longer be the primary focus for younger audiences, Nielsen Sports' analysis (2020) suggests that Facebook still holds value for engaging older demographics and fostering community engagement within established fan networks. In light of these observations, football clubs, including those in the NNL, must adapt their social media strategies to capitalize on the strengths of each platform while remaining agile in response to evolving trends. By diversifying their content strategy, optimizing platform effectiveness, and embracing emerging technologies, clubs can cultivate a robust fan base and maximize fan engagement in the digital age.

Furthermore, it was gathered that NNL football clubs would not commit significant human resources to manage their fan-media relationship during the 2020-2021 league season. The findings indicated that NNL football clubs allocated substantial human resources to manage their fan-media relationships during the 2020-2021 league season have several implications for both clubs and the broader sports industry. This allocation of resources underscores the strategic importance placed on fan engagement and media communication within football clubs. Findings were in line with the work of Garcia and Rodriguez (2017) who posited that the commitment of significant human resources highlights the recognition by NNL clubs of the critical role played by fan-media relationships in modern sports marketing and branding strategies. Academic research emphasizes the importance of cultivating strong relationships with fans through various media channels to foster loyalty and support (Smith et al., 2020). By dedicating personnel to manage these relationships, clubs aim to ensure consistent and meaningful engagement with their fan base.

Findings was also in agreement with that of Jones and lee (2020) who pointed out that the allocation of resources to fan-media relationships reflects clubs' acknowledgment of the evolving nature of media consumption in the digital age. With the proliferation of social media platforms and digital technologies, fans now have greater access to club-related content and expect more personalized and interactive experiences (Jones & Lee, 2020). By investing in skilled personnel to manage these interactions, clubs can effectively navigate the complexities of the digital landscape and meet the diverse needs and preferences of their fan base.

Conclusion

Based on the findings from the study it was concluded that NNL football clubs should leverage on social media platforms effectively in fostering fans engagement. The significant preference of fans for specific social media outlets highlights the need for clubs to tailor their communication strategies to meet the preferences of their fan base. By prioritizing platforms where fans are most active and engaged, clubs can maximize the impact of their fan-media relationships. Also, the

commitment of significant human resources to manage fan-media relationships demonstrates the strategic importance placed on fan engagement by NNL football clubs. By dedicating personnel and expertise to effectively engage with fans and media outlets, clubs can optimize their communication strategies and maximize the benefits of fan support. Furthermore, building trust is crucial for fostering positive relationships and enhancing fan engagement with the club. Additionally, the findings suggest a significant influence of the fan-media relationship on both training and competition performances of NNL football clubs.

Recommendations

The following recommendations were made based on the findings of this study.

- i. NNL football clubs should tailor their communication strategies to align with fan preferences on different social media platforms. By understanding which platforms fans prefer for engaging with the club, clubs can allocate resources more effectively and ensure they deliver content that resonates with their audience
- ii. Recognizing the significant commitment of human resources required to manage fan-media relationships, clubs should allocate dedicated personnel and expertise to fan engagement initiatives. By investing in skilled professionals, clubs can optimize their communication strategies and maximize the benefits of fan support.
- iii. Prioritize trust-building efforts with fans and media outlets by maintaining open communication channels, responding promptly to inquiries and feedback, and demonstrating authenticity in their interactions.
- iv. Recognizing the influence of the fan-media relationship on training and competition performances, clubs should integrate fan engagement strategies into their performance management systems. By fostering a supportive and motivating environment through fan support, clubs can enhance player morale and confidence, ultimately improving on-field results.

REFERENCES

Adebayo, A. (2019). Media coverage and football club performance in Nigeria. *Journal of Sports Management*, 12(3), 145-158.

Adeyemi, T. (2021). Fan engagement and its impact on football club success: Evidence from the Nigerian National League. *African Journal of Sports Studies*, 18(2), 112-127.

Eze, N. (2019). The role of fan loyalty in enhancing football club performance in Nigeria. *Nigerian Journal of Sports Science*, 9(4), 301-315.

Eze, P., & Nnamdi, O. (2020). The symbiotic relationship between fans and media in Nigerian football: Implications for club performance. *International Journal of Sports Marketing and Sponsorship*, 22(1), 56-72.

Ogunleye, B. (2018). Football club performance in Nigeria: A multi-dimensional approach. *Journal of Sports and Social Sciences*, 13(4), 178-192.

Ojo, T., & Adeola, M. (2020). Leveraging social media for fan engagement in Nigerian football clubs. *African Journal of Digital Media and Sports*, 6(2), 149-164.

Okafor, J. (2019). The passion of Nigerian football fans: A critical analysis of its impact on club performance. *Journal of African Sports Culture*, 5(3), 89-105.

Okeke, C. (2020). The impact of media on the commercialization of football in Nigeria. *Journal of Sports Economics and Management*, 10(2), 223-238.

Nwachukwu, C. (2020). Football fandom in Nigeria: The influence of media and fan support on club performance. *Nigerian Journal of Communication and Media Studies*, 7(2), 203-218.

Nwosu, O. (2018). Fan engagement and media strategies as determinants of football club success in Nigeria. *Journal of Nigerian Football Studies*, 11(1), 34-48.

Udeh, P. (2021). Media relations in sports: The case of Nigerian football clubs. *Journal of African Communication Research*, 14(3), 194-209.

Wann, D. L., & Branscombe, N. R. (1993). Sports fans: Measuring degree of identification with their team. *International Journal of Sport Psychology*, 24(1), 1-17.

EFFECT OF CONTEXT-BASED LEARNING ON STUDENTS' ACADEMIC ACHIEVEMENT IN SENIOR SECONDARY SCHOOL BIOLOGY

Margaret Abisola AYANWANDE, Uchenna UDEANI & Racheal, O. OKUNUGA

Department of Science Education

University of Lagos, Akoka

ayanwandeabisola@gmail.com

ABSTRACT

Biology is one of aspects of science that study living things in their environment and is an on-going science process that allows scientists and students to conduct scientific investigations which are very useful in discovering new things. However, students' achievement is not encouraging. Researchers have therefore pointed out the need for the adoption of student-centred instructional strategies to address this problem. Literature have recognized the use of many strategies in enhancing students learning outcomes in other science subject but few studies have been carried out on students' academic achievement in biology using context-based learning. This study, therefore, examined the effect of context-based learning on secondary school students' academic achievement in biology in Lagos State. The moderating effect of gender was also investigated. The research design is a pretest-posttest non-equivalent control group quasi-experimental design. Two schools were selected from the Kosofe Local Council by random sampling. Four intact classes of SS1 students were selected from each of the schools. A total of 294 students participated in the study. Students were randomly assigned to context-based learning and control group. The study lasted for 5 weeks. The Biology Achievement Test (BAT) research instrument was used for the study. The reliability of the instrument was established using the Kuder-Richardson Formula 20 (KR-20) which produced a reliability coefficient of **0.713**. Two null hypotheses were tested at 0.05 level of significance. Analysis of covariance and Scheffe post hoc test were used to analyses data. The ANCOVA result revealed a significant effect of treatment on students' academic achievement in biology, $F (2, 459) = 341.45, p < .001$, with a large effect size, partial $\eta^2 = .598$. The two-way interaction effect of treatment and gender on student learning outcomes was not significant. Context-based learning enhances students' academic achievement. Context-based learning strategies should therefore be adopted in teaching of biology in senior secondary school.

KEYWORD: Academic Achievement, Biology, Context, Context-based learning.

Introduction

Biology is one of vital science subjects which provide contents, skills and habit of mind in the training of students who want to study science- related careers. Learning of biology is very important to secure a well-paid job in many science- related careers such as nursing, agriculture, pharmacy. Also, biologists desire and strive to understand how the world work following a systematic methodology based on evidence. The purpose of teaching and learning science is to master the basic principle of biology, as well as organizing the scientific method that is based on scientific attitude to solve problems and to understand the natural world (Suryawati and Osman 2018).

It is extremely important for schools to develop students' understanding. Understanding is at the basic level of cognition. If students are well –nurtured with the basic level of cognition, they will not have difficulty in reaching higher cognitive level (Kamulzanan et al, 2017). Understanding is therefore a vital factor in achieving learning outcomes such as academic performance which is one of the ultimate learning outcomes in science education. Abebe (2024) defined conceptual understanding as having a deep flexible and justified grasp of the basic scientific principles, aptitudes and generalizations with rich links and connections, as well as being able to use and apply them to different domains of environmental science. Conceptual understanding improves retention because students who understand concepts are more likely to retain information and remember it when needed.

Academic achievement can be defined as students' test score as measured by the grades obtained. Performance in science course including biology can be early predictor of students' interest to pursue further in science related field. When students understand science concepts and perform well, they may stay motivated to study science. However, conventional method of teaching, traditionally based lecture and expository methods focus on transmission of excessive out-of-context information to students (Abebe 2024). Cabbar and Senel (2020) noted that students generally study out of context topics for examination. Students may likely forget abstract information since they are not given opportunity to actively engage with learning activities which may lead to lack of conceptual understanding. Ural (2020) revealed that transmitting scientific facts with fewer activities is not enough to develop conceptual understanding. According to Fikadu et al (2019), lack of conceptual understanding may undermine students' performance in procedural understanding test. Lack of conceptual understanding has really weakened students' performance in Nigeria secondary school in biology. Researches have shown that academic achievement of biology students over the years in science subjects remain discouraging and inconsistent in the senior certificate examination (WAEC 2018, 2019, 2020, 2021, 2022). The table below shows inconsistent performance of students across all the three science subjects biology, chemistry, and physics in the May/June 2014-2022 West African Senior School Certificate Examinations in Nigeria.

Table 1: Performance of students in the May/June 2014-2022 West African Senior School Certificate Examinations for biology, chemistry, and physics in Nigeria

Year	Biology total sat	credit pass	% pass at credit level	Chemistry total sat	credit pass	% pass at credit level	Physics total sat	credit pass	% pass at credit level
2014	1,365,384	766,971	56.17	636,268	397,649	62.49	635,729	386,270	60.76
2015	1,390,234	798,246	57.42	680,357	412,323	60.60	684,124	410,543	60.01
2016	1,200,367	740,345	61.68	706,873	408,122	57.74	705,125	415,655	58.95
2017	580,449	394,898	68.03	377,970	320,632	84.83	377,851	205,757	54.45
2018	1,087,063	679,299	62.48	728,551	424,231	58.22	728,354	571,687	78.49
2019	1,003,304	775,103	75.01	726,132	566,156	77.96	725,853	565,746	77.94
2020	1,051,447	874,237	84.08	756,101	674,361	89.89	755,772	634,400	84.61
2021	1,039,912	913,463	89.23	769,642	649,535	85.44	768,613	663,949	87.44
2022	1,057,577	699,430	66.69	806,579	527,433	65.78	805,948	502,172	62.65

Unsuitable teaching method and strategies like conventional method of teaching, traditionally based lecture and expository methods have been identified as one of the factors that contribute to students' poor performance (Oladipo & Akhigbe, 2022). Science education profession has a direct responsibility to make male and female students equally fulfil their cognitive potential in science. Science education also works toward anti-bias teaching. Gender equity means ensuring all students of all sex have full opportunity to become successful science learner. Science education believes that all gender identity is valid. Gender equity is essential to the advancement of science and to the achievement of science literacy. Gender refers to the social/cultural construct, characteristics and roles which are ascribed to male and female in any society. Gender stereotyping is a collection of commonly held beliefs about what are appropriate characteristics, behaviours and activities for male and for female in any society. Abuh (2021) revealed that traditional learning environment greatly encourages gender stereotyping because of role and activities ascribed to male and female students in the classroom. The roles which are ascribed to male help them in the learning process and academic achievement while female are excluded in the learning activities which make

them experience discouragement. This may lead to poor academic achievement. Kang (2022) reported that recent studies keep indicating that girls possess a lower interest in science compared to boys.

Context-based learning is one of the constructivist approaches that can improve students' performance. Context-based learning is a method of teaching where context is used as a teaching strategy to provide background information to adequately illustrate biology topics. Context can be used as background information to illustrate, gives meaning, illuminates and explains concepts in biology. Cabbar and Senel (2020) noted that in teaching, context helps to examine the situation of the concepts and to present it from different aspects of relationship. Context makes abstract concepts relevant so that the relevance between daily life and the concepts will be experienced by the students. CBL changes the role of student and teacher by placing students' activity at the centre of teaching process (Bacay and Herrera, 2020). The teaching environment in this way is seen as a stimulating factor for students for effective learning and understanding

Context-based learning is a learning technique that enables the transfer of knowledge by associating the subject covered by the teacher with daily life. Associating subject with daily life has an important place in developing understanding of science course (Karasubasu, 2023). Abebe (2024) noted that context-based learning encourages group work which allows students share ideas, opinion listen to what others will say and gain collective knowledge. Gaining collective knowledge can impact students' performance positively. Cabbar and Senel (2020) noted that connecting an abstract topic with daily life will increase the permanence of information. Context-based teaching approach used in the study comprising of Orientation, Elicitation of ideas, Restructuring of idea, Application of idea and Review change in ideas.

Phase 1: Orientation

The introduction of real-life situations as orientation to learners was meant to provide a reason for teaching new scientific concepts) and to provide a setting of real-life experiences.

Phase 2 Elicitation of ideas

Engage students in question-and-answer sessions to establish student previous knowledge and alternative ideas.

Phase 3 restructuring of idea

Construction of new ideas and evaluation.

Phase 4: Application of idea

In the final phase, learners were given tasks that required them to apply the concepts they had learned to already discuss situation at the orientation stage and new situations. The tasks involved applying content learnt to in resolve science related problem.

Phase 5: Review change in ideas

The phase was further intended to provide educators with feedback on the effectiveness of the learning cycle in enhancing conceptual understanding.

Based on the WAEC chief examiner report showing inconsistent academic performance of students in biology, especially in some selected topic like ecology, it is necessary to investigate the effect of context based learning on biology students' academic achievement in biology probably this would improve the academic achievement of students in biology.

Statement of the Problem

Researches have shown that academic performance of students over the years in science subjects remain discouraging and inconsistency in the senior certificate examination (WAEC 2018, 2019, 2020, 2021, 2022). When students perform poorly, they may no longer stay motivated to study science. Hence, there is need to investigate the effect of context-based learning on biology students' academic performance in carbon cycle.

The specific objectives of the study

1. Examine the effect of context-based learning and the conventional lecture method on students' academic achievement in biology.
2. Examine the interaction effect of context-based learning and gender on students' academic achievement in biology.

Research Questions

Based on the stated objectives, the following research questions were raised to guide the study:

1. What is the effect of treatment and conventional lecture method on students' academic achievement in biology?
2. What is the interaction effect of treatment and gender on students' academic achievement in biology?

Research Hypotheses

The study tested two null hypotheses at 0.05 % level of significance in the study:

H₀₁: There is no significant effect of context-based learning on students' academic achievement in biology

H₀₂: There is no interaction effect of context-based learning and gender on students' academic achievement in biology

Methodology

The study adopted a pretest-posttest, non-equivalent control group, quasi-experimental design. Treatment group is context-based learning while the control group is conventional lecture method. Dependent variable includes students' academic achievement in biology.

Participant

The participants in the study are biology students selected from two public co-educational senior secondary schools in educational district 2 Lagos State. Context based learning consists of 148 students from four intact classes while the control group consists of 146 students from four intact classes. The students in experimental group were taught using context-based learning, while those in control group were exposed to the conventional lecture method of teaching.

Instrument for data collection

Instruments used for the study is Biology Achievement Test (BAT). BAT was prepared by the researcher through the objectives of the topics of carbon cycle, air pollution and oxygen-carbon balance. Questions related to carbon cycle, air pollution and oxygen-carbon balance were adopted and modified from Programme for International Student Assessment (PISA) and United State Environmental Protection Agency, (US EPA) archive document on carbon through the season lesson. The test comprises 30 questions. It was administered to students during pre-test and posttest. It was administered to students during pre-test and posttest. Biology achievement test is in seven sections. Section A was used to obtain information about students' biodata; section B -G comprises of open-ended questions in biology for students. Test contents cover the concepts of carbon cycle and air pollution and oxygen and carbon balance in four levels of cognitive domain of remembering, understanding, applying and creating. The instrument consisted of 30 short-answer test items designed to assess students' academic performance in biology. Each item was dichotomously scored (1 = correct, 0 = incorrect), making the obtainable scores range from 0 to 30. The reliability of the instrument was established using the Kuder-Richardson Formula 20 (KR-20), which produced a reliability coefficient of 0.713. This indicates that the BAT has an acceptable level of internal consistency and is suitable for use in this study.

Validation of the instruments

The content validation was carried out by biology experts in the science education department, experienced biology teachers in secondary schools and colleagues in the field of biology. The items were also validated using table of specification to ensure adequate distribution of test items across the specified cognitive objectives. This is also to ensure the tests items representativeness of the major content area: carbon cycle, air pollution and oxygen-balance are in line with the specified objectives. The three major content areas of the topics covers four levels of cognitive taxonomy which are remembering, understanding, applying and creating. In addition, the face and content validation of the instrument was done by experts in the field in order to ensure that it measures what it intends to measure.

Experimental Procedure

Experimental procedure consists of three stages, the pre-test, and implementation of the learning task and the administration of post-test. The pre-test was conducted in the first week. The researcher administered research instrument to experimental groups and the control group during the first week. After the pre-test the students were exposed to the instruction and learning activities which lasted for three weeks .The experimental group was exposed to context-based learning, while the control group was exposed to the conventional lecture method. The treatment administration lasted for

three weeks. At the end of the administration of treatment, all the students took post-test in all the study lasted for five weeks.

Result

Research Question 1: What is the effect of treatment and conventional lecture method on students' academic achievement?

H01: There is no significant effect of treatment on students' academic achievement

Table 1: Descriptive Statistics of Students' Learning Outcomes in Biology by Treatment

Treatment	Learning Outcomes	Pre-test Mean	Pre-test SD	Post-test Mean	Post-test SD	Mean gain
CBL148	AAB	3.24	2.401	16.51	5.679	13.27
CLM146	AAB	3.57	2.831	4.99	2.669	1.42

Based on Table 1 both CBL is more effective in improving students' academic achievement in biology compared to the CLM with CBL showing the greatest improvement.

Table 2: Analysis of Covariance on the Effect of Treatment on Students' Academic achievement

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	17450.898 ^a	3	5816.966	302.855	<.001	.664
Intercept	12685.182	1	12685.182	660.442	<.001	.590
BAT Pretest	3287.673	1	3287.673	171.170	<.001	.272
Treatment	13116.673	2	6558.336	341.454	<.001	.598
Error	8816.065	459	19.207			
Total	106108.000	463				
Corrected Total	26266.963	462				

R Squared = .664 (Adjusted R Squared = .662)

The ANCOVA results (see Table 2) reveal a significant effect of treatment on students' academic achievement in biology, F(2, 341.45, $p < .001$, with a large effect size, partial $\eta^2 = .598$.

Table 3: Bonferroni Post-hoc Analysis on the Effect of Treatment on Students' Academic achievement

Treatment (I)	Treatment (J)	Mean Difference (I-J)	Std. Error	Sig. ^b	95% Confidence Difference ^b	Interval for	
						Lower Bound	Upper Bound
CBL	AIS	.707	.505	.487	-.506	1.920	
	CLM	11.836*	.512	.000	10.606	13.066	
AIS	CBL	-.707	.505	.487	-1.920	.506	
	CLM	11.129*	.502	.000	9.923	12.335	
CLM	CBL	-11.836*	.512	.000	-13.066	-10.606	
	AIS	-11.129*	.502	.000	-12.335	-9.923	

Based on estimated marginal means: *a. The mean difference is significant at the 0.05 level. b. Adjustment for multiple comparisons: Bonferroni.*

Post-hoc Bonferroni analysis (Table 3) shows that students exposed to Context-Based Learning (CBL) performed significantly better than those taught using the Conventional Lecture Method (CLM), with mean differences of 11.84 which is significant at $p < .001$.

Research Question 2: What is the interaction effect of treatment and gender on students' academic achievement?

Ho2: There is no significant interaction effect of treatment and gender on students' academic achievement

Table 4: Descriptive Statistics of Treatment Interaction with Gender on Students' academic achievement

Treatment	Learning outcomes	Gender	Mean	Std. Deviation	N
CBL	AAB	Male	15.70	6.065	74
		Female	17.31	5.181	74
CLM	AAB	Male	4.77	2.936	65
		Female	5.17	2.438	81

Table 4 indicate that female students achieved higher academic achievement across all treatment.

Table 5: Analysis of Covariance on the Interaction Effect of Treatments and Gender on SAA

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	17553.094 ^a	6	2925.516	153.093	.000
Intercept	12532.065	1	12532.065	655.808	.000
BAT Pretest	3181.390	1	3181.390	166.483	.000
Treatments	12925.987	2	6462.993	338.211	.000
Gender	45.656	1	45.656	2.389	.123
Treatment * Gender	49.302	2	24.651	1.290	.276
Error	8713.869	456	19.109		
Total	106108.000	463			
Corrected Total	26266.963	462			

a. R Squared = .668 (Adjusted R Squared = .664), BAT = Biology Achievement Test

The ANCOVA results in Table 5 revealed that there is no significant interaction effect between treatment and gender on students' academic achievement in biology ($F = 1.290$, $p = .276$). However, treatment has a significant effect ($F = 338.211$, $p < .001$), indicating that the instructional method has effect on students' scores. Gender alone has no significant influence achievement ($F = 2.389$, $p = .123$), though pre-test scores are significant covariate ($F = 166.483$, $p < .001$). The R^2 value of .668 suggests that approximately 67% of the variance in post-test academic achievement is explained by the model, mainly driven by the treatment differences rather than gender or their interaction.

Discussion

Effect of Treatment on Students' Academic Achievement in Biology

Context-based learning (CBL) has a significant effect on students' academic achievement in biology compared to conventional lecture method. Students in context-based learning experimental group perform better than the students in the conventional lecture method in the biology achievement test. This is in line with the work of Karasubasi and Hatice, (2023) which revealed that context – based learning has a significant effect on Turkish students' science academic achievement. In addition, Akinsola, Okebukukola and Oladejo, (2022) finding revealed that CBL has a significant difference impact on students' academic achievement in biology has a positive effect on motivation as well as academics success. Esra & Figen (2015) revealed that CBL improves biology learner performance because narrative contexts tied to their everyday lives help students in learning biology. Students are more receptive to stories and stories are easier to remember. Students could recall story, consider the principle contained inside and make connection to their concepts, teamwork, and discussion research assisted. Abebe (2023) also noted that relating students' experiences and concepts can help students better understand biological concepts. In addition, another reason for success in CBL over conventional lecture method of teaching might be because students learn in group and this give students chance to share ideas and opinion , listen to what others have to say, support each other and gain collective knowledge (Abebe 2023). Research evidence revealed that teacher's usage of inefficient way of teaching instruction to teach transmitted knowledge could be linked to science student's poor academic performance in conventional lecture method of teaching (Adunola 2011).

Interaction Effect of Treatment and Gender on Students' Academic Achievement in Biology

The result revealed there is no significant interaction effect of treatment and gender on students' academic achievement in biology. Eshetu and Assefa (2019) revealed that CBL causes increment in the mean scores of both male and female students. Sunday, Olaoye and Audu (2021) findings show that there is no significant difference between the mean achievement scores of students; taught in geometry with contextual teaching strategy and those taught with conventional method. There is no significance different between the mean achievement score of male and female students taught geometry with CTS. The success of male and female students in context-based learning may be due to interaction of context that is common to all students into teaching and learning process. Fikadu et al (2019) reported that interaction of context that is common to all students in teaching and learning process engage male and female in a variety of learning activities is valuable for both male and female students. The issues of gender and student's academics achievement in science remain controversial issues.

Conclusion

Context based learning used in this study have been found to improve students' academic achievement in biology. Context based learning is a suitable strategy that can improve male and female academic achievement in biology.

Educational Implications of Finding

The significant effect of context-based learning used in this study has been found to improve students' academic achievement in biology. This is because these methods allow active participation of students during teaching and learning process. Teachers also engaged students actively by providing series of learning activities such as the use of context, group discussion, given reason while engaging in scientific explanations. It could be used as alternative to conventional method to improve students' learning outcomes.

Recommendation

Based on the findings of this study, the following recommendations are expedient:

1. Biology Educator should embrace context-based learning as teaching and learning strategy to improve students' learning outcomes because according to Sangoleye et al (2022) teachers are responsible for translating of theory into practice in the classroom.
2. Teachers should be trained on the use of context-based learning
3. Curriculum developer should arrange the topic in the curriculum and make of context, pictures, charts, more of girls' pictures in the textbooks; various learning activities that will cater for male and female students should be provided. This can enhance equitable opportunities for all students to acquire full knowledge of subject matter.

REFERENCES

Abebe, W. K., Tafari, H. W., & Faris, S. B. (2023). Effects of context-based approaches on students' reasoning on hereditary concepts. *Pedagogical Research*, 8(4), em0166.

Abebe, W. K., Tafari, H. W., & Faris, S. B. (2024). Effect of context based react strategy on students' conceptual understanding of heredity. *Cogent Education*, 11(1), 2290104. <https://doi.org/10.1080/2331186x.2023.2290104>

Abuh, P. Y. (2021). Influence of gender on students' academic achievement in science and technology education when taught using innovative strategies. *AJSTME*, 7(1), 14-20. <https://www.ajstme.com.ng>

Adunola, O. (2011). *The impact of teachers' teaching methods on the academic performance of primary school pupils in Ijebu-Ode*. <http://pdfs.semanticscholar.org>

Bacay, M., & Herrera, L. (2020). Context-based learning in teaching senior high school: Basis for science instructional material development. *Asia Pacific Journal of Education, Arts and Sciences*, 7(1), 73-81. <http://www.apjeas.apjmr.com>

Cabbar, B. G., & Senel, H. (2020). Content analysis of biology education research that used context-based approaches: The case of Turkey. *Journal of Educational Issues*, 6(1), 203-218. <https://doi.org/10.5296/jei.v6i1.16920>

Eshetu, F., & Assefa, S. (2019). Effects of context-based instructional approaches on students' problem-solving skills in rotational motion. *Eurasia Journal of Mathematics, Science and Technology Education*, 15(2), em1665. <https://doi.org/10.29333/ejmste/102283>

Kamarulzaman, M. S., Sailin, S. N., Mahmor, N. A., & Shaari, A. J. (2017). Correlation between LOTS and HOTS scores among UUM students. *Asian Journal of Educational Research*, 5(3), 71-74. <http://www.multidisciplinaryjournals.com/wp-content/uploads/2017/05/Full-Paper-CORRELATION-BETWEEN-LOTS-AND-HOTS-SCORES-AMONG-UUM-STUDENTS.pdf>

Kang, J. (2022). Interrelationships between inquiry-based learning and instructional quality in predicting science literacy. *Research in School Education*, 52(1), 339-355.

Karasubaşı, Ö., & Güngör-Seyhan, H. (2023). A meta-analysis on the effect of context-based learning on students' science academic achievement in the Turkish education system. *Journal of Computer and Education Research*, 11(21), 44-66. <https://doi.org/10.18009/jcer.1206532>

Oladipo, A. J., & Akhigbe, J. N. (2022). Design and implementation of the performance arts enhanced three-stage instructional model. *The Journal of Educational Research*, 11(3), 209-222. <https://doi.org/10.1080/00220671.2022.2096555>

Okebukola, P. A., & Oladejo, A. I. (2022). *Conference: 6th edition international conference of faculty of education, LASU, Nigeria*.

Sangodoyin, I. A. (2011). *Effects of computer graphics and animation presentation modes on senior secondary school students learning outcomes in biology in southwestern Nigeria* [Doctoral dissertation, University of Ibadan].

Sunday, A. O., Olaoye, A. E., & Audu, H. (2021). Effect of contextual teaching strategy on geometry achievement of students in junior secondary schools in Katsina. *Sapienta Foundation Journal of Education Sciences & Gender Studies*, 3(1).

Suryawati, E., & Osman, K. (2018). Contextual learning: Innovative approach towards the development of students' scientific attitude and natural science performance. *Eurasia Journal of Mathematics, Science and Technology Education*, 14(1), 61-76. <https://doi.org/10.12973/ejmste/79329>

Ural, E., & Gençoglu, D. M. (2020). The effect of argumentation-based science teaching approach on 8th graders' learning in the subject of acids-bases, their attitudes towards science class and scientific process skills. *Interdisciplinary Journal of Environmental and Science Education*, 16(1), e2204. <https://doi.org/10.29333/IJESE/6369>

EFFECT OF SIMULATION-GAMES STRATEGY ON RETENTION AND PERFORMANCE IN TRIGONOMETRY AMONG SENIOR SECONDARY STUDENTS IN NIGER STATE, NIGERIA

¹ Umaru Salihu MOMOZOKU, ² Yahaya Korau KAJURU; & ³ Ibrahim Omeiza IDRIS

¹Department of Mathematics, Faculty of Science, Federal University of Education, Kontagora Niger State Nigeria

^{2,3}Department of Science Education, Faculty of Education, Ahmadu Bello University, Zaria Kaduna State Nigeria

Abstract

This study investigated the effect of Simulation-Games Strategy on Retention and Performance in Trigonometry among Senior Secondary Students in Niger State, Nigeria. A Non-equivalent Control Group design with retention follow-up which used pre-test post-test control group (retention test) design was adopted. The study used SSII students with a population of 20,154 and sample size of 190 selected from four schools randomly assigned to experimental and Control group(s). Two research questions and two hypotheses were formulated and investigated. Forty items research instruments of Trigonometry Performance Test (TPT) and Trigonometry Retention Test (TRT) with reliability coefficient of 0.75 and 0.71 respectively were used for data collection. Research questions were analysed using means, mean and standard deviations. t-test statistics was used for hypotheses testing at $\alpha = 0.05$ level of significance. The results indicated that, there was significant difference among the mean retention ability and performance of students taught Trigonometry using Simulation-Games strategy and conventional teaching method; and that the Simulation-Games strategy was significantly more effective than the conventional teaching method. Based on the findings it is recommended among others that the use of Simulation-Games strategy for teaching Mathematics and Trigonometry should be encouraged in Nigerian secondary schools to improve their retention ability and performance in Trigonometry

Keywords: *Simulation-Games, Performance, Retention and trigonometry*

Introduction

Trigonometry is a branch of Mathematics which deals with indirect measurement as in plane geometry and surveying; and concerned with the properties of trigonometric functions and their application to the determination of the angles and sides of right-angled triangles (Williams, 2019; Obeng, Benson & Owusu, 2024; Bolaji, Kajuru, Ibrahim & Momozoku, 2017). According to Onah (2024), trigonometry account for 35% of secondary mathematics curriculum content in Nigeria. It is one of the main branches of pure mathematics. Bolaji, Kajuru, Ibrahim and Momozoku (2019); Mailizar, Johar and Hidayat (2025) define trigonometry as the branch of mathematics that studies relationship involving lengths and angles of triangles. Bolaji et al (2017) stated that trigonometry is one of the contents offered in Senior Secondary School Mathematics Curriculum. Its study involves the acquisition of practical skills which enables the learners to acquire the skills in visual, verbal, logical representation and applications (Onah, 2024; Ngeobo, Madonsela & Arijlall, 2019; Bolaji et al, 2017). Bolaji et al (2019); Onah, (2024) and Mailizar et al (2025) stated that trigonometric functions are widely applied in astronomy, geography, chemistry, physics, mechanical and electrical engineering, computers and technologies, music and acoustic as well as ecology and biology; and it is the foundation of surveying and architecture (Onah, 2024; Bolaji et al, 2019). Mastering problem-solving in trigonometry are great assets to any secondary students as such skills are the tools for developing critical and logical thinking that can facilitate the learning of mathematics and other science subjects.

According to Bolaji et al (2017) and Williams (2019), students come across contents in Trigonometry in their Senior Secondary One (SSI). This is believed to have caused the difficulties students generally to encounter when solving problems in Trigonometry. Studies have shown that Trigonometry has been identified as one of the most difficult topics

teachers find hard to explain for easy comprehension by the students (Fui, Shahrill, & Mundia, 2015). Furthermore, teachers often lack mastery of Trigonometry and their use of traditional talk and chalk methods is found to be an ineffective instructional strategy (Damayanti, Santi & Hima, 2024; Fererde, Mihrka, Avele & Arara, 2024). This could be the reason why students' fear and shun away from the learning of Trigonometry leading to their persistent low performance particularly in Trigonometry and Mathematics in general.

Inekwe (2002) view performance as the quality of results produced by students as reflected in the quality of their examination scores. It has to do with achievement of success in a given task or obligation. Therefore, in order to have better students' performance in Trigonometry, there is need to motivate the students positively towards the study of Trigonometry so that they can retain the contents treated.

Retention refers to a student's ability to recall material immediately or after a specific time interval in an assessment or examination. It requires a student to reproduce correctly what has been previously learned (Bichi, 2002). Before students can retain a lesson taught, it must have meant and be interesting to them. The amount of retention is directly affected by the degree of importance they attach to the subject which is also affected by the instructional strategy applied during the lesson delivery which in turn influence their performance. To improve academic achievement and retention of contents treated in trigonometry, its teaching and learning requires activity oriented and practical approach to facilitate retention and performance by the students (Kajuru, Bolaji & Salihu, 2012). Several activity-based instructional strategies have been suggested by researchers and Mathematics educators to improve students' performance in Mathematics generally. Thus, for Trigonometry to be taught effectively in secondary schools, Simulation-Games strategy has been advocated by Kajuru et al, (2012) as Simulation games had potentials to enhance students' performance, increase retention ability to learn and raises their interest in learning. Barti and Soni (2024) and Caniglia (2019) define simulation-games as series of instructional designs that use elements from simulation and gaming. Bello, Ibi and Bukar (2016) define simulation-games as instructional scenarios where the learner is placed in a 'world' defied by the teacher. They represent a reality within which students interact. The teacher control the parameters of this 'world' and uses it to achieve the desire instructional results. In addition, students experience the reality of the scenario and gather meaning from it.

A simulation is a form of experiential learning. It is a situation that fits well with the principle of student-centered and constructivist learning and teaching. Simulation-games are characterized by their non-linear nature by their controlled ambiguity within which students must make decisions (Bello et al, 2016, Bolaji et al, 2017; Barti & Soni, 2024). The innovativeness and commitment of the participants usually determine the success of simulation-games. When students use a model of behavioral to gain or better understanding of that behaviour, they are doing a simulation. Barti and Soni (2024) stated that simulation-games allow students to learn mathematics concepts in practical and interesting way which offer a dynamic and interactive learning environment. Studies revealed that student's performance in mathematics is enhanced by simulation-games. It enhances students' computational skills, conceptual grasp of mathematical concepts, capacity to visualize abstract ideas, willingness to experiment with variables and students participate in reflective processes, self-mentoring, self-awareness and increase success were the results of the simulation-games (Caniglia, 2019; Ibrahim & Abu-Hamaid, 2017; Bolaji et al, 2017). Students are motivated, have positive attitude and increased interest and retention of mathematical concepts. Games promote and help creative solution to problem-solving. Games promote significant changes and mental reinforces activities (Barbieri, Barbieri & Capone, 2021). Therefore, embedding mathematics learning into Simulation games may enhance students' motivation and learning performance in Mathematics.

Simulation games teaching strategy will make teaching and learning more motivating, interesting, make the classroom environment lively, arouse the interest of the learners and sustained their interest and attention throughout the teaching and learning period. It is activity oriented and learner centered approach. In studies by researchers, simulations and games are believed to improve academic achievement and increase retention abilities as supported by evidence from Emmanuel and Odeyi (2024), whose result showed that students taught trigonometry using triangle solver games retained more than those taught with conventional method. Ani (2025) stated that students taught trigonometry using mathematics card games had significantly retained better than their counterpart taught trigonometry using other methods. Caniglia (2019) stated that the experience of simulation can increase long term retention and memory of material learned showing the teaching strategy have considerable impact in improving retention ability in students at secondary school level. Idris (2016) study discovered that the ability to remember takes place more effectively when experiences are passed across to the learner through appropriate instructional method such as simulations and games.

In addition, Kajuru, Bolaji and Kauru (2014) carried out study on impact of simulation-Games on students' performance and found that there was significant difference in the performance scores of the students taught Trigonometry concepts due to treatment. Dorji and Rigidel (2024) which indicated that student's experimental group had positive significantly higher mathematics achievement than control group demonstrating the effectiveness of games and simulation in learning ($P<0.05$). In the studies conducted by Emmanuel and Odeyi (2024), their result revealed that students taught trigonometry using triangle solver games achieved higher and retained more than those taught with conventional method. Onah (2024) study showed that students taught using trigoludo games strategy achieved higher and retained more in trigonometry than their counterpart in control group. In addition, Ani (2025) study revealed that the student's trigonometry using mathematics card games had significant academic achievement and retained better than their counterpart taught trigonometry using other methods

This finding agreed with the findings of Idris (2016) and that of Piu, Fregole and Barbieri, (2016) who found that students who learned geometrical concepts through simulation games had a higher level of both content retention and level of abstraction compared with those in control group. Simulation-Games can be done with board games, computer assisted board games, or fully computerized environments. Bolaji et al (2019) see Simulation games as board games which are sold in the market or those different types of games made in the Mathematics Laboratory by teachers and students for classroom use. Examples of games include Geometric, Fraction, Trigonometric, Numbers, the Fours', Ludo, Snakes and Ladders, "Ayo" and others. Such games essentially try to lay emphasis on processes and relationships (Ojaleye & Niyi, 2008) and thereby concluded that not only do such games allow students to discuss and take practical decisions, but they also facilitate the development of the imagination. Students usually find them very stimulating and motivating. The use of simulation games in teaching-learning situation is since simulation games provide fascinating challenges to learners and add interest, activity and novelty to the lesson. In addition, simulation-game is intended to help students translate mathematics principles, concepts, and theories into practice, thus making the learning process an interesting, interactive, and long-lasting experience (Bolaji et al, 2017). The purpose of simulation game is not for winning but for developing the spirit of the game, that is, the spirit of tolerance, planning and give and take. The educational benefit of simulation and gaming is that students develop expert behaviors such as pattern recognition, problem solving, qualitative thinking, and principled decision-making as their individual expertise with games increase. Students' performance, skills, and ability to explore, experiment and collaborate increased by playing games. In addition, Bolaji et al (2017) stated that with realistic games, students not only become smarter and intellectually engaged but also realize their desire for hard fun, delayed gratification, rewards, making right decisions, participation, depth of understanding, challenge, and using their pattern recognition and problem-solving skills. They concluded that both resource-deprived and resource-affluent students make significant learning gains after playing well designed simulation games; their spatial abilities and cognitive development increases after playing with simulation games among both genders.

Therefore, game-based teaching allowed students opportunity to actively participate in their learning creating room for higher academic achievement and retention of what they were taught (Ku, Chen, Wu, Lao, & Chan, 2014). Hence, this study investigated the effect of Simulation-Games strategy on Retention and Performance in Trigonometry among senior secondary students in Niger State, Nigeria.

Research Questions

The following research questions were posed to guide the study:

- 1.What is the difference in the mean retention ability scores of students taught Trigonometry using Simulation-Games strategy as compared with those taught using conventional method?
- 2.What impact did the use of Simulation-Games strategy have on the students' performance in Trigonometry as compared with their counterpart taught using conventional method?

Hypotheses

The following null hypotheses were formulated and tested at 0. 05 level of significance:

1. H_{01} : There is no significant difference among the mean retention ability scores of students taught Trigonometry with Simulation-Games strategy and those taught using conventional teaching method.
2. H_{05} : There is no significant difference among the mean performance scores of students taught Trigonometry using Simulation-Games strategy and those taught using conventional teaching method.

Methodology

Research Design: The study employed a Non-equivalent Control Group Design with Retention Follow-up. The

experimental group received the Simulation-Games Strategy intervention after the pre-test, while the control group received the conventional teaching method

Area of the Study: The study was carried out among senior secondary students in Niger state-Nigeria

Population, Sample and Sampling Technique: The populations of the study comprised of all senior secondary two (20,154) students in Niger state. A multi-stage stratified random sampling procedure was used in selecting the sample for the study. The first stage was done by grouping the schools into clusters of three senatorial zones. The second stage was done by grouping into clusters of seven education zones including the number of schools in each education zone and their respective local government areas. Three education zones of Kontagora, Kutigi and Bida were selected from the seven education zones through stratified random sampling procedure. Out of these three education zones, Kontagora education zone was selected through random sampling procedure. There are ten senior secondary schools in Kontagora education zone out of which four were randomly selected for the study using balloting technique. The first two picked schools served as experimental group while the third and fourth picked schools served as control group respectively through balloting method. A total of one hundred and ninety (190) students were selected as sample for the study. There are ninety-seven (97) students in experimental group and ninety-three (93) students in control group. In determining the sample for the study, the researcher adopted Sambo (2008) recommendation that the sample size $N \geq 30$ can be used to establish a relationship between two groups in experimental research.

Instruments and reliability of instruments: Two research instruments were used for data collection which were Trigonometry Performance Test (TPT) and Trigonometry Retention Test (TRT) each containing forty multiple choice questions with option A to E. The face and content validity of the TPT and TRT test items were found to be within the ability level of the students, free from ambiguities, covered the content area and measured what is expected to measure by the three mathematics educators that moderated. They were pilot tested and found with reliability coefficient of 0.75 and 0.71 respectively determined using Cronbach alpha (α_{20}).

Procedure for Data Collection: After teaching for six weeks and administration of treatments to the experimental group; the research assistance administered the instruments to the two groups under the same conditions and retrieved them from the students after forty minutes time allocated for the test lapsed. Both pre-test and post-test scripts were marked, scored and the results recorded.

Procedure for Data Analysis: The Statistical tools of mean; mean difference and standard deviation were used to answer the research questions while t-test statistics was used for hypotheses testing at $\alpha = 0.05$ level of significance.

Results

The data collected from this study were analysed using descriptive statistics of means, standard deviation and standard error to answer the research questions and inferential statistics of t-test was used for the hypotheses testing at $\alpha = 0.05$ level of significance. The detail of the analyses were as follow:

Research Question one: What is the difference in the mean retention ability scores of students taught Trigonometry using Simulation-Games strategy as compared with those taught using conventional method? To answer this research question, the results was presented in Table 1.

Table 1: Means, Standard Deviations and Mean Differences of the Simulation-Games Strategy and Conventional Method in Trigonometry Retention Test.

Strategy	N	Mean	SD	Df	Mean Diff
Simulation-Games	97	66.60	11.17	188	28.96
Conventional	93	37.64	18.53		

Table 1: indicated that Simulation-Games strategy has a mean retention score of 66.60 with standard deviation of 11.17 compared with conventional Method having a mean retention score of 37.64 with standard deviation of 18.53. The mean difference between the two groups was 28.96 which could be considered as significant.

Research Questions two: What impact did the use Simulation-Games strategy have on the students' performance in Trigonometry as compared with their counterpart taught using conventional method? To answer this research question, the results was presented in Table 2.

Table 2: Mean, Standard Deviation, Standard Error and Mean Differences of the Simulation-Games Strategy and Conventional Method in Trigonometry Performance Test

Strategy	N	Mean	SD	Df	Std Error	Mean Diff.
Simulation-Games	97	54.86	10.67		1.26	
Conventional	93	43.10	14.45	188	1.70	11.76

Results in Table 2 showed that the mean performance score of Simulation-Games strategy was 54.86 with standard deviation of 10.67 and the mean performance scores of the conventional method was 43.10 with standard deviation of 14.45. The mean difference between Simulation-Games strategy and Conventional Method was 11.76. This shows that there was impact of treatment on academic performance of the students exposed to Simulation-Games teaching strategy employed during the study.

Hypotheses Testing

Based on the study, the following null hypotheses were formulated and tested at 0.05 level of significance:

H_0 : There is no significant difference in students mean retention ability scores towards Trigonometry when exposed to Simulation-Games strategy and those taught using conventional teaching method. To test the hypothesis t-test statistics was used as in Table 3.

Table 3: t-test analysis of difference in the mean retention ability scores of students taught Trigonometry with Simulation-Games strategy and those taught using conventional teaching method.

Group	No	Mean(X)	St dev	MD	df	t-cal	P-value	Remark
Experimental	97	66.60	11.17					
				28.96	188	8.25	0.00*	Significant
Control	93	37.64	18.53					

*Significant at $P \leq 0.05$

Table 3 showed a calculated t-cal of 8.25 and the calculated p-value was 0.00 which was less than alpha value of 0.05. it means that there was a significant difference in the retention ability between the experimental and control groups. Based on this result, the null hypothesis of no significant difference was rejected and the alternative hypothesis is upheld. This implies that there was significant difference in the mean retention ability of students taught Trigonometry concepts using Simulation-Games strategy as compared with the conventional teaching method.

H_0 : There is no significant difference among the mean performance scores of students taught Trigonometry using Simulation-Games strategy and those taught using conventional teaching method. To test the hypothesis, t-test statistic was used as presented in Table 4:

Table 4: t-test analysis of difference in the mean performance scores of students taught Trigonometry with Simulation-Games strategies and those taught using conventional teaching method.

Group	No	Mean(X)	St dev	MD	df	t-cal	P-value	Remark
Experimental	97	54.86		10.67				
				11.76	188	5.20	0.001*	Significant
Control	93	43.10	14.45					

*Significant at $P \leq 0.05$

Table 4 above shows a t-cal of 5.20 with df of 188 and P=0.001. Since $P \leq 0.05$, it means that there was a significant difference in the academic performance between the experimental and control groups. The null hypothesis of no significant difference is therefore rejected. It implies that the difference in the means scores of the two groups was significant. Therefore, the alternative hypothesis is retained

Discussions

The objective of the study was set to investigate the effect of Simulation-Games Strategy on Retention and Performance towards Trigonometry among Senior Secondary Students in Niger State, Nigeria. The explanation of the findings obtained

from the hypotheses tested and supported by other related studies: The findings from the analysis of H_0 in Table 3 showed that there was statistically significant difference between the mean retention ability of students taught Trigonometry concepts using Simulation-Games strategy as compared with the conventional teaching method. This agrees with the studies conducted by Emmanuel and Odeyi (2024), whose result revealed that students taught trigonometry using triangle solver games retained more than those taught with conventional method. In another study by Ani (2025) revealed that students taught trigonometry using mathematics card games had significantly retained better than their counterpart taught trigonometry using other methods. Canigla (2019) stated that the experience of simulation can increase long term retention and memory of material learned showing the teaching strategy have considerable impact in improving retention ability in students at secondary school level. The result supported that of Idris (2016) who discovered that the ability to remember takes place more effectively when experiences are passed across to the learner through appropriate instructional method. Result in Table 4 of hypothesis two showed statistically significant difference meaning that there was significant difference in the mean performance scores of students taught Trigonometry with Simulation-Games strategy and those exposed to conventional teaching method. This confirms the findings of Kajuru, Bolaji and Kauru (2014) that there was significant difference in the performance scores of the students taught Trigonometry concepts due to treatment. This finding is in line with the work of Dorji and Rigidel (2024) which indicated that student's experimental group had positive significantly higher mathematics achievement than control group demonstrating the effectiveness of games and simulation in learning ($P<0.05$). The studies conducted by Onoh (2024) showed that students taught using trigoludo games strategy achieved higher and retained more in trigonometry than their counterpart in control group. In addition, Ani (2025) study revealed that the student's trigonometry using mathematics card games had significant academic achievement and retained better than their counterpart taught trigonometry using other methods

Conclusion

The study indicated that the use of the use of Simulation-Games strategy in the teaching of Trigonometry enhances higher level of academic performance and increased retention ability towards Trigonometry among senior secondary (SSII) students on the experimental group than those in conventional group. When developing or adapting games for instructional purposes, look for existing gaming strategies which can be used for one's particular purposes. Use a highly visual simulation game which includes all participants to help understand, address, and resolve group decision-making. Make sure ones game has a way of ending so the satisfaction of the learner may be maximized. Gaming used for instructional purposes should not be overly complex for it will help promote interest in instructional materials as the learner's gaming abilities increase. Always use student centered approach to enhance students' performance and retention in trigonometry teaching and learning.

Reference

Ani, N. F. (2025). Effect of Mathematics Card and Ludo games on senior secondary school students' achievement and retention in trigonometry in Enugu education zone. *ESUT Journal of Educational Foundation (EJEF)*, 1-10.

Barbieri, G. G; Barbieri, R. & Capone, R. (2021). Serious games in high school mathematics lesson: An Embedded case study in Europe. *Eurasia Journal of Mathematics Science and Technology Education*, 17(5), em1963, 1-17 <https://doi.org/10.29333/ejmste/10859>

Barti, P. & Soni, C. (2024). Effect of Simulation-Games on secondary school students' mathematics achievement. *International Journal of Cultural Studies and Social Sciences*, 20(02-1), 132-139.

Bello, S; Ibi, M. B. & Bukar, I. B. (2016). Effect of Simulation techniques and lecture method on students' academic performance in Mafoni day secondary school Maiduguri, Borno state. *Journal of Education and Practice*, 11(24), 54-58. www.iiste.org

Bichi, S.S. (2002). The Effects of Gender on Academic Achievement in Evolution Concepts among Secondary School Students using Problem Solving Instructional Strategy. *Zaria Journal of Studies in Education*. 3(1), 132–138.

Bolaji, C; KajuruY. K; Ibrahim, M. O. & Momozoku, U. S.(2020). Effects of Jigsaw5-Cooperative and Simulation-Games Strategies on Motivation and Performance in Trigonometry Among Senior Secondary Students In Niger State, Nigeria. *The Journal of the Mathematical Association of Nigeria (abacus)*, 45(1), 85-91.

Bolaji, C; Kajuru, Y. K; Ibrahim, M. O. & Momozoku, U. S. (2019). Effects of Jigsaw5- Cooperative and Simulation-Games Strategies on Retention in Trigonometry among Senior Secondary Students in Niger State- Nigeria. *Journal of Mathematics Education and Mathematical Sciences (Arewa MAN Chapter)*, maiden edition, 94-104.

Bolaji, C; Kajuru, Y. K; Ibrahim, M. O. & Momozoku, U. S. (2017). *Effects of Jigsaw5-Cooperative and Simulation-Games strategies on motivation, retention and performance in Trigonometry among senior secondary students in*

Niger State, Nigeria. A PhD thesis submitted to department of science education, faculty of education, Ahmadu Bello University Zaria.

Caniglia, J. (2019). Simulation as a teaching strategy. Kent University Center. Retrieved from <https://www.kent.edu/ctl/simulation-teaching-strategy> Thursday on 11 September, 2025 at 17:27Hrs

Damayanti, I. M; Santia, I. & Hima, L. R. (2024). Analysis of students mathematical concept understanding ability in understanding trigonometry material for class XI senior high school. *International Journal of Research and Review (IJRR)*, 11(6), 706-712.

Dorji, N. & Rigdel, K. S. (2024). The Effect of Games and Simulations in learning mathematics. A Quasi-experimental study. *Vietnam Journal of Educational Science (VJES)*, 2(20), 1-15.

Emmanuel, E. P. Odey, S. H. (2024). Effect of Triangle solver game on secondary school students' achievement and retention in trigonometry in Ogoja education zone of Cross River state. *International Journal of Multidisciplinary Research and Analysis*, 7(12), 566-5677. Doi:10.47191/ijmra/v7-i12-40

Fererde, A. T; Mihrka, A. A; Avele, M. A. & Arara, A. A. (2024). Enhancing students conceptual understanding and problem-solving skills in learning trigonometry through contextual –based mathematical modeling instruction. *International Journal of Secondary Education*, 12(4), 108-119. Doi:10.11648/ijsedu.2024120415.

Fui, F. L., Shahrrill, M. & Mundia, L. (2015). Investigating Students' Conceptual Knowledge and Procedural Skills in the Learning of College Level Trigonometry. *Research Journal of Applied Sciences, Engineering and Technology*, 9(11), 952-962.

Ibrahim, B. & Abu-Hamaid, Y. (2017). The effect of teaching mathematics using interactive video games on fifth grade students' achievement. *An-Najah University Journal of of Research (Humanities)*, 31(3), 471-493.

Idris, I. O. (2016). Impacts of Concept Mapping Strategy on Attitude, Retention and Performance in Algebra on Different Abilities of Secondary Students, Kogi State, Nigeria. Unpublished Ph. D Thesis, Department of Science Education Faculty of Education, ABU-Zaria.,

Inekwe, I. O. (2002). Sensitizing Students Learning of Mathematics through Affective Means.A Focus on the Universal Basic Education. *Nigerian Educational Forum.A Journal of the Institute of Education*, ABU, Zaria, 16(7), 76-81.

Kajuru, Y. K. & Kauru, I. A. (2014). Impact of Constructivist Teaching Strategy on Students Academic Performance, Retention and Attitude towards Trigonometry among Senior Secondary Schools in Kaduna State, Nigeria.A Ph. D Dissertation, Department of Science Education, Ahmadu Bello University, Zaria.

Kajuru, Y. K; Bolaji, C. & Salihu, T. U. (2012). Effects of Simulation Games Strategy on the performance and motivation in Trigonometry among senior secondary school's students in Zamfara State. An Med Thesis, Department of Science Education, Ahmadu Bello university-Zaria Kaduna State.

Ku, O; Chen, S. Y; Wu, D. H; Lao, A.C.C.& Chan, T.W. (2014). The Effects of Game-Based Learning on Mathematical Confidence and Performance: High Ability vs. Low Ability. *Educational Technology & Society*, 17 (3), 65–78.

Mailizar, M; Johar, R. & Hidayat, M. (2025). Enhancing remedial learning outcomes using micro-lecture videos. The case of trigonometry. *Eurasia Journal of Mathematics, Science and Technology Education*, 21(4), 1-11

Ngcobo, A. Z; Madonsela, S. P. & Arijall, D. (2019). The Teaching and learning of trigonometry. *The Independent Journal of Teaching and Learning (IJTL)*, 14(2) <https://scielo.org.za>

Obeng, B. A; Benson, G. M. Owusu, E. & Owusu, R. (2024). Analysis of senior high school student's errors in solving trigonometry. *Cogent Education, Taylor and Francis Group*; 11(1), Doi.10.1080/2331186x.2385119.

Ojaleye, O. O. & Niyi, O. O. (2008). *Basic Mathematical Laboratory Practical and Games*. Kontagora: Unique Press.

Onah, D. O. (2024). Effect of Trigoludo game strategy on secondary school students' achievement and retention in trigonometry in Enugu state. *ResearchGate*

Piu, A; Fregola, C. & Barbieri, B. (2016). Geometry classrooms with Simulation-games. Research results and future outputs. *Sage Journal*, 47(6). <https://doi.org/10.1177/1046878116665464>

Sambo, A. A. (2008). *Research Method in Education*. Ibadan: Stirling – Horden Publishers (Nig) Ltd.

Williams, C. (2019). Understandings and misunderstandings of trigonometry. Georgia College. <https://www.gcsu.edu>

DIGITAL EQUITY IN SUB-SAHARAN AFRICA: BRIDGING THE EDUCATIONAL DIVIDE

Margaret Bola Oni

Human Capital Policy Department

Nigerian Institute of Social and Economic Research (NISER)

mbiodunoni@yahoo.com. Mobile: 08034027595

Abstract

This study explores the digital equity in Sub-Saharan Africa, focusing on its implications for educational access, inclusion, and outcomes. Drawing on recent literature (2019-2025) and a systematic literature review and secondary data analysis approach, the research identifies key barriers to digital inclusion, including infrastructural deficits, low digital literacy, and limited assistive technologies. A conceptual framework grounded in Resources and Appropriation Theory links policy support, access, skills, and meaningful use to educational outcomes. Findings reveal that South Africa (70%) tops the internet penetration, with a 20% divide between the urban and rural, while Uganda (30%), with digital access 40% between urban and rural, is at the base among the selected countries. Skill deficits, affordability, and connectivity gaps were the observed barriers to policy reforms and inclusion as enablers. Strategic vision and capacity building were among the policy and practice frameworks for bridging the divide. The study concludes that the digital divides in sub-Saharan Africa are real and have multifaceted implications; therefore, stakeholders must prioritise equity at every level from national policy to classroom practice.

Keywords: Digital equity, Sub-Saharan Africa, educational technology, inclusion, digital literacy

Introduction

In the 21st century, digital technologies have become indispensable to educational delivery, access, and equity. Yet, in Sub-Saharan Africa (SSA), the promise of digital transformation remains unevenly distributed. While global education systems increasingly integrate digital tools to enhance learning outcomes, SSA continues to grapple with infrastructural deficits, socio-economic disparities, and policy gaps that widen the digital divide (Baidoo-Anu et al., 2023). The COVID-19 pandemic further exposed these vulnerabilities, revealing stark contrasts in digital readiness between urban and rural communities, as well as between high-income and low-income nations (Mouongue & Rutazihana, 2024). Digital equity refers not only to access to devices and connectivity but also to the capacity to use digital tools meaningfully for learning, teaching, and innovation. In Sub-Saharan Africa, digital equity is a critical determinant of educational inclusion, particularly for marginalised populations such as girls, rural learners, and students with disabilities. Bridging this divide is essential for achieving Sustainable Development Goal 4 (SDG 4), which aims to ensure inclusive and equitable quality education for all.

Digital equity in education encompasses three interrelated dimensions: access, which is the availability of devices, internet, and electricity; skills, which involve digital literacy among students and educators; and meaningful use, which is integrating technology into pedagogy and curriculum. These dimensions are shaped by broader systemic factors, including income inequality, gender norms, geographic isolation, and policy frameworks (Constancio, 2024). In SSA, digital equity is not just about connectivity; it is about empowerment, participation, and the right to learn. Recent studies show that students in rural Sub-Saharan Africa communities often lack basic access to computers and stable internet, making online learning nearly impossible (Baidoo-Anu et al., 2023). Even where infrastructure exists, affordability and digital literacy remain significant barriers (Constancio, 2024).

Statement of the Problem

Governments and institutions across Sub-Saharan Africa have initiated digital transformation strategies, but these efforts are often fragmented and underfunded. For instance, the University of Dodoma in Tanzania has implemented digital literacy programs, yet many students still lack basic competencies due to curriculum gaps and limited resources. Also, in South Africa, mobile technology has expanded internet access. Still, disparities persist in rural and low-income communities, signifying that policy reforms must prioritise inclusive infrastructure, teacher training, and curriculum redesign to ensure that digital tools enhance, not hinder, educational equity.

Objectives of the Study

The objectives of this study are:

1. To critically examine the state of digital equity in SSA education.
2. To identify barriers and enablers of digital inclusion.
3. To propose policy and practice frameworks for bridging the educational divide.

Literature Review

Digital Equity, Literacy, Integration and Gap

Digital equity has evolved from a narrow focus on access to a broader framework encompassing skills, meaningful use, and outcomes. Van Dijk and Van Deursen's (2020) *Resources and Appropriation Theory* remains foundational, arguing that digital access is mediated by socio-economic status, education, and geography. In the Sub-Saharan African (SSA) context, this theory is particularly relevant due to entrenched inequalities that shape digital engagement (Constancio, 2024). Constancio's systematic review of 54 studies found that digital divide research in SSA often lacks contextual nuance, with an underrepresentation of rural and marginalised populations. He emphasises the need for localised frameworks that account for cultural, linguistic, and infrastructural diversity. Access to digital infrastructure remains a major barrier in SSA. Mouongue and Rutazihana (2024) analysed data from 29 SSA countries and found that internet and mobile cellular subscription gaps significantly correlate with lower secondary school enrollment and completion rates. Their regression models revealed that increased government spending on education, and electricity access positively influenced digital equity outcomes.

Ndibalema (2025) highlights the infrastructural challenges in higher education, noting that many universities lack the bandwidth, hardware, and technical support needed to sustain digital learning. His review of 14 empirical studies found that outdated ICT policies and unprepared lecturers hinder the development of 21st-century skills. Digital literacy is not just a technical skill; it's a pedagogical imperative. Ndibalema (2025) argues that without digital fluency, students cannot fully engage with online platforms or develop critical thinking and problem-solving abilities. His findings show that digital literacy gaps are most pronounced in rural institutions, where professional development for educators is limited. Moreover, Fernandez et al. (2023) and Habib (2023) suggest that digital literacy should be embedded into curricula as a core competency, not an optional add-on. Universities must prioritise digital culture, global mobility, and democratisation of knowledge to prepare students for a tech-driven world. Ajani and Gamede (2021) explore gendered barriers to digital education in rural Africa. Their study reveals that girls are less likely to own devices, have internet access, or receive digital training. Cultural norms and economic constraints further marginalise female learners, especially in STEM fields. Benkhadra (2025) adds that children with disabilities face systemic exclusion due to inaccessible platforms and a lack of assistive technologies. Her research calls for inclusive design principles and targeted interventions to ensure that digital transformation does not leave vulnerable populations behind. A cross-national study of 29 SSA countries found that disparity in internet and mobile cellular subscriptions significantly correlates with lower secondary school enrollment and completion rates (Mouongue & Rutazihana, 2024). Moreover, increased government expenditure on education and electricity access was positively associated with improved digital equity outcomes. Another study focusing on Ghana revealed that most students had no prior experience with online learning, lacked mental health support, and struggled to navigate digital platforms during the pandemic (Baidoo-Anu et al., 2023). These findings underscore the urgency of systemic interventions beyond infrastructure to include capacity building, policy reform, and inclusive design.

Resources and Appropriation Theory

This study draws on the Resources and Appropriation Theory (Van Dijk & Van Deursen, 2020), which posits that digital access is mediated by personal and positional categories -such as socio-economic status, education level, and geographic location. The framework identifies three levels of digital divide: access divide: Physical availability of technology, skills

divide: Ability to use technology effectively and outcome divide: Benefits derived from digital engagement. This theory is particularly relevant in Sub-Saharan Africa, where structural inequalities intersect with digital exclusion, reinforcing educational disparities (Constancio, 2024).

Recent studies underscore the severity of the digital divide in Sub-Saharan Africa. A pooled analysis of 29 Sub-Saharan Africa countries revealed gaps in internet and mobile cellular subscriptions significantly correlate with lower secondary school enrollment and completion rates (Mouongue & Rutazihana, 2024). In Tanzania, a systematic review found that inadequate digital infrastructure and unprepared lecturers hinder the development of 21st-century skills among university students (Ndibalema, 2025). In Uganda, children with disabilities were disproportionately excluded from digital learning due to inaccessible platforms and a lack of assistive technologies (Benkhadra, 2025). These findings highlight that digital equity is not a monolith; it varies across regions, populations, and educational levels.

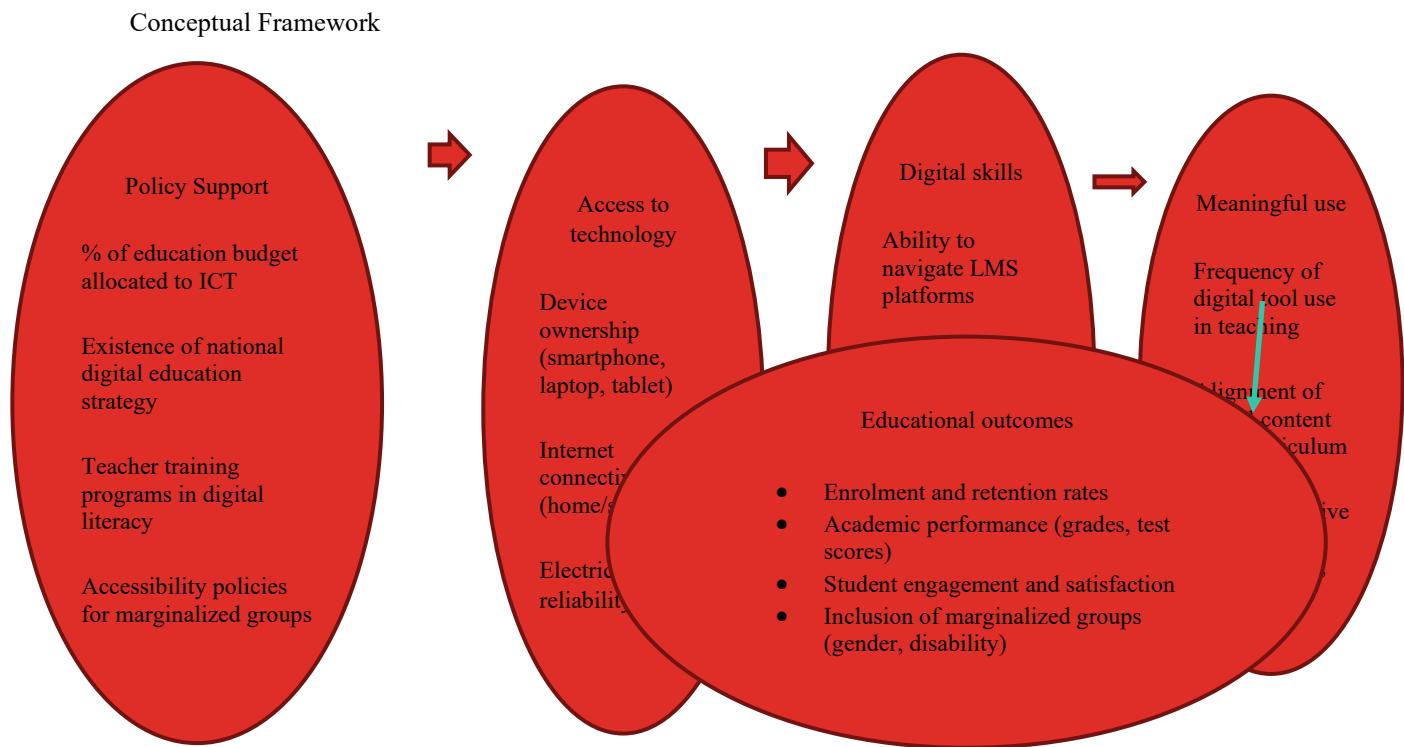


Figure 1: Conceptual Framework

Source: Author (2025)

The conceptual framework in Figure 1 shows a network of policy support which include budget, existence of national digital education strategy and training programmes in digital literacy dovetailing to access to technology such as device ownership, internet connectivity and electricity reliability. Also in the framework is subsequent impact of digital skills encompassing ability to navigate learning management system platforms, use of content creation tools and data analysis proficiency on meaningful use which include frequency of digital tool use in teaching, alignment of digital content with curriculum and use of inclusive design. And lastly, the resulting effects on educational outcomes like enrollment and retention rates, academic performance, student engagement and satisfaction, inclusion of marginalized groups among others.

Methodology

Research Design

This study employs a mixed-methods approach, combining quantitative analysis of regional data with qualitative insights from case studies and policy documents. The rationale for this design is to capture both the breadth of digital equity disparities across Sub-Saharan Africa (SSA) and the depth of lived experiences and institutional responses. The quantitative component uses secondary data from international databases and peer-reviewed studies, while the qualitative component synthesises findings from recent literature, government reports, and institutional case studies. This approach aligns with Constancio's (2024) recommendation for contextualised digital divide research that integrates multiple perspectives and avoids theory-ladenness.

Sampling Technique and Sample

The study covers seven Sub-Saharan African countries, selected based on data availability and regional representation. Countries include Nigeria, Kenya, Ghana, Tanzania, South Africa, Uganda, and Rwanda. For qualitative synthesis, three case studies were selected as follows: University of Dodoma (Tanzania): digital literacy program implementation, University of Cape Town (South Africa): Mobile technology integration and University of Ghana: post-pandemic digital recovery strategies. These cases were chosen for their diversity in institutional capacity, geographic location, and policy engagement.

Method of Collection and Analysis

Quantitative Data were sourced from the World Bank Education Statistics (2020–2024). These are from World Bank and Digital Development Partnership based on Digital House Survey DHS of 48 countries in African countries on Enrolment rates, internet penetration, mobile cellular subscriptions, UNESCO Institute for Statistics: Data on ICT access in schools and teacher training and National Education Ministries: Country-specific reports on digital education initiatives, while the qualitative Data were obtained from peer-reviewed studies from journals such as *Policy Futures in Education*, *Innovation and Education*, and *Cogent Education*, institutional case studies from universities in Tanzania, South Africa, and Ghana and policy documents from ministries of education and ICT. The reason for selecting these three universities is the availability and evidence of digital literacy programs in those institutions. The collected data were content analysed by extracting themes relevant to the specific objectives of the study.

Ethical Considerations

Although this study relies on secondary data, ethical integrity was maintained by citing all sources transparently, avoiding misrepresentation of vulnerable populations, and respecting cultural contexts in interpreting findings. The study also adheres to the Global Campus of Human Rights guidelines for inclusive education research. Policy frameworks across SSA vary widely in scope and effectiveness, while some governments have launched digital education strategies, implementation remains inconsistent. For example, the University of Dodoma in Tanzania has introduced digital literacy programs, but curriculum gaps and resource constraints persist (Ndibalema, 2025). Durevall (2025) emphasises the role of mobile technology in expanding access, particularly in South Africa. However, he cautions that without parallel investments in teacher training and curriculum reform, technology alone cannot close the equity gap.

Results

Table 1: Internet Penetration, Access and Digital Divides (2024)

Country	Internet Penetration (%)	Urban Penetration (%)	Rural Penetration (%)	Smartphone Penetration (%)
Nigeria	54	~70	~30	~40
Kenya	60	~75	~40	~50
Ghana	50	~65	~35	~38
Tanzania	35	~55	~15	~25
South Africa	70	~80	~60	~60

Uganda	30	~50	~10	~22
Rwanda	40	~60	~20	~30

Source: World Bank and Digital Development Partnership DDP 92023)

Table 1 presents the internet penetration, access and digital divides in the sub-sahara Africa. The data presented were from World Bank and digital development partnership based on Digital House Survey DHS of 48 countries in African countries. The findings reveal persistent disparities in digital access, literacy, and inclusion across Sub-Saharan Africa (SSA). The table revealed that South Africa (70%) top the internet penetration with 20% divide between the urban and rural. The trend continues through Tanzania (35%) penetration with about 40% access divide and lastly Uganda (30%) penetration with digital access divide of 40% between urban and rural. While some progress has been made post-COVID-19, structural barriers continue to hinder equitable digital transformation in education.

Table 2: Barriers and Enablers of Digital Inclusion in SSA

Country	Barriers	Enablers
Nigeria	Infrastructure gaps, inconsistent electricity, high data/device costs, gender & rural divides, weak policy implementation	Government digital literacy programs, public/private partnerships, and renewable energy projects
Kenya	Rural infrastructure deficits, affordability of services, and socio-economic disparities	Broadband rollout, innovation hubs, fintech expansion, and strong government digital initiatives
Ghana	Rural-urban access divide, affordability issues, and limited digital skills in rural areas	Youth digital skill programs, improving broadband, and community education initiatives
Tanzania	Electricity shortages, low internet infrastructure, and digital literacy gaps	Policy reforms, NGO/community digital inclusion programs
South Africa	Cost barriers and the digital divide persist in marginalised groups	Advanced broadband infrastructure, strong governance, literacy campaigns
Uganda	Lack of reliable power, poverty, and rural digital illiteracy	Renewable energy access, community training & inclusion efforts
Rwanda	Economic constraints, rural connectivity challenges	Government-led digital inclusion policies, training programs

Table 2 shows the barriers and enablers of digital inclusion in sub-Saharan Africa. The table revealed that barriers that are most prevalent across all the selected countries, skill deficits, affordability and connectivity gaps. The table also revealed

the prevalent enablers such as policy reforms, literacy and campaign on inclusion efforts. The complexity of digital inclusion is a multi-layered social challenge requiring coordinated efforts to reduce inequities and enable meaningful digital participation by all groups, especially marginalised communities. The results advocate for strategic alignment of enablers with identified barriers to achieve equitable access and usage. This is addressed in the next research objective.

Table 3: Policies and Practices for Bridging the Divide

Framework Aspect	Description	Key Actions/Components	Stakeholders Involved
Strategic Vision	National or regional digital learning vision aligned with inclusion and equity goals	Policy guidelines, aligned digital education strategies	Governments, education ministries
Infrastructure & Access	Ensuring affordable, reliable internet and digital device availability	Subsidies, public access points, and device distribution programs	Telecoms, public sector, private partners
Capacity Building	Digital literacy development for students, teachers, and communities	Training programs, curriculum integration, and continuous skilling	Schools, teacher training institutions, NGOs
Inclusive Content & Design	Developing accessible and locally relevant digital learning content	Multilingual resources, disability-accessible platforms	Content developers, education tech firms
Technology Integration	Leveraging emerging technologies such as AI ethically to enhance learning	Personalised learning tools, data-driven decision making	EdTech firms, researchers

Multi-stakeholder Collaboration	Coordinated efforts among government, private sector, NGOs, and communities	Cross-sector partnerships, international cooperation	All sectors
Monitoring and Evaluation	Systems to track implementation, measure impact, and adjust strategies	Data collection, reporting, feedback loops	Policy makers, education researchers

Table 3 shows the policy and practice frameworks for bridging the divide. The table revealed that the policy frameworks, description, key actions and the stakeholders involved in the frameworks. Capacity building, infrastructure access, technology integration, inclusive content and design, multi stakeholder collaboration, monitoring and evaluation were the observed policy frameworks across the selected countries. These frameworks were backed by respective key actions: training programmes, curriculum integration, continuous skilling, public access points and subsidies, personalised learning tools, data collection, reporting and feedback loops.

This finding shows that assistive technology remains under-utilised, especially outside South Africa. While investment is growing, it remains modest relative to need. Durevall (2025) argued that mobile tech alone cannot close the equity gap without parallel investments in pedagogy and infrastructure.

Discussion of Findings

The result on the internet penetration, access and digital divides in the sub-sahara Africa revealed persistent disparities in digital access, literacy, and inclusion across Sub-Saharan Africa (SSA). South Africa topped the internet penetration with mild divide between the urban and rural. Tanzania followed in line of internet penetration with more access divide and lastly Uganda less digital access more divide between urban and rural. While some progress has been made post-COVID-19, structural barriers continue to hinder equitable digital transformation in education.

The result of this study supports that of Mouongue & Rutazihana's (2024) findings who reported that internet access strongly correlates with school enrollment. Countries with higher digital penetration, like South Africa and Kenya, show better educational outcomes. This finding is also in tandem with that of Jinadu, Oyaremi and Rufai (2021) and Jinadu and Okwilagwe (2025) who independently found out that technology is disrupting and shaping different educational landscape with a varying degree of acceptance and adoption across digital natives and digital immigrants. This result is also in tune with the findings of Otunla and Jinadu (2014) who investigated university lecturer adoption of new educational technologies for effective service delivery in undergraduate medical education. The scholar reported a significant difference in the adoption of new technologies across gender and across ages among university lecturers.

The finding on the barriers and enablers of digital inclusion in sub-Saharan Africa revealed that barriers that are most prevalent across all the selected countries are skill deficits, affordability and connectivity gaps. The finding also revealed the prevalent enablers such as policy reforms, literacy and campaign on inclusion efforts. The result of this study agrees well with that of Baidoo-Anu et al (2023) who found out that while smartphones are widely owned, laptops and tablets essential for academic work are less accessible. This confirms a shift from access divide to use divide, as students struggle with functionality and platform compatibility. The complexity of digital inclusion is a multi-layered social challenge requiring coordinated efforts to reduce inequities and enable meaningful digital participation by all groups, especially marginalised communities. The results advocate for strategic alignment of enablers with identified barriers to achieve equitable access and usage.

The result on the policy and practice frameworks for bridging the digital divide revealed that the policy frameworks, description, key actions and the stakeholders involved in the frameworks were suggested. Capacity building, infrastructure access, technology integration, inclusive content and design, multi stakeholder collaboration, monitoring and evaluation were the observed policy frameworks across the selected countries. These frameworks were backed by respective key actions: training programmes, curriculum integration, continuous skilling, public access points and subsidies, personalised learning tools, data collection, reporting and feedback loops.

The result of this study on the policy and practice frameworks for bridging the digital divide corroborates that of Ndibalema (2025) who highlighted efforts to bridge gaps in educator preparedness, especially in higher-order digital skills. These findings reinforce the need for targeted professional development and curriculum reform. The result is also in tandem with Ajani & Gamede (2021) who observed that girls face cultural and economic barriers to digital access which underscores

the need for gender-sensitive digital policies. Also, Benkhadra (2025) emphasised the exclusion of children with disabilities due to a lack of inclusive design. These findings show that assistive technology remains under-utilised, especially outside South Africa. While investment is growing, it remains modest relative to need. Durevall (2025) argued that mobile tech alone cannot close the equity gap without parallel investments in pedagogy and infrastructure.

Conclusion

The study established that digital equity in Sub-Saharan Africa is not merely a technological challenge but also a multidimensional issue rooted in structural inequalities, policy gaps, and socio-cultural dynamics. This study has shown that while access to devices and connectivity is improving in some regions, meaningful use and digital literacy remain significant barriers to educational inclusion. Limited assistive technologies and uneven policy implementation continue to widen the divide. The conceptual framework illustrates how policy support, infrastructure, skills, and pedagogical integration must work in tandem to produce equitable educational outcomes. Bridging the digital divide requires more than hardware it demands human-centred design, inclusive pedagogy, and sustained investment in capacity building. It is therefore recommended that stakeholders must prioritise equity at every level from national policy to classroom practice. Only then can technology fulfill its promise as an empowerment, inclusion, and lifelong learning tool. Meanwhile, the current study relied heavily on secondary data, thereby limiting scope of case studies, generalizability and thus suggests avenues for further research in this area using primary data.

References

Ajani, O. A., & Gamede, B. T. (2021). Gendered barriers to digital education in rural Africa. *Journal of African Educational Research*, 5(2), 45–63.

Baidoo-Anu, D., Gyamerah, K., & Munezhi, M. (2023). Digital divide in higher education in Sub-Saharan Africa: Evidence from online learning during the COVID-19 pandemic. *SN Social Sciences*, 3(122).

Benkhadra, R. (2025). Bridging or widening the gap? Assessing digitalisation's impact on inclusive education for vulnerable children in Africa. *Global Campus of Human Rights*.

Constancio, F. (2024). The digital divide research in sub-Saharan education: Representations, localisation of elements, and theoretical implications. *Policy Futures in Education*.

Durevall, D. (2025). Digital development and educational outcomes in Sub-Saharan Africa. *University of Gothenburg Research Project*.

Jinadu, A. T. & Okwilagwe, E. (2025). Assessment and modelling of research undertaking, digital-technology construct and researchers' statistical software skills. *International Journal of Research in Education and Science (IJRES)*, 11(4), 759-778. <https://doi.org/10.46328/ijres.3724>

Jinadu, A. T., Oyaremi, M. K. & Rufai, M. D. (2021). Assessment of the Oyo state teaching service commission interactive learning platforms during covid_19 lockdown period in Nigeria. *Interdisciplinary Journal of Educational Research*, Volume 3 (1) 37-44. <http://doi.org/10.51986/ijer-2021.vol3.01.04>

Mouongue, A. K., & Rutazihana, P. N. (2024). Digital Divide and its Implications for Education in the Post-COVID-19 Era in Sub-Saharan Africa. *Innovation and Education*, 6(2), 108–132.

Ndibalema, P. (2025). Digital literacy gaps in promoting 21st-century skills among students in higher education institutions in Sub-Saharan Africa: A systematic review. *Cogent Education*, 12(1), 24-52.

Nnstancio, F. (2024). The digital divide research in sub-Saharan education: Representations, localisation of elements, and theoretical implications. *Policy Futures in Education*.

Otunla, A. O. & Jinadu, A. T. (2014). University Lecturers' Adoption of New Educational Technologies for

Effective Service Delivery in Undergraduate Medical Education. Journal of Educational Media and Technology. Volume 18 (1), pages 48-54.

Van Dijk, J., & Van Deursen, A. (2020). *The Digital Divide: Resources and Appropriation Theory*. Amsterdam University Press.

IMPACT OF LABOUR EXCHANGE CENTRES ON INCOME GENERATION IN TANKE, ILORIN KWARA STATE, NIGERIA

¹Halimah Oyebola AKINOSO & ²Sabainah Oyebola AKINOSO

¹Department of Business Administration, Coles College of Business, Kennesaw State University, USA

²Department of Science Education, Faculty of Education, University of Lagos

Abstract

The labour Exchange center plays a critical role in the effective and efficient organization of the labour market, and the attainment of the long-term goal of full, productive, and freely chosen employment. However, Nigeria has a lower concentration of research on the labour exchange center and income generation. Therefore, the study investigated the impact of labour exchange centers on income generation in Tanke, Ilorin. Specifically, the study examined the availability of the labour exchange center, its impact on the level of unemployment and the standard of living, and its contribution to Kwara State's internally generated revenue. A total of 100 casual workers in Tanke, Ilorin, were randomly selected with a simple random sampling process. A questionnaire was constructed; the responses to the questionnaire were complemented through personal interviews with the SMEs by the researcher. Descriptive analysis was used to identify the socio-economic characteristics of the respondents, and ordinary least squares (OLS) was used to test the significant impact of the labour exchange center on the level of unemployment, standard of living, and contribution to internally generated revenue. Findings of the study revealed; The Labour Exchange Centre enhances the number of hours worked by those who are registered with and have received training from the centre; those who visit the centre regularly pay more tax than those who do not, and as such, improve the IGR of the state and there was no statistically significant positive impact of the labour exchange centre on the standard of living of the respondents. It was recommended based on the findings of this study that unemployed youth in the state should patronize the labour exchange centre, as it has the potential to link them with employers; employers should also look towards the labour exchange centre while recruiting their workforce; and the state should grant registration status and then provide a regulatory role to the centre for proper organization.

Introduction

Employment security cannot only be achieved through economic growth and well-designed employment policies but must also be supported by complete and solid implementation of those policies (Sungpil, 2015). In implementing and delivering labour market programmes at the local level, labour exchange centers play an overarching role in achieving employment security, employment promotion, and job creation. The Labour Exchange Center refers to an organization that matches employers to employees. Labour exchange center adopts or provides job seekers and employers with services such as job placement and labour market information. The labour exchange center plays a critical role in the effective and efficient organization of the labour market, and attainment of the long-term goal of full, productive, and freely chosen employment. By facilitating the efficient matching of supply and demand for labour and alleviating structural and frictional bottlenecks in the labour market, employment services contribute to a better functioning of the labour market, improved productivity, overall growth, and poverty reduction. Labour exchange centers in a developing country context can assist in the implementation of employment policies, provision of labour market information and matching services, with respect to the informal economy, promoting self-employment and formalization of such employment. In the latter case, employment services provide information on various labour market programmes being offered, as well as ensuring coordination of such services to maximize their impact.

In all developed countries, there is a publicly funded employment agency and multiple private businesses that act as employment agencies. Examples of such include employment services in Korea, which have been provided by various types of organizations, such as the central government, local governments, government-affiliated bodies, and private employment agencies (Krivet, 2010). In other words, both public employment services and the private agencies co-exist in Korea. However, the public employment services are more developed and play a key role in the labour market in terms of their size, functions, and performance. By contrast, the private employment agencies tend to be smaller in terms of human and material resources and provide job placement services and carry out tasks outsourced by the public employment service (Krivet, 2010). Although some parts of the public employment service are provided by a few Korean central government ministries, local governments, and government-affiliated bodies, the core organization delivering the public

employment service is the labour exchange centre operated under the supervision of the Ministry of Employment and Labour (MOEL) (Dug Ho, 2014).

Similarly, the Federal Ministry of Labour and Employment in Nigeria implemented National Labour Exchange programmes to promote job exchange processes across Nigeria. National Labour Exchange is designed to evolve a database of employable labour in the country in order to facilitate the job exchange functions of the Ministry. It provides advice on skill demand, thereby creating a link between employer needs and skills, and provides employers with both local and international access points to the available labour in the country (National Electronic Labour Exchange, 2016). Ogundare (2016) argued that the Lagos State Ministry of Wealth Creation and Employment inaugurated the job registration/labour exchange centre to enable jobless youths and artisans get their data captured and guidance and counselling to register and guide them through a career path. The labour exchange center provides employability skills for those who are seeking employment so that in the long run, citizens would get something doing in terms of getting paid or being self-employed. Hence, reduces social vices and poverty level; improving the standard of living of the people, through income generation in the state in terms of creation of wealth and employment.

However, no other state government in Nigeria has a formal setting of a labour exchange center, and as such, it is regarded as an informal sector. Ghebregiorgis, Mehreteab, and Hailemariam (2016) argued that in the developing world, the informal sector is generally a larger source of employment than the formal sector. Scholars were of the view that the informal sector is seen as having a positive influence on the economy because it creates more jobs and grows more quickly than the formal sector. In general, the informal sector contributes to the nation's income; it creates employment and serves as an important linkage with the formal sector of an economy (Blunch & Dhusyant, 2001; Chen, 2001; Charmes, 2000; Hussmanns, 2004). Similarly, (Rakowski, 2014; Moser, 2014) argued that the informal economy provides a solution to poverty and economic problems of developing countries and is a useful tool in improving the economic situation of the poor as it generates employment and income for the poverty-ridden masses. Despite the sectors' contribution to income generation, it could still be observed that there is rampant poverty raging among those who are active in this sector. As a result, many researchers associate poverty with the informal sector. Some scholars express their concern over the tendency to conflate informality and poverty as one and the same. The fact that most of the world's poorest people work in the informal sectors has led observers to use the terms 'informal' and 'poor' almost synonymously, as well as other terms associated with vulnerability, such as 'marginalized', 'excluded', or 'precarious'. But not all informal workers have poor income, and not all who earn poor income are engaged in the informal economy (Peattie, 2007).

Statement of the Problem

In the contemporary global world, the upshot of unemployment has become an all-encompassing concern. It is a challenge that most economies are facing in the current economic circumstances. Research has also shown that unemployment was high in the 1980s, but the available reports from various local and international bodies show glaring evidence of joblessness in decades of Nigeria's chequered history, where unemployment is as serious as it is now. The Labour Exchange Center is a special income generation intervention adopted throughout the globe. The Federal Ministry of Labour and Employment in Nigeria launched a labour exchange center to match employers to suitable employees, reduce unemployment, ensure wealth creation, and reduce the poverty level across the nation. However, though the formal public labour exchange center is yet to be reported in Nigeria, the available labour exchange center is characterized as non-formal and casual. The non-formal labour exchange center recorded a large number of would-be employees daily. The settings allow for a would-be employee to be on stand while waiting for an employer that will hire them for any form of services, such as washing and cleaning, or working as construction labourers. Despite the large number of labourers who turn out daily, the exchange center is yet to gain approval of the State or any other formal institutional support. This could be due to the low level of engagement in taking up small economic activities, low capital, low manpower, and above all, a low gestation period. Furthermore, the study area is characterized by poor educational access and a poor standard of living despite the income generation of the people in the study. Thus, it is pertinent to look into the impact of labour exchange centers on income generation in Tanke Area in Ilorin, metropolis.

Objectives of the Study

The main objectives of this study are to determine the impact of labour exchange centers on income generation in Tanke, Ilorin. Other specific objectives are to:

1. Examine the availability of the labour exchange center in the Tanke area, Ilorin.
2. Assess the impact of the labour exchange center on the level of unemployment in the Tanke area, Ilorin.
3. Evaluate the impact of the labour exchange center on the standard of living in the Tanke area, Ilorin Metropolis.
4. Evaluate the contribution of the labour exchange to internally generated revenue in Kwara State.

Research Questions

The following questions were answered in this research.

1. What is the level of labour exchange center availability in Tanke area Ilorin, Kwara State?
2. Does labour exchange center reduce the level of unemployment in Tanke area, Ilorin?
3. Does labour exchange center improve standard of living in Tanke area in Ilorin?
4. Does labour exchange center contribute to internally generated revenue in Kwara State?

Hypotheses

H_01 : Labour exchange center has no impact on unemployment level in Tanke area, Ilorin.

H_02 : Labour exchange center has no impact on standard of living in Tanke area, Ilorin.

H_03 : Labour exchange center has no impact on internally generated revenue of Kwara state.

Review of Related Literature

Labour is regarded as one of the primary factors of production. Labour is the collective name given to the productive service, embodied in human physical efforts, skill, and intellectual power. There are different types of effort and skill content. This means that labour input is not homogeneous according to the principle of economics of production. Resources are relatively scarce or limited in supply, which means the demand for goods and services exceeds the productive capacity. The word is volatile, uncertain, complex, and ambiguous (Akinoso, 2015). It requires innovative experience and strategies always (Akinoso, Awofala, 2021). Since resources are scarce and human wants are unlimited, society is obliged to manage these resources efficiently. Labour economics, therefore, looks at ways labour as a resource could be efficiently utilized. Labour market institutions are generally regarded as an important determinant of efficient economic performance and welfare distribution in an economy. However, there is no consensus regarding the kind of policy that positively affects the economy in relation to its cost (Botero et al., 2004). For example, the sovereign debt crisis in European countries since the middle of the 2000s revealed the challenges of agreeing on priorities in labour market policies when the government budget is strictly constrained.

The intricacy of labour market policies is mainly due to the complex relation among policies themselves, which are usually divided into four dimensions. First, the mandatory provisions of labour contracts, which determine the minimum level of wages, the maximum hours of work, and other important items of the contracts. Generally, a simple mutual agreement between an employer and employee cannot escape legal provisions; in other words, the restriction on freedom of contracts is the fundamental root of labor market policies. Second, policies that provide income support for disadvantaged people, typically provided by unemployment insurance, are often referred to as "passive" labour market policies. Based on a normative tradition of poverty relief, which most societies have historically constructed as a safety net in terms of income. Third, "active" labour market policies involve the solving of inefficient mismatches in labour markets by intermediating demand and supply by public employment offices and other entities. Occasionally, this involves vocational training of job seekers, who can then obtain skills that meet the potential demand of employers.

As governments prepare labour market policies bearing in mind all the categories mentioned above, it is not easy to isolate the effect of a single institution. A typical example is numerous econometric evaluations of unemployment benefits and vocational training. Although economists have attempted to exploit carefully designed experimental circumstances, they have not yet reached an unambiguous consensus (Card et al., 2010). These trials indicate that it is difficult to simultaneously control for the four policy dimensions mentioned above in sophisticated societies. Given such difficulties, a historical

review provides an alternative means of understanding and evaluating the role of labor market institutions in the process of economic development. Before the 1930s, labor market institutions were much simpler even in the three most industrialized economies, including the US, the UK, France, and Germany. In addition, their economic circumstances had some similarities to those of certain developing and emerging countries of today, which allows us to deduce practical policy implications from their historical experiences.

Labour Exchange Center refers to an office of the central or state government, which collects and furnishes information on the prospective employers, available vacancies, and job seekers, thereby facilitating job seekers to find a suitable job and for industry to find suitable manpower. Job seekers register themselves with the Employment Exchanges and get notified as soon as any vacancy matches their desired profile. The main activities of the employment exchanges are registration and placement of job seekers, and to some extent, career counselling and vocational guidance, particularly for the under-privileged sections of society, and the collection of employment market information. Some of the State Governments arrange the disbursement of unemployment allowance to certain specific categories of job seekers out of their own resources through the employment exchanges registered with them.

Theoretical Review

The theoretical support for output growth in economic discussions usually centres on theoretical analysis of labour and industrial relations.

The Dualist Approach: The dualist approach explains the informal sector as a set of subsidiary activities that provide incomes for the deprived, those who are incapable (for various reasons) of accessing employment in the formal sector (Reimer, 2003). According to Gordon (1982: 188), the informal sector growth is because not enough modern job opportunities have been created to absorb surplus labour, due to a slow rate of economic growth and/or a faster rate of population growth." The formal sector dominates the key industrial sector, capturing rapidly expanding markets and initiating innovative technological changes. As the economy grows, the formal sector economy becomes increasingly differentiated from the informal sector economy that remains on the periphery. African countries are characterised by more than one "labour market" with huge differences between one market and another (Chen, 2007). The labour market is the market in which people battle for occupations and employers compete for the available workforce. There are various ways of thinking about these two markets: informal-formal markets. The formal sector is deemed superior to the informal sector, and these two types of sectors result in economic dualism that comprises informal sector employment and formal sector employment (Gorden, 1988).

Human Capital Investment Theory: This theory was put forward by Becker in 1975. Through the theory, Becker (1975) highlights various interaction paths between income expenditure and human capital development. The theory explicitly demonstrates that spending increases human capital and enhances an individual's income-generating ability in the form of an increase in output. The theory in its original form states that high income allows people to invest more financial resources in educational attainment, both in terms of quantity and quality, which may eventually affect both present education performance and future education demand.

Neo-liberalism: Peruvian economist Hernando De Soto caused a paradigm shift of sorts when he published his treatise on Latin America's informal sector (Henken, 2005). Neo liberalism is an ideology based on economic liberalism. The ideology favours economic policies that minimize the role of the state and maximize the private business sector (Wikipedia, 2010). Neo-liberalism seeks to transfer control of the economy from the public to the private sector under the belief that it will produce a more efficient government and improve the economic health of the nation. De Soto (1989) asserts that the informal sector is a response to excessive state regulations. De Soto subscribes to the notion that the informal sector comprises 'plucky' micro-entrepreneurs who choose to operate informally to avoid the costs, time, and effort of formal registration. He noted that micro-entrepreneurs would continue to produce informally so long as government procedures are cumbersome and costly in terms of bureaucratic red tape, lack of property rights, and difficult accessibility to productive resources like finance and technology. In his view, unreasonable government rules and regulations are stifling private enterprise.

Methodology

A descriptive design of the survey type was used for this study. A survey technique was employed based on the nature of the area under study, which demands a significant amount of data from a meaningful population size in an efficient manner. The two survey techniques employed are the questionnaire and interview, since they are the methods that are well understood by researchers. A structured questionnaire was used and designed to capture accurate data and unbiased responses. The study employs a cross-sectional survey design. A cross-sectional survey design is a suitable way to describe events and opinions rather than the manipulation of variables (Oso & Onen, 2009). It is this intention to describe "variables as they are" that made the sectional survey an ideal design for the study.

The study targeted population is the labour exchange center and the readily available casual workers in Tipper garage junction, Tanke. The sampling technique used was simple random sampling since not all casual workers in Tanke can be reached for data. A simple random sampling technique was used to provide equal chances of being selected for fair and adequate distribution of the research instrument used (Questionnaire). The technique was used to select 100 casual workers, who constituted the respondents' frame. Of the 100 distributed questionnaires, 95, representing 95 % were useful for the analysis of the study. The instrument used was a researcher-designed and well-structured questionnaire. Since the sample size is 100 respondents, a total of 100 copies of the questionnaire were administered for the purpose of this study. The questionnaire was structured to ensure that all the data collected for the research were accurate and transparent. The questionnaire was based on five sections: A', 'B', 'C', 'D', and 'E'. Section A sought the demographic information of the respondents, while 'B', 'C', and 'D' provide the level of unemployment, standard of living, and internally generated revenue in Kwara state, respectively.

Model Specification

The model for this study is specified based on the lessons learnt from the reviewed theoretical and empirical literature. Based on the model of Iturbe (2003) the model for this study is accordingly expressed as follows

$$Y=f(LEC, HHC)---(1)$$

Where Y, is the dependent variable, is the income generation of casual workers which depends on (LEC), that is labour exchange centers, and HHC that is household characteristics.

The model can be decomposed and modified as

$$Y=(UE, SOL, IGR)---(2)$$

Where UE is the level of unemployment, SOL is the standard of living, IGR is the internally generated revenue.

$$HHC=(GND, MRST, FMS)---(3)$$

Then

$$Y=f(LEC, GND, MRST, FMS)---(4)$$

Using 2, the three models of the study are $UE=f(LEC, GND, MRST, FMS)---(5)$

$$SOL=f(LEC, GND, MRST, FMS)---(6)$$

$$IGR=f(LEC, GND, MRST, FMS)---(7)$$

The three (3) equations above can be expressed in linear form as:

$$UE=\beta_0+\beta_1 LEC+\beta_2 GND+\beta_3 MRST+\beta_4 FMS+\mu---(8)$$

$$SOL=\beta_0+\beta_1 LEC+\beta_2 GND+\beta_3 MRST+\beta_4 FMS+\mu---(9)$$

$$IGR=\beta_0+\beta_1 LEC+\beta_2 GND+\beta_3 MRST+\beta_4 FMS+\mu---(10)$$

Where all variables are as described above,

β_1 to β_4 are the slope coefficients to be estimated,

β_0 is the intercept term and μ is the error term

Variable Description and Measurement

The dependent variables of the study are unemployment, standard of living and IGR. The unemployment is measured using the number of hours worked by individuals. The more hours an individual works in a week, the lower the tendency of him/her being categorized as being unemployed. The standard of living is measured by addition of five (5) key indicators and individual has very low standard of living if he/she is only able to meet one, low if two, moderate if 3, high if four and very high if 5. The IGR is measured by the amount that an individual pay annually on average as tax to the state government.

The independent variables of the study include labour exchange which is assigned 1 if individual visit the labour exchange centre regularly and 0 otherwise; gender (GND) which is assigned 1, if individual is male and 0 if female; marital status which is assigned individual is single and 0 if married, and family size which is the number of individual in the household of the respondent.

Table 1: Summary Statistics

Variable	Obs	Mean	Std.Dev.	Min	Max
Continuous Variables					
HoursWorked per week	95	13.932	12.066	0	50
TaxPaid per year	95	1360.588	1318.711	0	4000
95					
Categorical Variables					
Frequency					
Percent					
SOL:					
Very low			23	24.21	
Low			25	26.31	
Moderate			22	23.16	
High			21	22.11	
Very High			4	4.21	
Maritastatus:	95				
Single			59	62.11	
Married			36	37.89	
Divorce			0	0	
Gnd:	95				
Male			60	63.16	
Female			35	36.84	
LEXC:	95				
Visit Regularly			67	70.52	29.47
Not Visit Regularly			28		

Source: Author's computation, 2019

The summary statistics of the variables of the study are presented in table 1. From the table, the respondents worked for an average hour of 13.9 per week and paid on average #1,360.00 annually as tax. The study also revealed that, the 24.21 percent reported very low level of living standard and 26.31 percent reported low level of living standard, 23.16 reported moderate, 22.11 reported high and 4.21 percent reported very high level of living standard. Of all the respondents, 62.11 percent are single while the remaining 37.89 percent are married. Also, 63.16 percent are male while 36.84 percent are female. In terms of

visitation to the labour exchange centre, 70.52 percent of the respondents visit the centre regularly while the remaining 29.47 percent do not visit regularly. The inability of the proportion of respondents to visit the labour exchange centre may be as a result of lack of awareness and the nature of the centre since it is not organized. The correlation coefficients among the variables are presented in the correlation matrix of table 2. The correlation matrix shows that the variables are moderately related and none of the estimated coefficient is close to 0.9. This implies that the problem of multicollinearity is not likely to be encountered in the regression analysis to obtain the slope coefficient of explanatory variables in each of the regression models of this study.

Table 2: Correlation Matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) SOL	1.000						
(2) HoursWorked	0.333	1.000					
(3) TaxPaid	0.235	0.889	1.000				
(4) LEXC	0.135	0.297	0.357	1.000			
(5) Gnd	0.068	0.201	0.194	0.542	1.000		
(6) maritastatus	0.172	0.133	0.137	0.207	0.200	1.000	
(7) Fms	0.044	-0.129	-0.153	-0.341	-0.197	-0.127	1.000

Source: Author's Computation, 2019

Regression Results

This section presents the estimated regression results for each of the three models in the study. Table 3 relates to the assessment of the impact of labour exchange on the internally generated revenue of Kwara state. The results show the variable signs of LEXC as positive indicating that, labour exchange has a positive impact on the tax remittance by the respondents. The effect is not only positive, but also statistically significant at 1 percent level given its associated p-values of 0.000 which is less than 0.01. The implication of the result is that, the average tax paid by those who visit the centre regularly are higher than those who do not collaborate with the labour exchange centre in Tanke area of Ilorin.

Table 3: Estimated Regression Results for IGR

TaxPaid	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]
LEXC	904.429	233.193	3.88	0.000	444.003	1364.855
Gnd	-19.082	212.315	-0.09	0.928	-438.286	400.122
Maritastatus	183.038	159.938	1.14	0.254	-132.752	498.827
Fms	-22.485	44.179	-0.51	0.611	-109.715	64.744
Constant	985.373	258.261	3.81	0.000	475.450	1495.295
Mean dependent var		1360.58	SD dependent var			1318.711
		8				
R-squared	0.132		Number of obs			95.000
F-test	4.658		Prob > F			0.001
Akaike crit. (AIC)		2910.01	Bayesian crit. (BIC)			2925.697
		8				

Source: Author's Computation, 2019

The results further revealed that, none of the control variables of the study is statistically significant at any conventional level of significance. This is because none of the control variables coefficient has an associated p-value that is below at least 0.1.

The results of the R-squared (R^2) indicate 13.2 percent which is relatively low, which is tolerable in cross-sectional study (Gujarati, 2009). The F-test with its corresponding p-values of 0.001 shows all the explanatory variables are jointly significant in explaining the model. The post estimation heteroscedasticity is presented in appendix section, and the results accept the null hypothesis of constant variance. Thus, there is no evidence of heteroscedasticity in the model.

The results in table 4 relates to the impact of labour exchange on job creation. The results indicate that, those who visit the labour exchange centre regularly work longer hour in a week than those who do not. This is further demonstrated by the positive signs of the coefficient of the labour exchange rate. This result is significant at 1.0 percent level of significance with a p-value of 0.003 that is less than 0.01. From the three control variables included in the study, none of the variables have significant influence on the hours worked by the respondents.

Table 4: Estimated Regression Results for Job Creation

HoursWorked	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]
LEXC	6.084	1.990	3.06	0.003	2.156	10.013
Gnd	1.159	1.770	0.66	0.514	-2.336	4.654
Maritastatus	1.772	1.615	1.10	0.274	-1.416	4.960
Fms	-0.175	0.445	-0.39	0.695	-1.054	0.704
Constant	10.501	2.679	3.92	0.000	5.211	15.791
Mean dependent var		13.932		SD dependent var		12.066
R-squared		0.096		Number of obs		95.000
F-test		3.485		Prob > F		0.009
Akaike crit. (AIC)		1321.05		Bayesian crit. (BIC)		1336.737
		8				

Source: Author's Computation,
2019

The results of the R^2 to be shows 5.1 percent. Though it is relatively low, such result is not uncommon with cross-sectional data according to Gujarati (2009). The F-test with a p-value of 0.067 indicates that the explanatory variables are jointly significant in explaining the model since it is at least less than 0.1. The Breusch-Pagan post estimation diagnostic test failed to reject the null hypothesis of constant variance indicating no evidence of heteroscedasticity .

Table 5 result presents the standard of living of the respondents and assess to labour exchange centre. The results show that though labour exchange positively affect the standard of living with the coefficient of LEXC being positive, the impact is not significant since the p-value of 0.103 is above 0.1. Among the explanatory variables, only marital status has positive and significant impact on the standard of living while the remaining two are not statistically significant since their corresponding p-value is above 0.1. Thus, labour exchange has no impact on the standard of living of the respondents.

Table 5: Estimated Regression Results for Standard of Living

SOL	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]
LEXC	0.413	0.252	1.64	0.103	-0.085	0.911
Gnd	-0.068	0.237	-0.29	0.775	-0.535	0.399
Maritastatus	0.441	0.217	2.04	0.043	0.013	0.869
Fms	0.079	0.057	1.38	0.168	-0.034	0.191
Constant	1.920	0.334	5.74	0.000	1.260	2.580
Mean dependent var		2.676	SD dependent var			1.308
R-squared		0.051	Number of obs			95.000
F-test		2.236	Prob > F			0.067
Akaike crit. (AIC)		573.795	Bayesian crit. (BIC)			589.474

Source: Author's Computation,
2019

The F-test and the associated p-value of 0.067 indicate that the explanatory variables of the model are jointly significant in explaining the behavior of standard of living. The post estimation Breusch-Pagan diagnostic test of heteroscedasticity failed to reject the null hypothesis of constant variance which

indicates that no evidence of heteroscedasticity is present in the result.

Discussion of Findings

The results presented above indicate that labour exchange centre enhances the number of hours worked by those who are registered with and received training from the centre. The implication of this is that labour exchange centre can play a key role in government efforts and concerned stakeholders in reducing unemployment thereby increasing productivity in Nigeria. Similarly, the results further revealed that, those who visit the centre regularly pay more tax than those who do not. The implication of this finding is that labour exchange centre creation can play a key role in the internally generated revenue enhancement effort of the government.

Also, the results could not have established positive statistically significant impact on labour exchange centre on the standard of living of the respondents. The explanation for this outcomes may be that, even though this increases the number of hours worked by the respondents that visit the centre regularly, the level of increase in their income is not substantial enough to improve their level of well-being to the fact that majority of them are under paid for the work done.

In the contemporary global world, Nigeria inclusive, the up-shoot of unemployment has become an all reaching concern. Research have shown that, unemployment was high in the 1980s, but the available reports from various local and international bodies, and the glaring evidence of joblessness in this decades are clear indications that there was no time in Nigeria's chequered history that, unemployment is as serious as now (Arosanyin, Olowosolu and Oyeyemi, 2011). By facilitating the efficient matching of supply and demand for labour and alleviating structural and frictional bottlenecks in the labour market, labour exchange centres can help to reduce the level of unemployment. The study put this into empirical test by examining the extent to which labour exchange centre in Tanke Areas facilitates income generation.

The study was based on the neo liberalism theory framework which models the relationship between informal sector (trade workers) in relation to income generation on one hand and poverty alleviation on the other hand relevant to MDG goals. The study used linear regression model to analyse the data generated through Ordinary Least Square methods. The validity of the method was tested using post estimation diagnostic tests such as; heteroscedasticity test (using Breusch- Pagan-Godfrey test). The results of the test show no evidence of serial correlation and heteroscedasticity. The study examines the possibility of the presence of multicollinearity based on the correlation coefficient results, it was however found that, there was no evidence of multicollinearity since the correlation coefficients are not in any way closer to 0.9.

The results of the OLS regression revealed a positive and statistically significant impact of the labour exchange centre on the number of hour that the participants work. On average, those who visit labour exchange centre regularly work approximately 6.084 hours more than those who do not. It was also found that those who visit the labour exchange centre pay more in taxes on average than those who do not. Specifically, they paid on the average, #904 as tax annually than those who do not visit the centre regularly. However, the study failed to find positive impact on the labour exchange centre on the standard of living of the participants. This could be due to the fact that the participants are being under paid by their clients. All the control variables used to avoid omitted variable bias are not statistically significant in the first two models, but marital status of the respondents influences their standard of living.

Conclusion

Labour exchange centre improves income generation of both individual and the government. The significant impact on labour exchange centre and job creation was established in this study thereby leading to increase in internally generated revenue for the state. However, though the impact on the standard of living was positive, it was not statistically significant as indicated in the results obtained.

Recommendations

The recommendations of this study are as highlighted below:

- (i) Unemployed youth in the state should patronize labour exchange centre as it has potential to link them with employers. This action will help them to quickly and easily come in contact with the employers who may need their skills.
- (ii) Employers in the state should also look towards the labour exchange centre while recruiting their workforce. According to the findings of the study, over sixty percent unemployed are already patronizing the centre. By patronizing the area, employer could easily find the people with skill required at relatively lower transaction/search cost.
- (iii) The state should grant registration status and then provide regulatory role to the centre to ensure that this is more organized. This will ensure that, workers are adequately remunerated and improve confidence on the employer and workforce from this centre.

References

Akinoso S. O. & Awofala A.O. (2021). Innovation and Mathematics Teaching in the Era of Globalisation. *Education in a Rapid Changing World*, 57-71.

Akinoso S. O. (2015). Teaching Mathematics in a Volatile, Uncertain, Complex and Ambiguous (VUCA) World: The use of concrete-representational-abstract instructional strategy. *Journal of International Society for Teacher Education (JISTE)*, 19 (1), 96-107.

Arosanyin, G. T., Olowosolu, M. O., & Oyeyemi, G. M. (2011). Employment generation and earnings in the informal sector in Nigeria. *International Business and Management*, 2(2), 66–74.

Becker, G. S. (1975). Human capital: A theoretical and empirical analysis, with special reference to education (2nd ed.). National Bureau of Economic Research.

Blunch, N. H., & Dhushyanth, R. (2001). The informal sector revisited: A review of evidence from the literature. The World Bank.

Botero, J. C., Djankov, S., La Porta, R., Lopez-de-Silanes, F., & Shleifer, A. (2004). The regulation of labor. *The Quarterly Journal of Economics*, 119(4), 1339–1382.

Card, D., Kluve, J., & Weber, A. (2010). Active labor market policy evaluations: A meta-analysis. *The Economic Journal*, 120(548), F452–F477.

Charmes, J. (2000). The contribution of the informal sector to GDP in developing countries: Assessment, estimates, methods, orientations for the future. Fourth Meeting of the Delhi Group on Informal Sector Statistics, New Delhi, India.

Chen, M. A. (2001). Women in the informal sector: A global picture, the global movement. *SAIS Review*, 21(1), 71–82.

Chen, M. A. (2007). Rethinking the informal economy: Linkages with the formal economy and the formal regulatory environment (DESA Working Paper No. 46). United Nations Department of Economic and Social Affairs.

De Soto, H. (1989). *The other path: The invisible revolution in the Third World*. Harper & Row.

Dug Ho, K. (2014). Employment services in Korea: History and current status. Korea Labor Institute.

Ghebregiorgis, F., Mehreteab, H., & Hailemariam, A. (2016). The impact of the informal sector on income generation in Eritrea. *Journal of Developing Areas*, 50, 359–370.

Gordon, D. M. (1982). *Segmented work, divided workers: The historical transformation of labor in the United States*. Cambridge University Press.

Gordon, D. M. (1988). The global economy: New edifice or crumbling foundations? *New Left Review*, (168), 24.

Gujarati, D. N., & Porter, D. C. (2009). *Basic econometrics* (5th ed.). McGraw-Hill/Irwin.

Henken, T. (2005). Cuba's second economy: From behind the scenes to center stage. *Cuban Studies*, 36, 13–40.

Hussmanns, R. (2004). Measuring the informal economy: From employment in the informal sector to informal employment (Working Paper No. 53). International Labour Office.

Iturbe, P. (2003). *Economic models of informal labour markets*. University of Madrid.

Kayode, A., Arome, A., & Ayio, A. (2014). Impact of unemployment on economic growth in Nigeria. *International Journal of Business and Economics Research*, 2(1), 20–30.

Krivet. (2010). Employment services and labor market performance in Korea. Korea Research Institute for Vocational Education and Training.

Moser, C. O. N. (2014). *Gender, planning and human rights*. Routledge.

National Electronic Labour Exchange. (2016). About Nelex. Federal Ministry of Labour and Employment.

Ogundare, T. (2016). Lagos inaugurates job registration centres. *Vanguard Nigeria*.

Oppong, S., & Sachs, J. (2015). *The age of sustainable development*. Columbia University Press.

Oso, W. Y., & Onen, D. (2009). *A general guide to writing research proposal and report*. Jomo Kenyatta Foundation.

Peattie, L. (2007). An essay on the informal economy. *Review of Urban and Regional Development Studies*, 1(2), 90–105.

Rakowski, C. A. (2014). *Contrapunto: The informal sector debate in Latin America*. SUNY Press.

Reimer, S. (2003). Payment for care: A political economy of the informal sector. *Review of Political Economy*.

Sungpil, K. (2015). The employment safety net in Korea. Korea Labor Institute.

Wikipedia. (2010). *Neoliberalism*. <https://en.wikipedia.org/wiki/Neoliberalism>

STUDENTS' ATTITUDE TO PROBLEM-SOLVING, CAREER ASPIRATION AND LOCUS OF CONTROL AS DETERMINANTS OF STUDENTS' ACHIEVEMENT IN STOICHIOMETRY

Adedeji TELLA & Adeleke Sunday ADESINA

Department of Science and Technology Education
Faculty of Education,
University of Ibadan, Nigeria

Department of Science Education
Faculty of Education
University of Lagos, Nigeria

aadesina@unilag.edu.ng

Abstract

This study determined the predictive relationship of students' attitude to problem-solving, career aspiration in chemistry and locus of control as predictors of students' achievement in stoichiometry at senior secondary school level. Using multi-stage sampling, the study sampled a total of 1,171 students from public schools in Lagos State, Nigeria. Three research questions were raised and answered in the study. Four research instruments were used to collect data for the study. The instruments were validated and the reliability was determined using Cronbach Alpha and KR-20. The data were analysed using Pearson Product Moment Correlation and Regression at 0.05 level of significance. The findings of the study showed that students' attitude to problem-solving and locus of control had a significant positive relationship with students' achievement in stoichiometry while the relationship with career aspiration was positive but not significant. The study also shows that the variables had a significant composite contribution in predicting students' achievement in stoichiometry with attitude to problem-solving and locus of control having significant relative contributions. It was therefore recommended among others, that education stakeholders should give more attention to improving the non-cognitive factors of locus of control, attitude to problem-solving and career aspiration in chemistry. Schools should also organize career day to show students career opportunities available in chemistry and science.

Introduction

Stoichiometry is regarded as one of the fundamental tools for understanding some essential concepts in chemistry. Stoichiometry focuses on establishing the quantitative relationships among constituents (elements and compounds) in a chemical reaction. According to chemistry educators, solving those stoichiometric problems necessitates having a solid understanding of chemical concepts, being able to create and balance chemical equations, and being able to use those balanced equations to determine the amount of the substances involved in the reactions. However, despite the importance of stoichiometry to chemistry, evidence in literature reveals that students have demonstrated challenges in learning some stoichiometry concepts such as balancing of chemical equations, mole concept, mass and volume relationships, identification of limiting reagents and theoretical yield as indicated by WAEC Chief Examiners' Report, 2013 -2016, 2018 -2019).

More so, Shadrack and Enunuwe (2018), found that students struggle to identify the limiting reagent, utilize inconsistent stoichiometry relationships, balance chemical equations poorly, and show poor understanding of theoretical yield determination and identification of substances in excess. Olatunde (2021), identified that students cannot balance chemical equations, properly identify products and reactants, and also cannot make sense of subscripts in a reaction. Researchers have associated many student characteristics to their achievement in stoichiometry. Among them are student attitude (Omilani and Ajayi, 2023); career aspiration (Anis, Krause and Blum, 2016); and locus of control (Arsini, Ahman, and Usmana, 2023).

Attitude serves as a key factor that motivates students towards achieving success (Mohtar, Halim and Iksan, 2016). Students' like or dislike for a subject influences their achievement in that subject. According to Jader et al. (2020), one of the essential competencies' students need to have to fit into today's fast changing world is problem-solving. Problem-solving is a mental process that entails determining how to accomplish an objective. It involves application of knowledge and computational skills to achieve set goals geared towards providing solutions to identified problems. Peloff (2016) defined students' attitude to problem-solving as the emotional and mental disposition that drives a student towards solving problems to achieve specific goals. Furthermore, the ability of a learner to apply the theoretical concepts he has learnt in solving quantitative concepts and problems in chemistry and in life is essential for building learners who will become problem solvers in the future. However, the chief examiners reports showed that one of the causes associated with students' failure in chemistry is their poor problem-solving skills which could have resulted from students' negative attitude towards problem-solving. The attitude that students have toward solving mathematical problems and their academic performance are positively correlated, according to Cutumisu and Bulut (2017).

The term "career aspiration" refers to a person's ideal, intended professional path, and the degree to which they plan to take action to progress to a higher position. Students' stoichiometry achievement and their career aspiration in chemistry and STEM courses are strongly correlated, according to Cairns and Dickson (2021). Students who have high achievements in chemistry are motivated to advance their education in chemistry or other Science, Technology, Engineering and Mathematics (STEM) courses.

Furthermore, locus of control speaks about a person's broad assumptions about who has influence over what will happen next. Stated differently, what or who is accountable for the events that transpire. Locus of control is a psychological concept. According to Choudhury and Borooh (2017), it is the degree to which people think they exercise control over circumstances that impact them as opposed to outside factors that are out of their control. It has been discovered that, in the field of education, academic achievement strongly correlates positively with internal locus of control while external locus of control has a negative correlation (Majzub, Bataineh, Ishak and Rahman, 2016). Additionally, Arsini, Ahman, and Usmana (2023) found a positive relationship between locus of control and students' academic performance. They assert that students who believe they have power over what happens to them, are self-motivated and work harder to create their educational experiences in school which cumulatively influence their academic achievements positively.

Research Questions

1. What is the relationship between attitude, career aspiration and locus of control and students' achievement in stoichiometry?
2. What is the relative contribution of attitude, career aspiration and locus of control on students' achievement in stoichiometry?
3. What is the joint contribution of attitude, career aspiration and locus of control on students' achievement in stoichiometry?

Methodology

The study adopted the descriptive research design of the ex post facto type. The study population is senior secondary school class two chemistry students and their teachers in the six education districts of Lagos State, Nigeria. A total of 1,171 students were sampled using a multi-stage sampling method. In the first stage, stratified sampling was used to select one Local Government Area from each of the six (6) educational districts to make six (6) Local Government Areas for the study. At the second stage, five (5) schools were randomly selected from each of the Local Government Areas. At the third stage, intact classes of all the chemistry students from each school were used to make up a sample of 1, 171 students. There were 486 male and 685 female participants. The instruments used were Students' Attitude Towards to Problem-solving (CSAPS), Students' Career Aspirations in Chemistry Scale (SCACS), Chemistry Students Locus of Control Scale (CSLCS) and Stoichiometry Achievement Test (SAT).

Chemistry Students Attitude to Problem-Solving Scale (CSAPS)

The Chemistry Students Attitude to Problem-Solving Scale (CSAPS) adapted from the Problem-solving skills Scale by Aiken (1979) was used for this study. It measured the students' attitude to problem-solving in chemistry. It is made up of two parts. Section A asks questions on the respondent's age, gender, and name of school. Section B is made up of 17-items which the respondent is to respond to by expressing their opinions on a 4-Likert Scale questions ranging from 1 – not like me, 2 – not much like me, 3 – somewhat like me, 4 – very much like me. Using Cronbach Alpha, the instrument's reliability coefficient was found to be 0.70.

Students' Career Aspirations in Chemistry Scale

The Career Aspirations in Chemistry Scale (CACS) adapted from the Career Aspirations rating scale developed by Osokoya (1998) was used for this study. It measured the career aspirations of the students in chemistry. It comprises a list of 30 career choices. The courses are rated based on their chemistry requirement for each profession with 30 points being the highest and 1 being the lowest. Some chemistry teachers and experts in science education were consulted for re-validation of the rating based on their relative relevance of chemistry to the different professions. The consensus of all the experts was adopted for the final rating of the instrument. The 2022/2023 JAMB brochures for The Unified Tertiary Matriculation Examination (U.T.M.E) and Polytechnic/College of Education examinations were used as guides. The reliability of the instrument was determined using Scott's pi and the inter-rater consistency yielded 0.98.

Chemistry Students Locus of Control Scale (CSLCS)

The Chemistry Students Locus of Control Scale (CSLCS) adapted from the Locus of Control Scale developed by Yemen and Clawson (2003) was used for this study. It measured the students' locus of control. It is made up of two parts. Section A asks questions on the respondent's age, gender, and name of school. Section B comprises 20-items which the respondents are to respond to by expressing their opinions on a 4-Likert Scale questions ranging from 1 – not like me, 2 – not much like me, 3 – somewhat like me, 4 – very much like me. Using Cronbach Alpha, the instrument's reliability coefficient was found to be 0.81.

Stoichiometry Achievement Test (SAT)

The Stoichiometry Achievement Test (SAT) was used to measure students' knowledge of stoichiometry. It is made up of two parts. Section A asks questions on the respondent's age, gender, and name of school. Section B contains multiple-choice questions evaluating students' achievement in stoichiometry. The initial draft contained 40 multiple choice questions on stoichiometry selected from the West African Examination Council chemistry past question and modified to fit the purpose of this study. It had four response options A-D. Topics on which the test was based are mass and volume relationships, and chemical equations. The test was then administered to 20 SSIII chemistry students which are excluded from the sample of this study. Before they were administered, copies were given to experts in the field of science education for face and content with necessary corrections and modifications effected. Responses were collected, scored and analysed and the KR-20 reliability coefficient was found to be 0.63.

Consequently, the instrument was reviewed and items found unfit were eliminated leaving 15 questions. The 15 items had a difficulty index between 0.2 -0.75 and discrimination index of between 0.3-0.69. The reliability coefficient for the instrument was then calculated using KR-20 and was found to be 0.81. The table of specification for the 15 items is shown in table 1 below.

Table 1: Table of Specification for SAT

CONTENT	KNOWLEDGE	COMPREHENSION	APPLICATION	TOTAL
MASS & VOLUME RELATIONSHIP	11 (1)	15 (1)	1, 3, 4, 6, 8, 10, 12, 13, 14, (9)	11
CHEMICAL EQUATIONS	2, 7 (2)	5, 9 (2)	-	4
TOTAL	3	3	9	15

Note: The subscripts indicate the item's serial number in the SAT, while the numbers in brackets indicate the number of items in each cell.

Results

Relationship between Attitude to problem-solving , Career Aspiration and Locus of Control and Students' Achievement in Stoichiometry

Table 2: Relationship between the variables of the study

Pearson Correlation	Stoichiometry Achievement	Attitude to Prob. Solv.	Career Aspiration	Locus of Control
Stoichiometry Achievement	1.00	.16	.02	.29
Attitude to Prob. Solv.	.16	1.00	.21	.72
Career Aspiration	.02	.21	1.00	.24
Locus of Control	.29	.72	.24	1.00

N= 1, 171 Sig (2-tailed)

Table 3: Composite Contribution of Student Characteristics

Model	Sum of squares	Df	Mean square	F	Sig
Regression	997.802	3	332.601	40.519	0.00
Residual	9825.687	1168	8.209		
Total	10823.489	1171			
R = 0.304 Adj R ² = 0.090					

Table 4: Relative Contribution of the Independent variables

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
(Constant)	1.320	.391		3.373	.001
1 Std Att to Probl Solv	.026	.010	.102	2.547	.011
Career Aspiration	.012	.007	.044	1.566	.118
Locus of Control	.109	.012	.376	9.346	.000

Table 2 shows that the relationship between students' attitude to problem-solving ($r = 0.16$; $p < 0.05$), locus of control ($r = 0.29$; $p < 0.05$) and students' achievement in stoichiometry is positive, moderate and significant while career aspiration ($r = 0.23$; $p > 0.05$) has a positive but not significant relationship. This implies that achievement of students in stoichiometry is associated with students' attitude to problem-solving, career aspiration and locus of control.

Composite Contribution of Attitude to Problem-solving , Career Aspiration and Locus of Control to Students' Achievement in Stoichiometry

Table 3 reveals there is a significant, composite contribution of attitude to problem-solving, career aspiration and locus of control to students' achievement in stoichiometry ($F_{(3, 1200)} = 40.52$; $p < 0.05$). From table 2, the adjusted R value of 0.090 shows that the independent variables are responsible for 9% of the total variance in students' stoichiometry achievement. The remaining 91% variance is attributed to variables that are not residual in this study.

Relative Contribution of Attitude to Problem-solving, Career Aspiration and Locus of Control to Students' Achievement in Stoichiometry

Table 4 reveals that the relative contributions of students' attitude to problem-solving ($\beta = .102$; $t = 2.547$; $p < 0.05$) and locus of control ($\beta = .376$; $t = 9.346$; $p < 0.05$) to achievement in stoichiometry are significant while the contribution of career aspiration ($\beta = .044$; $t = 1.566$; $p > 0.05$) is not significant. The standardized coefficients (Beta) are used.

Discussion of Findings

This study aims to determine the influence of students' attitude to problem-solving, career aspiration and locus of control on students' achievement in stoichiometry. The findings of this study revealed that students' attitude to problem-solving is a predictor of students' achievement in stoichiometry. This implies that when students demonstrate a more positive attitude to solving problems in chemistry, their achievement in stoichiometry will improve. This result is in support of previous similar studies conducted by Cutumisu and Bulut (2017) who reported that there's a positive relationship between students' attitude to problem-solving in mathematics and their achievement. From Bandura's self-efficacy theory, students with a positive problem-solving attitude are more likely to believe they can successfully solve stoichiometric problems. This high self-efficacy increases effort, persistence, and strategic thinking, especially when the students encounter difficult mole-ratio or limiting-reagent problems. Such students are willing to attempt problems multiple times, learn from errors, and apply different strategies, leading to deeper conceptual understanding. This also agrees with the findings of Wun and Yew (2015) who reported that students with a strong attitude to problem-solving in chemistry had higher achievement scores.

Also, the result of this study showed that students' locus of control has a predictive significant relationship with achievement in stoichiometry. This implies that the higher the locus of control of the students, the higher their achievement in stoichiometry. This result corroborates the findings of Kumar and Asha (2016) who reported that there is a significant positive relationship between students' locus of control and achievement in science. This result also agrees with the findings of Majzub, Bataineh, Ishak and Rahman (2016), who found that there's a positive relationship between locus of control and high scores of students. Students with an internal locus of control believe success in

stoichiometry depends on their effort, understanding, and strategies. This belief strengthens their self-efficacy because students perceive a direct connection between what they do and how well they perform. As a result, they adopt self-regulated learning behaviors, such as checking calculations, reviewing errors, and seeking clarification which deepens their understanding and an improvement in their achievement. More so, this result also confirms the findings of Arsini, Ahman and Usmana (2023). They submitted that students with high internal locus of control had super resilience and high achievement.

Furthermore, the result of this study also shows that students' career aspirations in chemistry does not significantly predict their achievement in stoichiometry even though the results reveal a positive correlation between them. This implies that students with higher career aspirations tend to perform better in stoichiometry, however when other variables such as attitude to problem-solving, locus of control, self-efficacy, or study habits are included in a regression model, career aspiration may not explain additional variance. This suggests that career aspiration operates indirectly, influencing achievement through motivational or cognitive variables rather than directly affecting performance. Thus, while aspiration is related to achievement, it may not independently predict stoichiometry performance. This result is in consonance with the findings of Cairns and Dickson (2021) who reported that there's a positive relationship between students' career aspiration in STEM related courses and their achievement in science subjects. This result also aligns with the study conducted by Bewunetu and Tewodros (2022) that the career aspiration of students in higher education correlates with their achievement. They reported that students who showed interest in pursuing a career in higher education performed better in science subjects. Although literature shows a positive correlation between career aspiration and academic achievement, career aspiration may not be a significant predictor of senior secondary school students' achievement in stoichiometry because it is a distal, indirect, and often unstable motivational factor. Achievement in stoichiometry is more strongly driven by proximal variables such as self-efficacy, attitude to problem-solving, locus of control, and persistence, which directly influence students' engagement and learning processes.

Conclusion

The findings from this study indicated that students' attitude to problem-solving and locus of control have positive relationships and significantly predict students' achievement in stoichiometry while career aspiration in chemistry has a positive non-significant relationship and does not also significantly predict students' achievement in stoichiometry. This study is limited to only three non-cognitive variables; thus, we cannot generalize the findings for all non-cognitive variables. More so, we cannot generalize the results for cognitive variables. The study was conducted in Lagos State, therefore the findings cannot also be generalized for other states in Nigeria.

Recommendation

Based on the findings of this study, it is therefore recommended that policy makers should research on other cognitive factors that could significantly predict students' performance in stoichiometry so that teachers can consider these factors in the teaching and learning process. Schools should also organize career day to show students career opportunities available in chemistry while also encouraging students to develop their internal locus of control and attitude to problem-solving as these can cumulatively improve their performance in stoichiometry.

References

Aiken, L.R. (1979).. Attitudes toward mathematics and science in Iranian middle schools. *School Science and Mathematics* 79: 229-23.

Anis, Y. Krause, J.A. and Blum, E.N. (2016). The relations among mathematics anxiety, gender, and standardized test performance. *Research in the Schools* 23:2: 28-37.

Arsini Y., Arhman and Usmana S. (2023). The role of locus of control and resilience in students' academic achievement. *International Journal of Learning, Teaching and Educational Research*, 22:3. 396 -412.

Bewunetu Z. and Tewodros H. (2022). Higher education and career aspirations among secondary school students in southern Ethiopia. *International Journal of Adolescence and Youth* 27:1. 235-248.

Cairns, D. and Dickson, M. (2021). Exploring the relations of gender, science dispositions and science achievement on STEM career aspirations for adolescents in public schools in the UAE. *Asia-Pacific Education Research* 30:1.153-165.

Choudhury, S.A and Borooah, P. I. (2017). Locus of control and academic achievement of undergraduates' college students of Guwahati City of Assam India. *International Journal of Humanities and Social Science Invention* 6.4: 67-70.

Cutumisu, M. and Bulut, O. (2017). Problem-solving attitudes and gender as predictors of academic achievement in mathematics and science for Canadian and Finnish Students in the PISA 2012 Assessment. *Proceedings of EdMedia* 728-738.

Jader, J., Lithner, J and Sidenvall J. (2020). Mathematical problem solving in textbooks from twelve countries. *International Journal of Mathematical Education in Science and Technology* 51.7: 1120 -1136.

Kumar, J. and Asha. (2016). A study of the relationship between academic achievement and locus of control of male and female senior secondary school students. *Scholarly Research Journal for Humanity Science and English Language* 4.21: 4979 – 4986.

Majzub, R. M. Bataineh, M. Z. Ishak, N. M. and Rahman, S. (2016). The relationship between locus of control and academic achievement, and gender in a selected higher education institution in Jordan. *Proceedings form the 8th WSEAS International Conference on Education and Educational Technology*.

Mohtar L. E. Halim L. Samsudin M. A. and Ismail M. E. (2019). Non-cognitive factors influencing science achievement in Malaysia and Japan: An analysis of TIMSS 2015. *EURASIA Journal of Mathematics Science and Technology Education* 15.4: 1- 17.

Olatunde, T. A. (2021). Assessment of Learning Difficulty in Writing and Balancing Chemical Equation in Senior Secondary School. An Unpublished Undergraduate Project in the Department of Science and Technology Education, University of Ibadan.

Omilani, N. and Ajayi, T. (2023). Cognitive and affective predictors of students' achievement in stoichiometry Oyo, Oyo State. *Journal of Global Research in Education and Social Science* 17.3: 1-10.

Osokoya, M. M. (1998). Some determinants of secondary school students' academic achievement in chemistry in Oyo State. Unpublished Ph.D Thesis of the Institute of Education, University of Ibadan, Nigeria.

Peloff, R. M. (2016). The dynamics of persuasion: communication and attitude in the 21st century. <http://dx.doi.org/10.4324/9781315657714>.

Shadreck, M. and Enunuwe, O. C. (2018). Recurrent Difficulties: Stoichiometry in Problem-solving. *African Journal of Educational Studies in Mathematics and Sciences* 14: 2018.

West African Examinations Council (WAEC) Chief Examiners' Report (2013 -2016, 2018 -2019)

Wun, T. W. and Yew, C. S. (2015). Relationship between students' attitude towards problem solving and their achievements in mathematical problem solving. *Journal of the Association for Science & Mathematics Education* 18: 1 -15.

Yemen, G. and Clawson, G. (2003). Locus of Control Scale. *University of Virginia Darden School Foundation, Charlottesville, VA*.