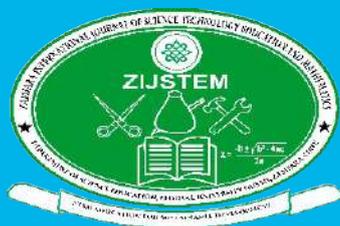


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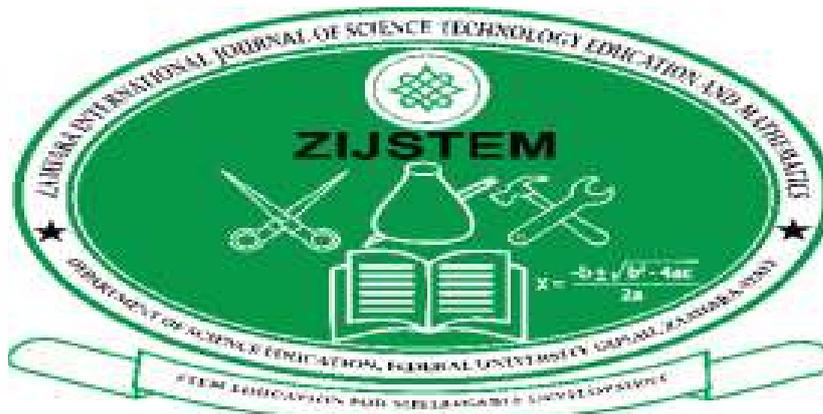
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The aim and scope of the journal is to provide an academic medium and an important reference for the advancement and dissemination of information that supports high level learning, teaching and research in the fields of Sciences, Technology, Education and Mathematics.

The articles in this volume are academic and professional discourse written by reputable scholars in their area of specialization.

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FORWARD

On Behalf of the staff and students of the Department of Science Education, Federal University Gusau, Zamfara state, Nigeria, we humbly acknowledge and thank Allah (S.W.T) the most beneficent, the most merciful for without his will, collection and computation of this journal publication would not have been possible. May all praise be ascribed unto Him. The department is sincerely grateful to its accommodating mentor Prof. M.G. Abubakar, Vice Chancellor, Federal University, Gusau and his management team for giving the department enabling environment for academic activities. The department's profound gratitude goes to Dr. Umar Sodangi who doubled as the Dean, Faculty of Education, Federal University, Gusau and Associate Editor of Zamfara International Journal of Science, Technology, Education and Mathematics (ZIJSTEM). Furthermore, Special gratitude goes to our contract and visiting Professors, the staff and students of the Department of Science Education, Federal University, Gusau, for their supports and foresight towards actualizing the dream of the department.

The Zamfara International Journal of Science, Technology, Education and Mathematics (ZIJSTEM) is a brain child of Department of Science Education with the aim of bringing science and technology education into global and well recognized journals of science and technology education research. This is first of its kind, among Science Education Departmental Journals in Northwest, Nigeria and by extension one of the highly placed departmental journals in Nigeria, considering its online visibility and originality, based on well-known global best practices.

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Impact of Team-Teaching Strategy on Performance and Retention in Biology Concept among Secondary School Students in Sokoto State, Nigeria

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Abstract

This study examines, the impact of team- teaching strategy on performance and retention in biology concept among secondary school students in Sokoto State, Nigeria. A quasi-experimental research design, involving pre-test and post-test assessments, was adopted to answer two research questions and test two corresponding hypotheses. A total of 357 SS-I biology students from four public secondary schools were selected through stratified random sampling to ensure gender and school type representation. The students were divided into experimental groups (190 students) taught using the team teaching method and control groups (167 students) instructed with conventional methods. Data collection was conducted using the Biology Achievement and Retention Test (BART), the instrument was validated by experts and also achieved the reliability coefficient of 0.78, a 20-item objective test administered as both pre-test, post-test and retention test. Descriptive statistics, including mean scores, were used to answer the research questions, while independent sample t-tests was used to test the hypotheses at a 0.05 significance level. These findings were that , team teaching enhances students' understanding, retention of biological concepts, making it a promising approach to improve academic outcomes in secondary education. Based on these results, the researcher recommends integrating team teaching into school curricula to foster interactive and effective learning environments. These findings suggest that longitudinal research should be conducted to examine the long-term effects of team teaching on student performance and knowledge retention over multiple academic years. This would provide insights into the sustainability of the benefits observed in this study.

Keywords: Team Teaching, Academic Performance, Retention, Biology Education

Introduction

Education is fundamental to national development as it shapes the knowledge, skills, and competencies necessary for societal progress. The quality of education depends largely on the teaching strategies employed, which directly influence student learning outcomes. The advancement of any nation is closely linked to its scientific, technological, and educational progress (Anaeto, Asiabaka, Ani, Nnadi, Ugwoke, Asiabaka, Anaeto & Ihekerony, 2016). A well-structured education system is essential for equipping individuals with the skills needed to tackle contemporary challenges and drive economic growth. Science and technology have proved to be significantly useful in man's daily struggle to control his environment and build a comfortable world. The teaching of science offers students the ability to access a wealth of knowledge and information which will contribute to an overall understanding of how and why things work like they do. Hence, Igwe (2017) defined science



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as a systematic process of obtaining knowledge and behaviour of the physical diverge through observation, experimentation, measurement and recording of information. Biology as a key science subject deals with the study of plants and animals. Biology is a natural science subject that deals with the study of living organisms including their structure, function, growth, distribution and taxonomy (Okenyi, 2015).

Team teaching promotes a collaborative, multi-faceted approach to instruction, combining subject expertise and various teaching techniques to create an engaging learning environment (Haruna, 2021). By sharing planning and delivery responsibilities, teachers can address students' needs more effectively, enriching their educational experience. Furthermore, team teaching fosters professional collaboration among educators, enabling them to refine their instructional techniques and enhance student learning through active engagement and critical thinking (Awodun & Alake, 2023). With multiple instructors available, students benefit from immediate feedback, which helps clarify concepts and improve academic performance (Davis, 2021). Additionally, the integration of different teaching perspectives fosters a broader understanding of the material, offering students alternative approaches to problem-solving (Darma, 2018). The concept of team teaching emerged in the mid-20th century, with Harvard University pioneering its implementation through an internship program in 1955. This model involved five teacher trainees working under the supervision of an experienced teacher. By 1965, team teaching had gained traction in England and reached its peak popularity in the Western world during the 1970s (Hooda & Sharma, 2016). Research indicates that team teaching enhances student comprehension by incorporating diverse instructional approaches, facilitating immediate clarification of misconceptions, and promoting active engagement in the classroom.

The concept "retention" is describes the remembering of a fact or idea after a passage of time. Meaningful learning is deemed to have taken place if after a passage of time the student could recall and apply information which he/she had been taught previously(Ibok & Unoh,2019) And this takes place when learning is coded into memory. In Nigeria, the predominant instructional approach in secondary schools is the conventional single-teacher method, where one teacher is responsible for instructing the entire class. While this method is widely used, it has certain limitations. It often relies on lecture-based instruction, where students passively absorb information (Noreen & Rana, 2019). Although effective in some contexts, it typically does not offer enough opportunities for active student engagement or deep exploration of complex subjects like biology (Behlol, 2009). Researchers suggest that collaborative teaching strategies, such as team teaching, enhance student engagement and improve knowledge retention, particularly in subjects like biology (Awodun & Alake, 2023;). Academic performance reflects an individual's level of knowledge and competence, distinguishing those with higher proficiency from those with lower achievement (Pareek, 2019). Several studies have examined the impact of team teaching and retention on academic performance across various subjects and educational levels. Akpan, Usoro, Akpan & Ekpo (2010) studied the effects of team teaching on student performance in Introductory Technology among Junior Secondary School students in Akwa Ibom State, Nigeria. Using a pre-test post-test non-randomized experimental design, 316 students from four schools participated. The results indicated that students taught using team teaching significantly outperformed those taught by a single instructor, leading to recommendations for adopting team teaching in Introductory Technology instruction. While this study targeted Introductory Technology students, the current research examines Biology students. Ahmed, Bello, Alabi, Sulaiman and Ahmed, (2022) investigated the effects of team teaching on senior school



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students' achievement in adaptation using a 20-item Adaptation Achievement Test (AAT) with 99 participants. A quasi-experimental design was used and hypotheses were tested via paired t-tests and ANCOVA. Results showed no significant difference in achievement when students were taught using team teaching, regardless of gender or initial performance levels. The study concluded that team teaching alone did not enhance learning outcomes and recommended integrating multiple teaching methods for better results in biology education. This study is very relevant to the current study because it studies effects of team teaching on senior school students achievement while the current research studies impact of team teaching on senior school students performance.

Ajayi and Ayeni (2019) explored the effect of team teaching on the academic performance of senior secondary school students in Lagos State, Nigeria. Using a quasi-experimental design with a sample size of 200 students, the study revealed that the experimental group (team teaching) had significantly better performance in their biology assessments compared to the control group (traditional teaching). Akinbode, Adepoju and Yusuf (2020) examined the influence of team teaching on the retention of biology knowledge among Nigerian secondary school students. A quasi-experimental design was employed with a sample size of 150 students across three schools in Ibadan. The study concluded that team teaching significantly improved students' retention of biological concepts, particularly in areas such as cell biology and human physiology. Zhang and Huang (2022) examined the impact of team teaching on biology education in rural secondary schools in China. A total of 300 students participated in a quasi-experimental study. The researchers found that students who received team-teaching instruction showed greater understanding and retention of biology topics, particularly in areas like ecology and genetics. The study concluded that team teaching should be encouraged to improve student outcomes, especially in resource-limited settings.

Statement of the Problem

One of the key topics in the Biology syllabus is the concept of microorganisms, which is crucial for understanding health, disease prevention, and various biotechnological applications. On the other hand, despite its importance, research and public examination reports West African Examination Council (WAEC) 2020, have consistently indicated that students' performance in Biology, particularly in concepts requiring abstract reasoning such as microorganisms, remains poor. This poor performance is often accompanied by low retention, meaning that students quickly forget what they have learned which undermines both examination success and long term scientific literacy. This study aims to investigate the impact of team teaching on students' academic performance and retention in Biology among senior secondary school students in Sokoto South Local Government Area, Sokoto State, Nigeria. By exploring how team teaching affects students' understanding and retention of biological concepts, the study seeks to provide valuable insights into the potential benefits of team-based instructional strategies in the Nigerian education system, contributing to the enhancement of teaching methods and student outcomes in science education.

Objectives of the study

The main objective of this study is to examine the impact of team teaching on secondary school students' academic performance and retention on microorganism concepts in Sokoto South Local Government Area, Sokoto State, Nigeria. The specific objectives of the study are to:



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1. Investigate the difference in academic performance between secondary school students taught microorganisms concepts using team teaching and those taught with the conventional (single-teacher) approach
2. Investigate the difference in retention between secondary school students taught microorganisms concepts using team teaching and those taught with the conventional (single-teacher) approach

Research Questions

The following research questions guided the study:

1. What is the difference in academic performance of secondary schools biology students taught microorganisms concepts using team teaching and those taught using conventional (single teacher) approach?
2. What is the difference in retention of secondary schools biology students taught microorganisms concepts using team teaching and those taught using conventional (single teacher) approach?

Null Hypotheses

The following null hypotheses were stated at 0.05 confidence level, to carry out the study:

H₀₁: There is no significant difference in academic performance of secondary school biology student taught microorganisms concepts using team teaching and those taught using conventional (single teacher) approach.

H₀₂: There is no significant difference in retention of secondary school biology student taught microorganisms concepts using team teaching and those taught using conventional (single teacher) approach.

Methodology

This study targeted Senior Secondary School I (SSS I) students in Sokoto South Local Government Area, Sokoto State, Nigeria, with a focus on those studying Biology. This study utilized Quasi experimental design. The target population comprised 7,185 students enrolled in 21 public secondary schools. A stratified random sampling technique was employed to select 357 students as sample from four secondary schools, ensuring fair representation of both boys' and girls' schools. Within each school, 190 students were assigned to the experimental group, which received team teaching, and 167 students were assigned to the control group, which received instruction using conventional teaching method. To assess academic performance and retention, the researcher developed the Biology Achievement and Retention Test for Secondary School Students (BARTSSS), which consisted of 20 multiple-choice questions covering key Biology topics. The test was designed to measure both academic performance and retention. Additionally, demographic data, including age and gender, was collected using a questionnaire. The instruments were validated through peer reviews and expert evaluations, with a satisfactory inter-rater agreement of 80%. A pilot study was conducted at the Women Center for Continuing Education, Sokoto, to assess the clarity and reliability of the instruments, resulting in a reliability coefficient of 0.78, which met the acceptable threshold. Ethical approval was obtained from the relevant authorities, including the Sokoto State Ministry of Education and school principals. The study followed ethical guidelines, ensuring the anonymity and confidentiality of participants. Data collection was carried out in phases: a questionnaire was administered before the pre-test, followed by the pre-test using BARTSSS to establish baseline performance. Afterward, the experimental group was taught using the team teaching method, and the control group received instruction using conventional instruction over four periods (160 minutes). Finally, a post-test was administered to assess changes in academic



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performance and followed by retention test. Descriptive statistics of mean and standard deviation were used to answer the research questions and Independent sample t-test was at 0.05 significance level used to test the null hypotheses and evaluate the impact of team teaching on academic performance and retention.

Presentation of Results

Research Question 1

What is the difference in academic performance of secondary schools biology students taught microorganism concepts using team teaching and those taught using conventional (single teacher) approach?

To answer this, the mean academic performance scores and standard deviations for both the team teaching (Experimental) and conventional (Control) groups were calculated from the post-test results.

Table 1: Mean Academic Performance Scores of Team Teaching and Conventional Groups

Group	N	Mean	Deviation	Std.
Experimental	190	3.01		0.25
Control	167	2.35		0.30

Source: Field Work (2024)

Table1: presents the descriptive statistics for academic performance on the post-test regarding methods used for teaching microorganisms concepts. The Experimental group, which received instruction through team teaching (N=190), achieved a mean academic performance score of 3.01 with (SD = 0.25). In contrast, the Control group, taught using the conventional approach (N=167), recorded a mean score of 2.35 (SD = 0.30). A direct comparison of these means indicates an observable difference in academic performance between the two groups. Specifically, students taught using the team teaching approach (Mean = 3.01) appear to have performed higher in academic performance on microorganism concepts compared to those taught with the conventional approach (Mean = 2.35).

Research Question 2

What is the difference in retention of secondary schools biology students taught microorganism concepts using team teaching and those taught using conventional (single teacher) approach?

To answer this question, the mean retention scores and standard deviations for both the experimental (team teaching) group and the control (conventional) group were calculated from the retention post-test results.

Table 2: Mean Retention Scores between Experimental and Control Group

Group	N	Mean	Std. Deviation
Experimental	190	3.03	0.39
Control	167	2.51	0.55

Source: Field Work (2024)

Table 2 presents the descriptive statistics for students' retention of microorganism concepts on the post-test. The Experimental group (N=190), which experienced team teaching, showed a mean retention score of 3.03 (SD = 0.39). In contrast, the Control group (N=167), taught conventionally, had a mean retention score of 2.51 (SD = 0.55).



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An initial examination of these means indicates that the team teaching group (Mean = 3.03) appears to have retained more information compared to the conventional group (Mean = 2.51). This suggests a potential positive impact of team teaching on the long-term retention of microorganisms concepts.

Hypothesis 1

H₀₁: There is no significant difference in academic performance of secondary school biology student taught microorganism concepts using team teaching and those taught using conventional (single teacher) approach

To test this hypothesis, an Independent Samples t-test was conducted to compare the mean academic performance scores of the experimental (team teaching) group and the control (conventional) group on the post-test. The significance level (α) was set at 0.05.

Table 3: Independent Samples t-test to compare the academic performance

Group	N	Mean	SD	Df	t-value	P-value	Decision
Experimental Group	190	3.01	0.25				
				344	15.83	.000	Rejected
Control Group	167	2.35	0.30				

Source: Field Work (2024)

The results of the Independent Samples t-test, as presented in Table 3, indicate a statistically significant difference in the academic performance of secondary school biology students taught microorganisms concepts using team teaching and those taught using the conventional approach. The null hypothesis (H₀₁), which posits no significant difference in academic performance between the two groups, is rejected ($t(346) = 15.83, p < .001$).

A comparison of the mean scores reveals that students in the experimental group (team teaching) achieved a higher mean score ($M = 3.01, SD = 0.25$) compared to students in the control group (conventional approach) ($M = 2.35, SD = 0.30$). This suggests that the team teaching approach has a positive impact on students' academic performance.

Hypothesis 2

H₀₂: There is no significant difference in retention of secondary school biology student taught microorganism concepts using team teaching and those taught using conventional (single teacher) approach.

To test this hypothesis, an Independent Samples t-test was conducted to compare the mean retention scores of the experimental (team teaching) group and the control (conventional) group on the post-test for retention. The significance level (α) was maintained at 0.05.

Table 4: Independent Samples t-test to compare the Retention of Students

Group	N	Mean	SD	Df	t-value	P-value	Decision
Experimental Group	190	3.03	0.39				
				180	10.83	.000	Rejected
Control Group	167	2.51	0.55				

Source: Field Work (2024)



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The independent samples t-test revealed a statistically significant difference in retention scores between the experimental group (team teaching) and the control group (conventional teaching). The experimental group has a higher mean retention score (3.03) compared to the control group (2.51), with a t-value of 10.83 and a p-value of .000.

These findings suggest that team teaching is a more effective instructional strategy for promoting retention of biological concepts among secondary school students. The results have implication for teaching practices and suggest that educators should consider adopting team teaching approaches to improve student outcomes in biology. In conclusion, the study provides empirical evidence to support the effectiveness of team teaching in enhancing student retention, and it is recommended that educators and policymakers consider these findings when designing instructional strategies for secondary school students.

Discussion of Findings

The finding indicates that students taught using team teaching performed significantly better than those taught with the conventional approach. This study is in line with Akpan et al. (2010) submission that team teaching significantly improved student performance in Introductory Technology among Junior Secondary School students. The study also aligns with Ajayi and Ayeni (2019) that team teaching significantly improved academic performance in biology among senior secondary school students. These studies suggest that team teaching is an effective instructional strategy for improving student performance. However, the study contradicts Ahmed et al. (2022), submission that team teaching alone did not enhance learning outcomes. These contrasting findings may be due to variations in implementation and context. The finding demonstrates that team teaching led to higher retention scores compared to the conventional method. This study is in line with Akinbode et al. (2020) submission that team teaching significantly improved students' retention of biological concepts. The study also aligns with Zhang and Huang (2022) that team teaching improved student understanding and retention of biology topics. These studies suggest that team teaching is an effective approach for enhancing retention and promoting long-term learning. However, further research may be needed to explore the specific factors contributing to improved retention in team teaching settings.

Conclusion

The findings from this study clearly demonstrate that team teaching is a highly effective instructional strategy for enhancing both the academic performance and retention of biological concepts related to microorganisms among secondary school students. Students exposed to the collaborative teaching approach showed significant improvements in their scores and retained information more effectively than their peers taught through traditional methods. These results suggest that adopting team teaching in secondary education can lead to more engaging, effective, and lasting learning experiences in biological sciences. Implementing collaborative teaching strategies can help educators address diverse learning needs, foster active participation, and improve overall educational outcomes. Therefore, curriculum developers and educators should consider integrating team teaching approaches to enrich biology instruction and promote sustained conceptual understanding among students.

Recommendations

Based on the findings of this study, the following recommendations are made by the researcher, to enhance teaching practices and improve educational outcomes in biology education:

1. Educational institutions should adopt team teaching methodologies as a standard practice in secondary school biology classrooms. The implementation of collaborative teaching



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approaches can engage students more effectively and improve their overall understanding and retention of biological concepts.

2. Schools should invest in professional development programs that focus on collaborative teaching techniques. Educators need training on how to effectively implement team teaching strategies, foster teamwork among staff, and create an engaging learning environment that maximizes student participation.

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Qualitative Study on Integration of Information and Communication Technology Tools for Adult Education Programmes in Nigeria: A Systematic Review

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Abstract

The paper systematically reviewed the importance of integrating information and communication technology (ICT) tools in adult education programmes in Nigeria. This was informed by the revolution in access and distribution of information brought by ICT, which makes ICT an increasingly influential factor in human interaction and educational pursuit. Therefore, the paper examined the concepts of adult education and ICT. It also discussed importance and factors affecting usage of ICT in adult education before recommendations on how to maximise benefits of ICT in adult education were made. Such recommendations include the need for the government and other stakeholders to prioritise provision of adequate funds to adult education for purchase of necessary ICT equipment needed in adult education, the need for adult education centres to employ qualified and competent facilitators who are skilful in uses of ICT and the need for adult education centres to continuously provide in-service training and workshops to facilitators in order to improve their proficiency and productivity.

Keywords: Adult education, Facilitators, ICT, Importance and Integration

Introduction

Technological advancement has revolutionised distribution and access to information, thereby making technology an increasingly influential factor in educational activities. Considering the centrality of the instructional procedures and quality of the materials used to the success of teaching and learning process, incorporation of information and communication technology (ICT) to complement and supplement adult educators' efforts in the learning process is paramount. Because of the importance of ICT to expanding access to a wide range of learning materials, Odiaka and Ajiye (2021) submit that adult educators are expected to avail themselves of the utilitarian values of ICT to facilitate effective learning that will translate to social, economic and political development. As development of every society rest on the ingenuity and creativity of the adults who are the initiators of development activities, there is need to maximise the potentials of ICT to meet the learning needs of adults in Nigeria. Achieving the learning needs of adult learners is tantamount to achieving programmes' objectives. Hence, it is important to properly harness and adequately exploit the potentials inherent in ICT to stimulate free flow of communication, exchange of ideas and cordial relationship among the learners as well as between the learners and facilitators in order to achieve the desired objectives of adult education programmes. More importantly, the multiplicity of programmes in adult education and diversities of differences among the adult learners calls for systematic integration of the conventional pedagogical procedures with modern digital technologies in the learning process (Motorga, 2023). This integration will enhance possibility of adult education in catering for the varied learning styles and needs of adults while leveraging the advantages of ICT for a more effective and engaging learning experiences. To this end, the paper explores the importance of information and communication technology (ICT) in adult education.



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The Adult Education Programmes in Nigeria

Adult education is a generic term covering all systematically organised educational programmes for individuals who have attained the status of adulthood, maturity and responsibilities (UNESCO, 2011). Adult education exists in different forms and each form caters for specific educational needs and conditions of varied individuals and groups. As educational programmes for people who have demonstrated manifestation of the expected behaviours normally attributed to adulthood after having satisfied the chronological criteria, adult education covers all processes through which individuals acquire knowledge, skills, attitude and other values that have positive contributions to individual and community development (Jegede, 2015).

Moreover, adult education also means the aggregate of all educational activities intentionally designed to facilitate acquisition of knowledge, skills and attitude for individuals whose age, social roles and self-perception define them as adults. This definition depicts the significance of adult education to promotion of lifelong learning opportunities. Through its varied programmes, issues in the world of work, literacy, health, and societal conflicts are managed through adult education, making it an essential tool for facilitating social, economic and political development (Adelore & Itasanmi, 2016). This informed why adult education has remained a recurrent issue in development discourse globally. This was championed, most especially, at the UNESCO 5th International Conference on Adult Education held in Hamburg, Germany, popularly called the “Hamburg Declaration” in 1997 (UNESCO, 1997 cited in NCCE & TDP, 2015). In the conference, adult education was seen as: The key to the twenty-first century; it is both a consequence of active citizenship and a condition for full participation in society. It is a powerful concept for fostering sustainable development, for promoting democracy, justice, gender equity, and scientific, social and economic development, and for building a world in which violent conflict is replaced by dialogue and a culture of peace based on justice (National Commission for Colleges of Education & Teacher Development Programme (NCCE & TDP), 2015:12).

As a vehicle for individual and community development, adult education is an inter-disciplinary and multi-disciplinary discipline, relatively planned, situational relevant and voluntary in nature to accord participants freedom to choose and participate in programmes that have bearing with their needs and aspiration. Adebayo and Uba (2025) observe that people enrolled in adult education for many reasons and the most common reasons include: to create positive change in their skills, attitude and knowledge level, to improve their technical and professional qualifications, to overcome identified inadequacies in coping with the current life problems and to improve their current social and economic status, among others. Therefore, it is important for adult facilitators to be properly trained for efficient discharge of their responsibilities towards the realisation of learners’ goals for enrolling in adult education programmes and the objectives for which a programme is organised.

Achieving objectives of adult education programme and learners’ goals for enrolling in programmes are correlated with many factors. Prominent among the factors is the use of relevant instructional materials to facilitate acquisition of learning experiences needed for preparation of adult learners for effective functioning and enhanced professional skills, knowledge, taste, attitude and a host of other benefits inherent in adult education. The relevance of the instructional materials is the ability of the materials to promote achievement of learners’ needs and programme objectives. Hence, usage of instructional materials should be based on the relevance of the materials to achievement of programme objectives, appropriateness of the materials to the learners’ socio-economic and



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educational background, ability of the materials to motivate and sustain learners' interest in the programme as well as availability and accessibility of the materials. Suffice to note that the behaviour of the facilitators and suitability of instructional materials may strongly influence the learning climate and learning outcome. As success of learning transaction depends, among other things, on the resourcefulness of the facilitators in designing environment that facilitates effective delivery of the instructional strategies, as well as on the ingenuity of the facilitators to continuously elicits and sustain interest of the learners in learning activities. To this end, there is need for adult educators to explore and exploit opportunities provided by the development of ICT.

Concepts of Information Communication and Technology (ICT) Tools

Advancement in information and communication technology (ICT) has revolutionised distribution and access to information. It has become an increasingly influential factor in learning and improvement of professional competence. Because access to meaningfully relevant information is central to success of any learning activity, ICT has provided unlimited access to a wide range of learning materials (Adamu, 2023). The term ICT refers to the convergence of audio-visual and telephone networks with computer networks through a single cabling or link system. This stresses the use of computers as well as necessary enterprise software, middleware, storage, and audio-visual systems to access, store, transmit, and manipulate information (Sahay, 2003 in Odiaka and Ajiye, 2021). According to 2019 National Implementation Guidelines of ICT on education in Nigeria cited in Abubakar (2023), ICT means the art and applied sciences that deal with data and information. It encompasses all equipment (including computational machinery - computers, hardware, software, firmware etc., tools, methods, practices, processes, procedures, concepts, principles and the sciences) that come into play in the conduct of the information activities: acquisition, representation, processing, presentation, security, interchange, transfer, management, organisation, storage and retrieval of data and information.

As a diverse set of technological tools and resources used to transmit, store, create, and exchange information (Saha, 2014), ICT includes radio, television, video, DVD, telephone (fixed line and mobile), satellite systems, computer and network hardware and software. Sorting Hat Technology Pvt Ltd. (2023) classifies ICT into the following four main categories:

Computing and Information Technology: Computing and information technology mainly refers to designing and building computers. It also refers to maintaining and troubleshooting the computer system. It also ensures that the computer runs smoothly.

Broadcasting: Broadcasting is the transfer of audio and video-visuals through any electronic mass communication to varied audiences all over the world. It mainly uses the electromagnetic spectrum to transfer the data.

Telecommunications: Telecommunications are the transfer of electronic information over several distances. This information may be in the form of voice, data, text, images or video.

Internet: The Internet is a global system that provides a variety of information and other communicational services by the use of interconnected networks. It uses the Internet Protocol (IP) to communicate with others.

The above classification is a reflection of the broadness of ICT's scope of coverage and importance especially in exchange of information. Leveraging on the potentials of ICT in facilitation of learning to different categories of learners has galvanised its adoption in education. Peni (2023) identifies the following as objectives of ICT in education:

1. To facilitate the teaching and learning processes.
2. To promote problem-solving, critical thinking and innovative skills.



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3. To promote life-long learning and advance knowledge.
4. To enhance the various teaching strategies required to meet the needs of the population.
5. To foster research and development.
6. To support effective and efficient education administration.
7. To enhance universal access to information.
8. To widen access to education and the range of instructional options and opportunities for learning.
9. To promote commercialisation of ICT in Education.
10. To develop and support technical infrastructure that maximises digital creativity, sharing and innovation.

Considering the objectives of ICT to facilitation of learning and achievement of learning objectives, it is imperative to highlight the importance of information and communication technology (ICT) in adult education. This will enable adult educators and facilitators to understand the need to integrate the use of ICT into adult education instructional delivery strategies in particular and the importance of ICT in adult education in general.

Importance of ICT in Adult Education Programmes in Nigeria

Expansion of access to learning opportunities: With the growing computer-centric lifestyle which we are currently witnessing, there is need for integration of ICT into adult education pedagogical instructional delivery. The use of ICT to complement and supplement the traditional methods of teaching will expand access to increased learning opportunities and ensure equity. As new innovations are unleashed on a daily basis to improve learning experience, adult educators must keep abreast with the development and continuously look for new opportunities to enrich the learning experiences of adult learners by integrating the use of ICT into various methods of teaching the adult learners.

Promotion of learners-centred instructional delivery: With the paradigm shift from the teacher-centred to learners-centred instructional delivery, the use of ICT will help to align adult education with the interactive learning opportunities provided by the use of ICT. This will enable the learners to become self-reliant and self-directed in acquisition and application of knowledge and skills provided by adult education programmes. For instance, adoption of software such as Interactive Geometry software, Instructional Software, Simulation, gaming and recreational software will provide rich alternative instructional experiences to the learners and help to remove fear and phobias related to study of a subject at the same time providing them opportunities to learn while playing or engaging in virtual applications of the principles and processes of a subject (Chatterjee, 2021). The adoption of ICT will thereby change the role of the facilitators from a mere knowledge-transmitter to that of learning-facilitators. This will enable the learners to become more responsible about their learning as they seek out relevant information and knowledge through their own efforts, synthesise and share their knowledge with others.

Improvement of interaction: Adoption of ICT in adult education will help create a more interactive and engaging learning environment for both the learners and facilitators in adult education. Creation and sharing of learning content with each other and access information from anywhere and anytime will not only promote improved teaching and learning activities but also makes the teaching-learning process easier. For instance, many people and organisations used different ICT-driven platforms such as Skype, Zoom, Google meet, among others, for interaction during the COVID-19 induced lockdown. Shuaibu and Ahmed, (2021) submit that the idea behind ICT-driven electronic learning is to empower learners to study without being confined to the four walls of classrooms or schools through the integration of learning with technology. Therefore, stakeholders in adult education



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should leverage on the opportunities provided by ICT to continuously bridge the gap of space and time in providing learning opportunities to adult learners.

Promotion of access to educational resources: The adoption of ICT in adult education will enable both learners and facilitators access wide range of educational resources available on the internet. These resources include online textbooks, e-book, videos, and educational software that can be accessed from anywhere and at any time. With increased access to educational resources, adult learners can study at their own pace and at their own time, allowing them to balance learning with other activities or responsibilities. In addition to having unlimited access to learning materials, the use of ICT will also enable adult learners and facilitators to easily prepare, organise and manage their notes in the digital format through the use of software such as Microsoft word, WordPad, PDF, etc.

Enhance effective evaluation: Evaluation is central to success of adult education programmes. Evaluation is the dynamic process of making value judgement about the merit, worth or otherwise of a part or the whole of a programme. This involves in-depth assessment of all elements involved in adult education to obtain feedback and to determine success or failure of a programme. The evaluation may be diagnostic (evaluation done to uncover causes of learning problems), formative (evaluation done before completion of a programme to provide feedback on progress) or summative evaluation (evaluation done at completion of a programme to determine extent to which the goal of a programme has been achieved). Feedback obtained from evaluation serves as a basis to decide on whether a programme should be recycled or overhauled. Through the use of ICT tools the programme objectives, learners' needs, available resources, performance of facilitators and learners, learning outcomes and other elements involved in adult education programmes can be effectively evaluated. The realisation of the objectives of ICT in Nigeria by the adult learners lies on the facilitators. The facilitators need to devise means by which the adult learners can be adequately taught and acquire knowledge and skills needed for satisfactory proficiencies in the utilisation of ICT for effective functioning in their respective endeavours. Therefore, ICT is both a tool for instruction for the facilitators and a content area of learning the knowledge of ICT. This covers using different ICT gadgets for storing, processing and retrieving information. It entails using emails and social networks to achieve various academic and social problems.

Despite the usefulness of ICT to promotion of teaching and learning, its utilisation in adult education by adult facilitators is low. This was revealed by the findings of a research conducted on knowledge and utilisation of ICT among adult literacy facilitators by Odiaka and Titus in 2021. Their findings revealed that 58% of the respondents do not know how to apply ICT knowledge and skills in facilitating the learning of their adult students, 70% of the respondents cannot apply ICT knowledge and skills for their own learning, 16% and 24% of the respondents respectively reported that they cannot switch on or shut down the computer, 76% of the respondents reported that they cannot store information on the computer with the same percentage reported that they cannot retrieve stored information on the computer, 80% of the respondents reported that they cannot utilise the electronic mail in sending and receiving information with another 80% reporting lack of knowledge of how to use social networks. This revelation is attestation to the fact that most adult educators do not understand the importance of ICT to promotion of professional competence and effective instructional delivery in adult education programmes in Nigeria. To maximise the importance of ICT to adult education programmes in Nigeria, inhibiting factors towards the use of ICT by adult educators must be identified. Such understanding is required for designing and implementation of appropriate policies to overcome challenges affecting effective utilisation of ICT in adult education programmes in Nigeria.



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Challenges affecting the use of ICT in adult education Programs in Nigeria

Poor funding: Utilisation of ICT in adult education programmes requires a magnum of funds, infrastructure and support facilities. Regrettably, funding of education in Nigeria is grossly poor and adult education suffers the most. While the government is unwilling to commit adequate funds to the adult education sector, donation from donor agencies are sometimes not judiciously utilised or are used for other programmes at the expense of adult education. Consequently, poor funding of adult education has resulted in non-availability of necessary ICT resources.

Inadequate qualified and competent facilitators: The quality of knowledge and skills imparted to the adult learners is systematically related to the competence of the facilitators employed for such. Facilitators as the implementers of adult education programmes have the greatest influence in arousing and sustaining the interest and attention of learners in the teaching-learning process. Disappointedly, education industry seems to be the only sector in Nigeria where workers with different specialisation are indiscriminately employed to work where they are not qualified or skilled. A trained teacher not trained as adult facilitator is not even qualified to teach adult learners due to the peculiarities of the learners, let alone those who are not trained teachers at all. Qualitative and functional adult education cannot be ensured if the bulk of facilitators in adult literacy centres in Nigeria are not trained adult facilitators and lack proficiencies in the use of ICT to equip the learners with necessary ICT knowledge and skills required in the 21st century.

High cost of ICT tools: Another important challenge to utilisation of ICT in adult education is the high cost of ICT tools. Due to poor financial allocation to adult education, it is practically impossible for most adult education centres to afford the cost of ICT tools. Consequently, the traditional face to face teaching and learning system is the saving grace for many centres.

Inadequate ICT infrastructure: ICT Infrastructure required for effective utilisation of ICT in adult education is not adequately available. Infrastructure such as hardware, software, internet access, stable electricity and similar other resources which are required to integrate the ICT technology in the teaching and learning processes are not sufficiently available.

Conclusion

To maximise the increasing benefits inherent in the integration of ICT into adult education pedagogical strategies, it is important to balance the uses of ICT with the traditional instructional delivery strategies. This will help to mitigate the potential negative challenges associated with the use of ICT. Therefore, to maximise the benefits associated with the utilisation of ICT in adult education programmes in Nigeria, the following recommendations must be systematically implemented.

Recommendations

1. The government and other stakeholders in adult education should prioritise provision of adequate funds to adult education. This will enable facilitators to purchase the necessary ICT equipment needed for proper integration and utilisation of ICT in adult education programmes in Nigeria.
2. Adult education centres should employ qualified and competent facilitators who are not only skilful in uses of ICT but who are also conversant with the adult psychology, guiding principles and methods of teaching adults in adult learning centres.
3. Adult education centres should provide regular in-service training and workshops to facilitators in order to acquaint them with new development in ICT world. This will enable the facilitators to update their knowledge, understanding, skills proficiency and productivity.



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Funding Science and Mathematics Education in a Depressed Economy in Nigeria: Issues, Challenges and the Way forward

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Abstract

The paper dwells much on the two intricately interwoven concepts: Mathematics and Science education. Though, different in both their scope and curriculum structure, the paper argues in terms of their relevance to national development in entrenching and developing a sound education system capable of yielding sustainable scientific and technological development. Nigeria's economy in recent years experienced downturn which consequently affect some indices responsible for the smooth growth of Mathematics and Science education as formidable disciplines. The indices, as encapsulated in the paper, include funding, infrastructural deficit, inadequate instructional resources, recruitment of professionally trained teachers, insufficient capacity building programmes, shortage of ICT facilities, insecurity and lack of proper supervision amongst others. In the end, the paper suggests amongst others, the provision of adequate educational indices capable of addressing the widening gap of Mathematics and Science education funding across the country's levels of education.

Keywords: Science, Mathematics, Education, Funding, Economy

Introduction

Science and Mathematics education play significant roles in the development of nations across their strata of human endeavor and spheres of development. Thus, the need for providing effective Science and Mathematics education becomes imperative for developing countries – Nigeria being one of them – to compete favourably with the developed ones in all facets of development. The importance of these two areas was stressed in the Nigerian compendium of education laws – National Policy on Education (Federal Government of Nigeria, 2013) that Mathematics and Science were mentioned immediately after required languages to be used in teaching Nigerian child. This underscored the centrality of the duo in building a nation whose sectors of the economy are expected to be strong, virile and globally competitive. This is because great nations excel on the ground of their achievements in both science and technology (Olson & Riordan, 2012); and this in turn depends on solid foundation of Science and Mathematics education encapsulated and clearly articulated in their curricula (Kaur, 2014; Confrey, Maloney & Corley, 2014). However, in spite this importance of the two areas in building a strong and viable economic sectors, Nigerian economy had suffered a major drawback recently which would have enabled the government to appropriate funds required to drive these two key areas of education to operate optimally. This was against the backdrop of poor budgetary provisions which is below the threshold of 26% set by United Nations Educational, Scientific and Cultural Organization (UNESCO, 2023)



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An Overview of Science Education in Nigeria

Education encompasses all the processes individuals go through in life; from birth to adulthood (Blossfeld & Von Maurice, 2019); in order to develop and optimally utilize their God-given innate potentials through the acquisition of knowledge, skills, abilities and attitudes that are considered instrumental for effective living in society (El-Moslimany, 2018). Education is therefore, a vital aspect of human evolutionary trend and cannot be left to unattended to. That is why nations take time to organize and invest in their education system for maximum benefits of their citizenry (Gleason, 2018). Thus, Nigeria, like other nations recognizes the importance of, and bearing to national development, of education. Hence, the history of education in the country, from its inception as a republic, witnessed attempts by succeeding governments to provide good education for her citizens.

Against the backdrop of this, in 1975, Nigeria declared Universal Compulsory Primary Education (Alikor, 2014; Afolayan, 2014). Secondary education was made tuition free while tertiary institutions enjoyed free tuition and bursary awards concurrently. Determined to use education as a tool for development, Nigeria participated in World Conference on Education held in Jomtein, Thailand. The conference ended with a declaration of Education for All [EFA], a global initiative of the United Nations directed at using education as the major instrument for sustainable development. The EFA document came out with guidelines, target areas as well as time frames to encourage nations to see to it that every citizen has access to basic education as a baseline for the eradication of illiteracy. As a consequence, in 1999, the Federal Government of Nigeria (FGN) embarked on Universal Basic Education (UBE) covering primary and junior secondary school levels, i.e. 9-year basic education. The expectation is that a person who is functionally literate and numerate, will be able to meaningfully participate in social, economic and political affairs of his/her country as a responsible citizen. In spite of the seemingly recorded changes in educational policies, our education sector has not been succeeded in transforming our nation from undeveloped or developing to a developed country. Again, Nigeria participated in EFA meeting which subsequently took place in Senegal in 2000 where the international community met, outlined and reaffirmed its commitments to assist African countries' initiatives to achieve EFA. Determined to help developing countries to fast track development process, a set of goals referred to as Millennium Development Goals [MDGs] were introduced, launched and agreed upon by the participating countries; under the auspices of the United Nations.

The understanding is that each nation would study the target areas of which education is one and prepare a blueprint to achieve these ambitious goals. As a consequence, Nigeria came to translate the MDGs document into what is known as the National Economic Empowerment Development Strategy (NEEDS) which has become the driving force behind many reforms that are currently going on in Nigeria today including the ones in education sector. Now, access refers to uninhibited availability of chances/opportunities towards a goal. In the context of education, access to education as pursued by Universal Basic Education Commission means, not only enrolment at no financial cost to learners but also the provision of quality learning experiences, provision of learning materials and a conducive learning environment aimed at equipping learners for self-actualization (Onchari, 2016). This means that when you provide opportunity for a child to enroll in school, you cannot claim that you have given the child access to formal education if you deny them good quality education, deny them of learning materials, of conducive and learner- friendly environment, of qualified and motivated teachers who are equity conscious and integrity-driven. Thus, access to education implies enrolment, quality, participation and equity.



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In Nigeria, education statistics reports increase in enrollment at all levels of education as well as increase in literacy rate; yet the country is still far from being a developed nation for a number of reasons. For one, increase in enrolment and/or possession of literacy and numeracy skills on their own have not proved sufficient to bring about national development because the dichotomy between “developed” and “developing” countries is the level of advancement in science and technology. To this end, rapid and sustainable development of any country can only be achieved through scientific research, rational applications of science and technology knowledge and skills as well as literate workforce (Wahono & Chang, 2019).

An Overview of Mathematics Education in Nigeria

Nigerian system of education had provided that Mathematics be taught at all levels of learning from primary through tertiary levels of education in the country. This was captured in the National Policy on Education (FGN, 2004) which made it vividly clear on the need for the inculcation of Mathematics knowledge for all children of school-going age at primary level (Class 1 to 6) and basic level (JSS 1-3); so as to ensure they can be free from numeracy problem. This was again lucidly explained in the revised version of the National Policy on Education (FGN, 2011), when education was categorized into four levels of education in Nigeria as *Early Childhood (Pre-primary)*, *Basic Education (9 years)*; comprising Primary and Junior Secondary Education, which is compulsory, universal and free, Senior Secondary Education (3 years) and Tertiary Education. It should be noted however, that all these levels of education outlined by both policies cannot be fully attained by the targeted individuals without the instrumentality of mathematics education; owing to the nature of the specializations in every field. For instance, Kurumeh, Omenka and Mohammed (2013) noted that the scientific and technological development of a nation depends on the mathematical knowledge of its citizens. This, according to them necessitated the country to make Mathematics one of the core subjects in both primary and senior secondary school curricula (FGN, 2004). This is to enable individuals at that level to be well grounded in the field of Mathematics so that whichever specialization they may choose later would be easily learnt devoid of any learning constraint.

On the structure of the Mathematics curriculum in Nigeria, Awofala, Ola-Oluwa and Fatade (2012) reported that the new basic education mathematics curriculum has a 3-level structure: *Lower Level Basic Education Mathematics Curriculum* which is for primary 1-3, *Middle Level Basic Education Mathematics Curriculum* which is for primary 4-6 and *Upper Level Basic Education Mathematics Curriculum* which is for JSS 1-3. The curriculum was re-structured in the present format to suit the current need of the mathematics requirement for the country, which according to them has a mandate of making the learners, who must have gone through the 9-year basic education to acquire appropriate levels of literacy, numeracy, manipulative, communicative and life-skills: as well as the ethical, moral and civic values needed for laying a solid foundation for life-long learning as a basis for scientific and reflective thinking. Thus, to enable individuals become enabled to generate employment for themselves and even engage others, they must be made to extol and harness the full provisions of the curriculum right from the outset so that, upon becoming mathematically literate and inclined, the employment they will generate would be sustainable. This will not only be beneficial to them alone, but to the entire community they hailed from. This would help in the improvement of the country’s depressed economy



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Snapshot of Nigerian Depressed Economy

Issues and Challenges

The key issues in Science and Mathematics education centered on funding. Thus, if funding is not sufficient enough, it leads to a number of challenges; such as infrastructural deficit, lack of instructional resources, and inadequate number of professionally trained teachers. Others are inadequate ICT facilities, prevalence of insecurity, and poor supervision amongst others. Therefore, these issues and challenges were carefully looked at as they each affect funding and dissemination of science and Mathematics knowledge as the drivers of nation's growth and development scientifically, technologically and economically as well.

Funding

In terms of funding, many scholars, both in Nigeria and beyond, were unanimous that one of the key indices central in entrenching a globally competitive Science and Mathematics education is funding (Maginson, 2022; Akinola, 2021). For instance, in their study, Sodangi, Isma'il and Abdulrahman (2022) stressed the need for adequate funding of public secondary school Science and Mathematics teachers because of its centrality in professional development and career progression. However, they argued that, over the years, lack of adequate funding hampered the progress of Science and Mathematics teachers professionally and most of the teachers missed a number of professional opportunities in Zamfara state occasioned by poor funding. Similarly, Abubakar and Olamoyegun (2023) argued that adequate funding is the solution to a number of problems bedeviling Science Education in Nigeria. Using secondary data in the study, the findings revealed that if funds are made available to secondary schools, it would address problems of teachers, facilities as well as laboratory equipment.

Infrastructural Facilities

In terms of infrastructure, many of the office buildings in our schools today are dilapidated, Science and Mathematics laboratories are worn out and libraries – housing Science and Mathematics books are virtually non-existent; where they are found available, there are no books or the collections are obsolete, and not in tune with the current challenge our society faces. In view of this, Kola, Gana and Olasumbo (2017) argues that, unless infrastructural facilities are made available and accessible to students, learning under conducive atmosphere as well effective secondary school teaching would be an illusion. Therefore, infrastructure plays an important role in addressing most of the problems within the school. Thus, on their part, secondary school Science and Mathematics teachers perform optimally if the provision of adequate and sufficient infrastructure is ensured (Egede & Asabor, 2019; Ma & Hall, 2018); alongside befitting laboratories and libraries capable of addressing our Science and Mathematics needs (Ekpo, 2022; Yeasmin, 2016).

Instructional Resources

Teaching Science and Mathematics in secondary school requires instructional resources in order to concretize the process of learning to the students in order to address the abstraction thoughtfully inherent in Science and Mathematics. In line with this, Santagata and Lee (2021) argued that when teaching/instructional resources are deployed in teaching, the possibility of getting substantial number of students to understand what the teacher is teaching is high. Sirajo and Abdullahi (2023) also believed that availability of instructional resources can influence students' performance in Mathematics in north-western Nigeria. On the contrary, when teaching/instructional resources are short in supply, students tend to be adamant and passive; without feeling the touch of what the teacher is teaching. In his argument, Raya (2017), and Adigun (2020) believed that teaching in secondary school especially in science related subjects such as Mathematics, Biology, Chemistry and Physics, the deployment of sufficient and adequate instructional materials is quite instructive.



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Similarly, Oguntuase, Awe & Ajayi (2013) argued the failure to use such materials as models of shapes in Mathematics, specimens and reagents in biology, conical flask, beaker and Bunsen burner in chemistry and glass block, glass prism and copper wire in physics would ultimately make the lesson less appealing, and the students less passionate and enthusiastic.

Capacity Building Programmes

Teaching and learning is a continuous process. After undergoing the prescribed training to acquire a specific type of qualification, say, NCE, Diploma or Bachelor's Degree, teachers need continuous update of their Science and Mathematics knowledge. And this can be ensured through in-service training and capacity building programmes. Teachers with lower qualifications need to proceed to have next higher qualification to enable them compete favourably amongst their peers; through in-service opportunities. Through funding, opportunities can be made to Science and Mathematics teachers to improve on their skills. In some instances, collaboration could be sought between government and some non-governmental donor agencies like UNICEF, FH360, and UNESCO etc. Therefore, government can leverage on counter-funding from those organizations to help in building the manpower capacity of Science and Mathematics teachers; especially amidst the dwindling resources of government and in the face of enormous challenges in the education sector.

Recruitment of Professionally Trained Teachers

Many research works recently indicated that most of the teachers in secondary schools today are either not professionally trained or they are out rightly not qualified to teach because they lack the requisite knowledge, skills and aptitude to do that (Hobbs, 2013). Similarly, research had shown how inadequate the number of Science and Mathematics teachers are in Nigerian education system and how that had affected many sectors of the country's economy where the services of these experts are required (Olatude-Aiyedun, & Ogunode, 2021; Ogunniyi & Rollnick, 2015). However, it was observed that significant number of Science and Mathematics in schools today doesn't have background neither in Science nor Mathematics but because they could not get jobs elsewhere they are recruited to teach Science and Mathematics.

ICT Facilities

In line with National Digital Economy Policy (2022) enacted, secondary schools are supposed to be equipped with ICT gadgets in order to make their operation seamless. Thus, in order to keep pace with the global trend, whereby everything relies on electronic means, it is imperative to make our education system ICT-compliant. Consequently, National Communications Commission (NCC) in collaboration with Federal Ministry of Communications and Digital Economy to make provision for ICT equipment in some selected secondary schools across the country. This is with a view to bridging the ICT gap amongst our teeming youth in those secondary schools in order to prepare for hand-on opportunities that require competence in ICT, and to enable them to be self-reliant.

Insecurity

In order to ensure the protection of the lives of students and staff across secondary schools, the recent insecurity being experienced in every nook and cranny of the state is unsettling, mind-boggling and, to say the least, disgusting; and it needs to be taken seriously in order to curtail escalation and henceforth deal with the problem decisively. When this is ensured, learning in these schools devoid of any fear, can be guaranteed. The insecurity threat that engulfed the north-western states had made it practically impossible in states like Zamfara to allow its students, in some parts of the state, to have access to schools. For instance, in the aftermath of the incident of kidnapping of some students at GSS Kaya, the state set up a committee to advise the government on what to do to address the problem. After careful assessment, the committee developed a criteria for classifying the state's schools based on their location, vulnerability as well as accessibility to the bandits.



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Consequently, the state stratified the secondary schools in the state in three categories: red, yellow and white. Those identified and tagged as red are the most vulnerable ones and the committee advised the government to close them immediately to avoid further attacks and kidnappings. Those identified as yellow were considered potentially vulnerable, and the committee advised the government to be vigilant on them and provide necessary additional security personnel in order to repel any potential threat to the students and staff of those schools so as to prevent them from total closure like the red ones. As for those marked, identified and tagged as white, they are safe and face no any danger of being attacked or suffer kidnapping. These are mostly the schools located in the urban areas of the state – mostly in local government headquarters and some major towns, where, in the event of any possible attacked, security can be dispatched immediately to neutralize the threat. Now, having painted this ugly picture of security threat bedeviling the secondary schools in the region, envisioning effective administration of these schools requires formidable and concerted effort by government in order arrest the situation and ensure that children of secondary school going age are not prevented or scared away from going to school because of that security.

Supervision

Supervision, when effective, is a vital tool for quality assurance and professional development in education. However, in the context of mathematics and science education in Nigeria, particularly in a depressed economy, it often falls short due to a combination of logistical, financial, and expertise-related challenges, compounded by insecurity. Addressing these supervisory deficits is critical for improving teacher quality, ensuring effective instructional delivery in core subjects like mathematics and science, and ultimately enhancing student learning outcomes across the nation.

Way forward in Funding Science & Mathematics Education

In order to address the lingering crisis of Mathematics and Science education funding in Nigerian educational institutions, the following suggestions are put forward:

1. **Increase funding:** the budgetary allocation to Mathematics and Science education sub-fields should be increased in order to reach the minimum threshold set by UNESCO so that the two fields can be taught properly across all levels.
2. **Infrastructural facilities:** government should provide adequate infrastructure in order to enable Mathematics and Science teachers as well as students have conducive environment and state of the art facilities so as to ensure effective teaching and learning.
3. **Capacity building programs:** regular capacity building programs should be organized for in-service teachers in order to update their teaching capacity. This is especially in the areas of emerging teaching technologies.
4. **Insecurity:** in view of the ravaging security situation in the country, security should be ensured by government in order to allow for uninterrupted teaching sessions in schools and prevent short-cut terms occasioned by insecurity.

Conclusion

The economic challenges in Nigeria present significant hurdles to adequately funding science and mathematics education. However, these challenges also serve as a powerful impetus for innovation and strategic re-evaluation. By prioritizing STEM education in national budgets, fostering genuine public-private partnerships, implementing transparent financial management, and aggressively leveraging digital technologies for both content delivery and teacher professional development, Nigeria can overcome its funding deficits. This holistic approach is essential to equip teachers with the necessary tools and training, create conducive learning environments, and ultimately produce a generation of scientifically and mathematically literate citizens crucial for Nigeria's sustainable development and emergence from economic depression.



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Effectiveness of Public-Private Partnerships in ... Okhawere, P. Y. O. (2025)

Effectiveness of Public-Private Partnerships in Enhancing Vocational Education in Nigeria

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Abstract

Vocational education in Nigeria plays a crucial role in equipping individuals with industry-relevant skills, yet persistent challenges such as inadequate funding, outdated curricula, and weak industry collaboration hinder its effectiveness. Public-private partnerships (PPPs) have emerged as a viable solution, leveraging private sector resources, expertise, and innovation alongside public sector support to enhance vocational training. By fostering infrastructure development, curriculum modernization, and apprenticeship opportunities, PPPs can bridge the gap between education and labour market needs. Despite their potential, PPPs in Nigeria face structural and operational constraints, including policy inconsistencies, bureaucratic inefficiencies, and limited private sector engagement. This study critically examines the effectiveness of PPPs in vocational education, identifying best practices and proposing strategies to optimize collaboration between public institutions and private enterprises. Key recommendations include strengthening regulatory frameworks, providing financial incentives such as tax breaks and subsidies, establishing performance metrics, enhancing industry-academia collaboration, and integrating digital learning platforms. A well-structured PPP framework can enhance vocational education accessibility, quality, and workforce alignment, ultimately driving economic growth. Addressing governance challenges and ensuring sustainable financing mechanisms are crucial for maximizing the impact of PPPs in Nigeria's vocational education sector.

Keywords: Public-Private Partnerships (PPPs) and Vocational Education

Introduction

Vocational education in Nigeria plays a critical role in equipping individuals with practical skills necessary for economic development and self-reliance. However, the sector has faced persistent challenges, including inadequate funding, outdated curricula, insufficient infrastructure, and limited industry collaboration (Okolie, Nwosu, & Mlanga, 2019). These barriers hinder its effectiveness in addressing unemployment and bridging the skills gap between education and labour market needs. Given these limitations, public-private partnerships (PPPs) have emerged as a viable strategy for enhancing vocational education by leveraging the resources, expertise, and efficiency of the private sector alongside public sector support (Osabuohien, Efobi, & Gitau, 2020). PPPs in education involve collaboration between government agencies, private enterprises, and non-governmental organizations to improve access, quality, and relevance of vocational training (Patrinos, et al, 2009). This approach has been successfully implemented in various countries, fostering innovation, infrastructure development, and curriculum enhancement (Tang, 2022). In Nigeria, where the education sector struggles with funding deficits, PPPs offer an alternative mechanism to promote sustainable skill development. Effective PPPs can bridge the gap between training institutions and industries, ensuring that vocational education aligns with labour market demands (Oketch, 2014). This study is significant because it critically examines how PPPs can be optimized to enhance vocational education in Nigeria. While the potential benefits are widely recognized, the implementation of PPPs in Nigeria has faced governance issues, lack of clear policies, and limited private sector participation (Olaniyan & Okemakinde, 2008). This research aims to explore the conceptual dimensions of PPPs in vocational education, identifying best practices and challenges to



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inform policy and decision-making. The objectives include analyzing the role of PPPs in improving vocational education, evaluating existing models, and proposing strategies for more effective collaboration between public and private stakeholders.

Conceptualizing Public-Private Partnerships in Vocational Education

Public-private partnerships (PPPs) in vocational education represent a collaborative approach where the public and private sectors share responsibilities, resources, and risks to enhance educational outcomes. PPPs are characterized by joint investment, long-term agreements, risk-sharing mechanisms, and a focus on improving access, quality, and relevance in education (Patrinos, et al, 2009). Unlike traditional state-led models, PPPs leverage private sector efficiency, innovation, and financial contributions while maintaining public oversight to ensure inclusivity and equity. This collaboration is essential in vocational education, where practical skill acquisition and industry relevance are critical for addressing labour market demands. PPPs in education take various forms depending on their scope and objectives. One prominent model is funding-based partnerships, where private firms co-finance vocational institutions through direct investment, subsidies, or tax incentives (Osabuohien, et al, 2020). Another form focuses on infrastructure development, where private entities construct and maintain vocational training centres, equipping them with modern technology and facilities to bridge the resource gaps faced by public institutions (Tang, 2022). Curriculum design partnerships involve collaboration between educators and industry stakeholders to develop competency-based training programmes that align with labour market needs, ensuring vocational graduates possess relevant and employable skills (Oketch, 2014). Additionally, apprenticeship and internship programmes facilitate industry-led hands-on training opportunities, integrating theoretical knowledge with real-world experience, thereby improving employability outcomes (Ziderman, 2016).

The theoretical foundations of PPPs in vocational education draw from multiple perspectives. Human capital theory, as proposed by Becker (1964), emphasizes the role of education and skill development in economic growth, positioning PPPs as a mechanism to enhance workforce productivity. Stakeholder theory (Freeman, 1984) highlights the importance of engaging multiple actors such as government, industry, and academia to foster sustainable and effective vocational training models. Institutional theory (North, 1990) provides insight into how formal and informal regulatory frameworks influence PPP success, emphasizing the need for structured policies, governance mechanisms, and regulatory clarity. These theories collectively explain why PPPs are vital in vocational education and how they can be structured for optimal effectiveness. However, challenges such as policy inconsistencies, weak institutional capacity, and limited private sector engagement often hinder the full realization of PPP benefits. Addressing these barriers through clear policy frameworks, incentive structures, and accountability mechanisms is essential to maximizing the potential of PPPs in vocational education.

Challenges Confronting Vocational Education in Nigeria: Structural and Systemic Barriers

Vocational education in Nigeria is critical for equipping individuals with practical skills essential for economic development and workforce integration. However, the sector faces significant structural and systemic challenges that hinder its effectiveness. One of the most pressing issues is inadequate funding and infrastructure. Vocational education has historically suffered from underinvestment, resulting in poorly equipped training centres, obsolete equipment, and insufficient learning materials



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(Okolie, et al., 2019). Government budgetary allocations to technical and vocational education and training (TVET) remain low, leading to a reliance on outdated facilities that fail to meet modern industry standards. Without adequate funding, vocational institutions struggle to provide quality training that aligns with contemporary labour market demands (Oketch, 2014). Another critical challenge is the poor alignment between vocational curricula and industry needs. Many vocational programmes in Nigeria continue to emphasize theoretical knowledge over practical competencies, creating a mismatch between graduates' skills and employers' expectations (Osabuohien, et al., 2020). Industry involvement in curriculum development is minimal, leading to programmes that do not reflect the evolving demands of the labour market. This misalignment contributes to the persistent gap between vocational education and employment readiness, reducing the effectiveness of TVET in addressing workforce shortages in technical and skilled labour fields (Tang, 2022). The shortage of skilled vocational instructors further exacerbates the challenges in the sector. Many vocational training centres lack qualified educators who possess both pedagogical knowledge and industry experience (Ziderman, 2016). The limited availability of professional development programmes for vocational teachers means that instructors often rely on outdated teaching methods, failing to expose students to contemporary industry practices. Without adequately trained instructors, vocational education institutions struggle to produce competent graduates equipped with relevant and in-demand skills (Olaniyan & Okemakinde, 2008). As a result of these challenges, Nigeria faces high levels of unemployment and underemployment among vocational graduates. Many TVET graduates find it difficult to secure jobs or establish sustainable entrepreneurial ventures due to inadequate practical training and limited industry connections (Oketch, 2014). The stigma associated with vocational education further discourages enrolment, reducing the number of skilled workers available to fill technical roles. Addressing these systemic barriers requires comprehensive policy reforms, increased private sector collaboration, and targeted investments in vocational training to enhance its effectiveness in driving economic development.

Frameworks for Public-Private Partnerships in Vocational Education: Collaborative, Market-Driven, and State-Led Approaches

Public-private partnerships (PPPs) in vocational education operate under different conceptual models, each reflecting varying degrees of government and private sector involvement. The collaborative model represents an equal partnership where both sectors share responsibilities in funding, governance, and curriculum development. This model ensures balanced decision-making, leveraging government oversight and private sector efficiency to enhance vocational education. Studies highlight that joint governance structures facilitate the development of industry-relevant curricula, improve training quality, and optimize resource allocation (Patrinos, et al., 2009). Countries that adopt this model, such as Germany through its dual apprenticeship system, demonstrate higher workforce readiness among graduates due to strong industry-academia collaboration (Oketch, 2014). However, challenges such as conflicting priorities and bureaucratic inefficiencies can hinder the smooth functioning of this model.

The market-driven model is predominantly private sector-led, with government playing a supportive role through policy incentives and regulatory oversight. This model thrives on industry investment in vocational education, often through corporate training centres, industry-sponsored institutions, and enterprise-based apprenticeships (Tang, 2022). Multinational corporations and large businesses establish training programmes aligned with their specific workforce needs, ensuring a steady pipeline of skilled labour. In Nigeria, initiatives such as the Dangote Academy exemplify how private firms



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contribute to skill development while benefiting from a readily available talent pool (Osabuohien, et al., 2020). The advantage of this model lies in its responsiveness to market trends and technological advancements. However, a major drawback is the potential exclusion of marginalized groups, as private entities may prioritize profitability over inclusivity (Ziderman, 2016). The state-led model is driven by government policies, with private sector input in curriculum design and training implementation. Here, public institutions retain control over vocational education while seeking industry expertise to enhance programme relevance. This model is common in developing economies where the government remains the primary financier of education (Olaniyan & Okemakinde, 2008). While it ensures broader access to vocational training, bureaucratic constraints and limited funding often undermine effectiveness. Strengthening PPPs in vocational education requires strategic alignment among stakeholders, clear policy frameworks, and mechanisms to balance state control with industry innovation.

Barriers to Effective Public-Private Partnerships in Vocational Education: Structural, Institutional, and Operational Constraints

Public-private partnerships (PPPs) in vocational education are often hindered by structural, institutional, and operational challenges that undermine their effectiveness. Bureaucratic bottlenecks and policy inconsistencies pose significant obstacles to the successful implementation of PPPs. In many developing economies, including Nigeria, the regulatory environment for vocational education is fragmented, with overlapping mandates across multiple government agencies (Oketch, 2014). Conflicting policies, slow decision-making processes, and excessive administrative procedures delay the approval and execution of PPP initiatives. Additionally, the frequent changes in government policies and leadership disrupt long-term vocational training programmes, creating uncertainty for private sector investors (Osabuohien, et al., 2020). Without a stable and transparent regulatory framework, PPPs struggle to achieve sustainability.

Another critical limitation is the limited private sector involvement due to perceived risks. Many private organizations hesitate to engage in vocational education due to concerns about return on investment, weak institutional capacity, and unpredictable policy environments (Ziderman, 2016). Unlike higher education, which often attracts private funding due to its perceived prestige and profitability, vocational training is sometimes viewed as less lucrative, discouraging industry participation (Patrinos, et al., 2009). Furthermore, businesses often fear that government bureaucracy and regulatory constraints will impede operational flexibility, reducing their willingness to contribute to infrastructure development, curriculum design, or job placement programmes. Overcoming this barrier requires stronger incentives, including tax relief, subsidies, and regulatory assurances that protect private sector interests while ensuring alignment with national education objectives.

Inadequate monitoring and evaluation (M&E) frameworks further weaken the impact of PPPs in vocational education. Many partnerships lack clear performance indicators, making it difficult to assess effectiveness and identify areas for improvement (Tang, 2022). Without robust M&E mechanisms, there is limited accountability, which can lead to inefficiencies, misallocation of resources, and substandard training outcomes. Regular assessments, transparent reporting structures, and data-driven decision-making are essential to ensure that PPPs deliver tangible results in skill development and employability. Addressing these challenges requires policy coherence, active industry engagement, and rigorous evaluation frameworks to enhance the role of PPPs in vocational education.



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Strengthening Vocational Education through Public-Private Partnerships: A Pathway to Workforce Development

Public-private partnerships (PPPs) play a pivotal role in strengthening vocational education by integrating private sector efficiency, innovation, and investment with government support to enhance funding, infrastructure, curriculum relevance, and employability outcomes. As economies evolve and industries demand more specialized skills, vocational education must adapt to remain relevant. PPPs provide a strategic mechanism to bridge gaps in vocational training by ensuring sustainable funding, up-to-date curricula, modern technology integration, and direct employment pathways for graduates. One of the fundamental contributions of PPPs to vocational education is in funding and infrastructure development. Historically, limited public sector resources have constrained the expansion and modernization of technical and vocational education. Governments alone struggle to provide adequate infrastructure, modern equipment, and industry-aligned training facilities. Through PPPs, private investments supplement public efforts, facilitating the establishment of state-of-the-art vocational training centres equipped with industry-standard tools and technology (Patrinos, et al., 2009). These partnerships enable institutions to procure modern machinery and digital tools, ensuring that students receive practical, hands-on training aligned with labour market needs (Osabuohien, et al., 2020). Moreover, PPPs often result in more efficient management of vocational training centres, reducing bureaucracy and ensuring better resource utilization.

Beyond infrastructure, PPPs play a critical role in curriculum development and industry collaboration. A major challenge in vocational education has been the disconnect between training programmes and employer needs, which has led to skill mismatches and high unemployment rates among graduates (Oketch, 2014). Through PPPs, industry stakeholders actively participate in designing and updating curricula to ensure alignment with current workforce requirements and technological advancements (Tang, 2022). This collaboration helps integrate competency-based learning models that emphasize practical skills and real-world applications, making graduates more employable. Employers can also provide feedback on emerging industry trends, enabling vocational institutions to continuously update their training content. Capacity building and teacher training represent another area where PPPs have a transformative impact. Many vocational instructors, particularly in Nigeria and other developing economies, lack contemporary technical skills due to limited professional development opportunities (Ziderman, 2016). Through PPPs, industry partners offer specialized training, mentorship initiatives, and professional exchange programmes that expose educators to modern industrial practices (Olanayan & Okemakinde, 2008). This collaboration enhances instructional quality and ensures that students receive training that reflects real-world industry standards.

Technology integration in vocational training is another crucial area where PPPs drive innovation. The adoption of digital tools, e-learning platforms, and smart workshops improves learning efficiency and accessibility. Virtual simulations, online certification programmes, and remote learning solutions expand the reach of vocational education, particularly in underserved regions where traditional training facilities may be inadequate (Osabuohien et al., 2020). Finally, PPPs contribute significantly to job placement, apprenticeships, and employability outcomes. By fostering strong industry linkages, these partnerships create internship opportunities, industrial attachments, and direct employment pathways for graduates (Okolie, et al., 2019). Employers engaged in PPPs often prefer hiring graduates from training centres they support, as they are already familiar with the skills



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imparted. Strengthening vocational education through PPPs is, therefore, a crucial strategy for workforce development, reducing unemployment, and ensuring economic growth.

Policy Recommendations and Strategic Framework for Effective Public-Private Partnerships in Vocational Education

To enhance the effectiveness of public-private partnerships (PPPs) in vocational education, a comprehensive policy framework is required to address structural, financial, and operational challenges. The following recommendations provide a roadmap for strengthening PPPs in vocational education:

I. Strengthening Regulatory Frameworks to Encourage Private Investment

A stable and transparent regulatory environment is essential to attract sustained private sector involvement in vocational education. Governments should streamline approval processes, reduce bureaucratic inefficiencies, and ensure policy consistency to build investor confidence. Regulatory bodies should provide clear guidelines on partnership structures, funding arrangements, and operational roles to minimize uncertainties and risks associated with private sector participation (Oketch, 2014).

II. Incentivizing Private Sector Participation Through Tax Breaks and Subsidies

Governments should introduce financial incentives such as tax relief, grants, and subsidies to encourage private enterprises to invest in vocational training. These incentives can help offset initial investment costs and motivate industries to establish training centres, provide apprenticeship opportunities, and contribute to curriculum development (Patrinos, et al., 2009). Public-private funding models should also be explored to ensure financial sustainability.

III. Establishing Clear Performance Metrics for Vocational Training Outcomes

A robust monitoring and evaluation (M&E) framework is necessary to assess the effectiveness of PPPs. Key performance indicators (KPIs) should include student employability rates, industry satisfaction with graduates, and the relevance of training programmes to labour market demands (Ziderman, 2016). Regular audits and impact assessments should be conducted to ensure continuous improvement.

IV. Enhancing Collaboration Between Industries, Vocational Institutions, and Government Bodies

To bridge the gap between education and industry, vocational training programmes should be designed in close collaboration with employers. Industry-driven advisory boards, joint curriculum development initiatives, and apprenticeship programmes should be institutionalized to align vocational training with labour market needs (Osabuohien, et al., 2020).

V. Leveraging Technology and Digital Learning Platforms

Integrating digital tools and e-learning platforms into vocational training can enhance accessibility and efficiency. Smart workshops, virtual simulations, and AI-driven skills assessment tools should be deployed to modernize training delivery (Tang, 2022).

VI. Ensuring Sustainable Financing for PPPs

Sustainable funding mechanisms, such as public-private trust funds and international donor support, should be explored. Multi-stakeholder financing models can ensure long-term sustainability and equitable access to vocational training.

Conclusion

Public-private partnerships (PPPs) have the potential to transform vocational education in Nigeria by addressing funding gaps, improving curriculum relevance, and enhancing employability. However, bureaucratic challenges, limited private sector engagement, and weak monitoring frameworks hinder their effectiveness. Strengthening regulatory policies, incentivizing industry participation, and



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integrating digital learning can create a more robust vocational education system. Future research should explore sector-specific PPP models, evaluate long-term impacts on employment rates, and examine innovative financing mechanisms to ensure sustainability. A well-structured PPP framework can bridge the skills gap and drive economic growth in Nigeria.

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Effects of Prior-Exposure to Biology Concepts on Science-Process-Skills and Performance among Secondary School Students in Sokoto State, Nigeria

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Abstract

This study investigates the effects of prior-exposure to biology concepts on science-process-skills and performance among secondary school students in Sokoto State, Nigeria. The persistent underachievement of students in biology is linked to limited foundational knowledge, which this research sought to address. A quasi-experimental design was adopted, targeting Senior Secondary II (SSII) biology students in public schools. From the population, a sample of 120 students was selected and divided into experimental and control groups. The experimental group received structured prior exposure to biology concepts, while the control group was taught using the conventional method. Data were collected using two validated instruments: the Science Process Skills Test (SPST) with a reliability coefficient of 0.82, and the Biology Academic Performance Test (BAPT) with a coefficient of 0.87. Descriptive statistics (mean and standard deviation) were used to answer the research questions, while independent t-tests at 0.05 significance level tested the hypotheses. Findings revealed that students exposed to prior biology concepts performed significantly better in both science process skills and academic performance compared to those in the control group. The study concludes that structured prior exposure enhances both science process skills and academic performance in biology. It is recommended that curriculum planners integrate early exposure modules into biology teaching, and teachers employ strategies that deliberately activate students' prior knowledge to improve learning outcomes.

Keyword: Prior exposure, science skills, performance and biology concepts

Introduction

Biology occupies a central position among the core science subjects at the senior secondary school level, particularly within the Nigerian educational system where it forms an essential component of the science curriculum. Its relevance is underscored by its foundational importance to numerous disciplines, including health sciences, agriculture, environmental science, biotechnology, and the broader life sciences. In the context of Nigeria's pursuit of national development and its aspiration for global competitiveness in science and technology, proficiency in biology alongside the acquisition of relevant scientific skills has become a critical necessity for cultivating a scientifically literate populace (Aliyu & Mustapha, 2020). Consequently, investigating pedagogical strategies that effectively promote students' academic performance in biology, especially through the mechanism of prior conceptual exposure, represents a significant and timely focus for contemporary educational research. Biology is the study of life and living organisms, encompassing structure, function, growth, evolution, distribution, and taxonomy. It relies not only on the acquisition of factual knowledge but also on the development of science process skills such as observation, classification, inferring,



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predicting, and experimentation. These skills form the basis of scientific inquiry and critical thinking (Oludipe, 2020). Over the years, the approach to teaching biology has evolved to incorporate more learner-centered and inquiry-based methodologies. However, challenges such as insufficient laboratory exposure, rote memorization, and lack of foundational understanding continue to hinder meaningful learning in Nigerian secondary schools (Abdullahi & Aliyu, 2018). Recognizing and leveraging students' prior exposure to biological concepts may offer a pathway to overcome these barriers and promote deeper cognitive engagement.

Prior knowledge, defined by Ausubel (1968) as the most significant factor influencing learning, encompasses the accumulated knowledge, skills, and experiences that students bring into the classroom, serving as a cognitive scaffold for new learning. In biology, prior exposure facilitates comprehension of abstract concepts, development of science process skills, and improved academic performance (Fang & Chen, 2021), while also boosting motivation and confidence linked to positive outcomes (Gardner, 2020). Attitude and preparedness to learn are shaped by what learners already know, prompting educators to adopt instructional approaches that activate and build upon existing knowledge. Research by Liu and Hsieh (2019) shows that students with prior biology exposure demonstrate greater competence in applying knowledge, interpreting data, and engaging in discussions, while Azman et al. (2018) highlight its role in enhancing inquiry skills and meaningful learning. Collectively, these strategies promote active participation, higher assessment performance, and long-term retention of scientific principles. The acquisition of science process skills is a critical educational goal in biology education. These skills equip learners with tools for systematic thinking and problem-solving skills that are valuable not only in academics but also in real-life situations and STEM careers (Bybee, 2010). Mastery of these skills allows students to approach biological problems analytically and enhances their overall academic performance. However, studies have shown that many students struggle with acquiring these skills due to a lack of foundational exposure to core concepts in earlier educational stages (Semilarski et al., 2019). Early and structured exposure to biology content, therefore, is essential to ensure that students can effectively develop these cognitive abilities.

In the Nigerian context, several educational challenges such as overcrowded classrooms, limited instructional materials, and underqualified teachers contribute to students' poor performance in science subjects, including biology. Despite curriculum revisions aimed at improving science education, many students still lack the foundational knowledge required to engage meaningfully with biology content at the senior secondary level (Mendez & Salazar, 2020). This is particularly evident in Sokoto State, where disparities in access to quality science education persist. Academic performance in biology reflects the extent to which students achieve their educational goals, often measured through exams, assessments, and practical evaluations, and serves as an indicator of instructional quality and curriculum effectiveness. Research highlights that performance is influenced by factors such as student engagement, motivation, interest, classroom environment, quality of instruction, and availability of learning resources (Aliyu & Bichi, 2019; Yusuf & Adigun, 2019; Ige & Adewale, 2021). Studies show that a deep understanding of biological principles, fostered by active learning and prior exposure to concepts, significantly improves outcomes (Lawal, 2019; Ibrahim et al., 2022). When biology is perceived as relevant and comprehensible, students are more likely to excel, and integrating prior knowledge into lessons enhances conceptual clarity, application skills, and retention (Olatoye, 2020; Alexander, Soeparman, & Supard, 2018). Consequently, effective pedagogy in biology should link new material to existing knowledge to optimize cognitive processing and performance.



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In addition to cognitive and instructional factors, socio-emotional variables such as self-efficacy, attitude toward science, and peer influence also contribute significantly to students' academic performance in biology. Research has found that students who believe in their capacity to succeed in science-related tasks tend to exhibit higher levels of academic performance (Eze & Okonkwo, 2021). Positive peer interactions and collaborative learning environments further reinforce motivation and deepen understanding, thereby enhancing performance. As noted by Afolabi and Matanmi (2020), students who engage in peer discussions and group problem-solving activities often demonstrate improved retention of biological concepts and perform better in assessments. These findings highlight the importance of a supportive learning climate that nurtures both intellectual and emotional aspects of student development in achieving optimal academic outcomes in biology. Recent research by Abubakar and Anas (2023) highlights the potential of early exposure to scientific concepts in improving student engagement and academic performance. Their findings suggest that targeted educational interventions that consider students' prior knowledge can foster the development of essential science skills. Given this, the present study investigates the effects of prior exposure to biology concepts on science process skills and academic performance among senior secondary school students in Sokoto State. By doing so, it aims to offer practical insights for science educators, curriculum developers, and policymakers on how to enhance biology education through evidence-based strategies.

Statement of the Research Problem

Ideally, students should perform well in Biology since it is a core science subject with greater instructional time compared to other subjects at the senior secondary level. With sufficient time, resources, and appropriate teaching methods, Biology ought to provide students with the foundational knowledge and skills necessary for higher education and careers in science and technology. However, the current situation reveals a persistent problem: students' performance in Biology has remained consistently poor, even though more classroom periods are allocated to it than to subjects such as Religious Studies and Languages. Interestingly, students tend to achieve better in those subjects despite the fewer instructional periods. This discrepancy appears to stem from the effective use of prior knowledge and culturally relevant examples in other subjects, which make new concepts easier to understand and apply. By contrast, Biology lessons are often dominated by teacher-centered methods such as lectures and rote memorization, which limit students' engagement and critical thinking. Additional challenges include a shortage of well-equipped laboratories, overcrowded classrooms, and limited opportunities for hands-on and collaborative learning. This has created a research gap, as limited studies in Sokoto State have examined the role of prior exposure to Biology concepts in improving science process skills and academic performance. Consequently, many students continue to exhibit weak inquiry skills, poor achievement, and inadequate preparedness for further studies in science-related fields, ultimately undermining national development in science and technology. It is therefore necessary to investigate whether structured prior exposure to Biology concepts can serve as an effective instructional strategy to enhance students' science process skills and academic performance. It is anticipated that findings from this study will provide evidence that activating students' prior knowledge can foster better engagement, deeper learning, and improved outcomes in Biology.

Objectives of the study

1. Assess the effect of prior exposure to Biology concepts on students' science process skills in Sokoto State, Nigeria.
2. Investigate the effect of prior exposure to Biology concepts on students' academic performance in Sokoto State, Nigeria.



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Research Questions

1. To what extent does prior exposure to biology concepts affect science process skills acquisition among senior secondary school students in Sokoto State, Nigeria?
2. To what extent does prior exposure to biology concepts affect academic performance of senior secondary school students in Sokoto State, Nigeria?

Hypotheses

1. There is no significant effect of prior exposure to biology concepts on the science process skills of senior secondary school students in Sokoto State, Nigeria.
2. There is no significant effect of prior exposure to biology concepts on the academic performance of senior secondary school students in Sokoto State, Nigeria.

Methodology

In this study, a quasi-experimental research design was used. The study targeted the entire population of Senior Secondary School II (SSII) students in Sokoto State, focusing specifically on those enrolled in public senior secondary schools. From this population, a sample of 120 students was selected and assigned into two groups: an experimental group and a control group. The experimental group was exposed to biology concepts, while the control group received traditional instruction without prior exposure to these concepts. Post-tests were administered to both groups using two instruments: the Science Process Skills Test (SPST), and the Biology Academic Performance Test (BAPT), to measure their initial equivalence and subsequent performance. A pilot study was conducted to establish the reliability of the instruments. The Science Process Skills Test (SPST) yielded a reliability coefficient of 0.82 using Cronbach’s alpha, while the Biology Academic Performance Test (BAPT) produced a coefficient of 0.87. Both the two instruments employed multiple-choice tests with four options (A–D). The data collected were analyzed using descriptive statistics such as mean and standard deviation to answer the research questions and t-test statistics was used to test the null hypotheses at 0.05 level of significance.

Presentation of Results

Based on the results obtained, the analysis and interpretation were done with the use of tables to provide a clear picture of the findings as follows:

Research Question 1

What are the effects of prior exposure to biology concepts on science process skills among Senior Secondary School Students in Sokoto State, Nigeria?

Table 1: Posttest Mean Scores of Students' Science Process Skills (SPS) in the Experimental and Control Groups

Group	N	Mean Score	Standard Deviation (SD)	Mean Difference
Experimental	60	68.42	6.15	22.69
Control	60	45.73	5.95	

Source: Fieldwork (2025)

Table 1 shows the posttest mean scores of students’ science process skills in the experimental and control groups. The experimental group, which received prior exposure to biology concepts, had a mean score of 68.42, while the control group scored a mean of 45.73. This reflects a mean difference of 22.69 in favour of the experimental group, indicating that prior exposure significantly enhanced their acquisition of science process skills. The standard deviations (6.15 for experimental and 5.95 for control) indicate a relatively consistent spread in students’ scores across both groups. These findings from research question one affirmatively show that students who were exposed to biology concepts before instruction performed better in science process skills compared to their counterparts who received traditional instruction only.



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Research Question 2

To what extent does prior exposure to biology concepts affect academic performance of senior secondary school students in Sokoto State, Nigeria?

Table 2 presents the post-test mean scores, standard deviations, and mean differences in biology academic performance between the experimental group (students exposed to prior biology concepts) and the control group (students not exposed).

Table 2: Posttest Mean Scores and Standard Deviations of Students' Academic Performance in Biology

Group	N	Post-Test Mean	SD	Mean Difference
Experimental	60	68.75	6.05	14.45
Control	60	54.30	5.72	

Source: Fieldwork (2025)

As shown in Table 2, the experimental group, which received prior exposure to biology concepts, recorded a post-test mean score of 68.75 with a standard deviation of 6.05, yielding a mean difference of 14.45. In contrast, the control group, which was not exposed to prior concepts, recorded a lower post-test mean score of 54.30 with a standard deviation of 5.72. The results indicate that students in the experimental group performed better in biology compared to those in the control group. This suggests that prior exposure to biology concepts had a positive effect on students' academic performance in the subject.

Hypothesis 1

There is no significant effect of prior exposure to biology concepts on the science process skills of senior secondary school students in Sokoto State, Nigeria.

This hypothesis was tested using a t-test on the posttest scores between the experimental and control groups.

Table 3: Posttest Scores of Science Process Skills (SPS)

Group	N	Mean	SD	t-value	p-value	Decision
Experimental	60	68.42	6.15	20.54	0.000	Null H ₀ Rejected
Control	60	45.73	5.95			

Source: Fieldwork (2025)

Table 3 presents the results of the independent t-test conducted to examine the effect of prior exposure to biology concepts on students' science process skills. The results show a statistically significant difference between the experimental group (Mean = 68.42, SD = 6.15) and the control group (Mean = 45.73, SD = 5.95), with a t-value of 20.54 and a p-value of 0.000. Since the p-value is less than the 0.05 significance level, the null hypothesis is rejected. This confirms that prior exposure to biology concepts significantly enhances the science process skills of senior secondary school students in Sokoto State.

Hypothesis 1

There is no significant effect of prior exposure to biology concepts on the academic performance of senior secondary school students in Sokoto State, Nigeria.

This null hypothesis was tested using t-test on the posttest scores of academic performance between the experimental and control groups. The result is presented in Table 4.

Table 4: Independent t-Test on Posttest Scores of Biology Academic Performance

Group	N	Mean	SD	t-value	p-value	Decision
Experimental	60	68.75	6.05	12.01	0.000	Null H ₀ Rejected
Control	60	54.30	5.72			



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Source: Fieldwork (2025)

Table 4 shows a statistically significant difference in academic performance scores between the experimental and control groups. The experimental group, which received prior exposure to biology concepts, had a higher mean score ($M = 68.75$, $SD = 6.05$) than the control group ($M = 54.30$, $SD = 5.72$). The p-value of 0.000 is less than the 0.05 level of significance, indicating that the null hypothesis (H_0) is rejected. This implies that prior exposure to biology concepts had a significant positive effect on the academic performance of senior secondary school students in Sokoto State.

Discussion of Findings

The first finding from the study revealed that prior exposure to biology concepts significantly improved students' science process skills. This aligns with Ausubel's (1968) theory of meaningful learning, which emphasizes the importance of connecting new content with prior knowledge to enhance understanding. Students in the experimental group, who were given foundational exposure to biology concepts, demonstrated greater proficiency in skills such as observation, inferring, classifying, and data interpretation compared to the control group. This confirms the assertions of Liu and Hsieh (2019), who found that students with foundational knowledge are better equipped to engage in scientific inquiry and apply learned concepts effectively. The results also support Oludipe (2020), who posits that mastery of science process skills contributes significantly to academic competence by enabling students to make sense of biological phenomena through hands-on engagement. It also aligns with Azman et al. (2018), who reported that inquiry-based strategies that leverage students' existing knowledge substantially improve engagement and scientific reasoning abilities. In this context, the structured exposure to key biology concepts before formal instruction likely activated students' prior schemas and enhanced their ability to observe, hypothesize, and draw scientific inferences.

The second finding of the study found that prior exposure to biology concepts had a positive effect on students' academic performance. The experimental group showed greater improvement compared to the control group. This finding highlights the importance of prior knowledge in promoting academic performance, a notion supported by Gardner (2020), who emphasized that students with relevant prior knowledge are more confident, motivated, and capable of assimilating new information effectively. Fang and Chen (2021) similarly highlighted the role of background knowledge in promoting conceptual clarity and enhancing performance in subjects with cumulative content structures like biology. It also agrees with the findings of Mendez and Salazar (2020), who reported that students with prior exposure to content demonstrated improved familiarity, confidence, and overall performance. Moreover, it aligns with the work of Semilarski et al. (2019), which found that students who encountered core scientific ideas earlier exhibited greater motivation and capability in both academic and practical scientific tasks.

These results collectively demonstrate that providing students with prior exposure to biology concepts can enhance both their science process skills and academic performance. The outcomes highlight that targeted pre-instructional activities could be an effective strategy to bridge learning gaps, especially in under-resourced regions like Sokoto State, where limited early exposure and inadequate instructional methods contribute to persistent underachievement (Lawal, 2019; Ibrahim et al., 2022). Hence, the study reinforces the importance of designing contextually responsive biology curricula that incorporate structured opportunities for prior exposure to key concepts.

Conclusion

Based on the results and analyses conducted in this study, it is concluded that prior exposure to biology concepts significantly enhances senior secondary school students' science process skills and academic performance in Sokoto State. The findings clearly show that students who received



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foundational exposure to biology demonstrated substantial improvements in cognitive abilities such as observation, classification, inferring, and data interpretation, which are key components of science process skills. Furthermore, the intervention led to a remarkable increase in students' academic performance in biology, as reflected in higher post-test scores when compared to those taught through conventional methods. These results affirm the effectiveness of integrating prior knowledge as a pedagogical strategy. When compared to traditional teaching approaches, the prior exposure method proved to be more impactful in promoting students' academic success and scientific competence. Therefore, embedding foundational biology concepts early in the instructional sequence is crucial for improving learning outcomes in science education.

Recommendations

Based on the findings of the study, the researcher made the following recommendations:

1. Biology curriculum planners and education authorities should incorporate structured early exposure programs to core biology concepts at the junior secondary school level.
2. Biology teachers should adopt instructional strategies that explicitly activate and build upon students' prior knowledge.

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Assessment of Teachers' Awareness on Integration of Artificial Intelligence Technology for Instructional Delivery among Secondary Schools in Osun State, Nigeria

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Abstract

Secondary school teachers in Nigeria are yet to fully explore AI in their educational activities, which may be due to inadequate awareness, teachers' attitude, lack of self-efficacy, opposition to change, lack of adequate preparedness to utilize AI. Hence, this study seeks to assess Teachers' awareness on Integration of Artificial Intelligence Technology for instructional delivery among Secondary Schools in Osun State, Nigeria. The study adopted a descriptive survey of research design. A sample of 100 Secondary school teachers during the 2024/2025 academic session in Osun State were selected using Proportionate Stratified Randomly Sampling Technique. The study was guided by one research question and a corresponding research hypothesis. A researcher-designed structured questionnaire validated by four experts was used for data collection. The pilot questionnaire was tested, and the data obtained were subjected to statistical analysis using Cronbach Alpha Correlation Formula and a reliability coefficient of 0.80 was obtained. The study revealed teachers are aware on the use of AI, no significant difference in the mean response of male and female secondary school teachers' awareness on the use of Artificial Intelligence. It was recommended among others that conferences, seminars and workshops should be organized for teachers to enable them use AI in augmenting their educational activities; enabling environment with adequate facilities that will enable the teachers to acquire adequate knowledge and skills on the use of AI should be provided by education stakeholders.

Keywords: Artificial Intelligence, awareness, secondary school, Gender

INTRODUCTION

Generative artificial intelligence (AI) is increasingly recognized as a transformative invention in education (Mello et al., 2023), the use of artificial intelligence reshaping classroom practices while presenting both opportunities and challenges for educators. According to a recent survey in the



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United States, 51% of teachers reported using ChatGPT, with 40% integrating it into their instructional routines and 10% employing it daily (Government Technology, 2023). Besides ChatGPT, a growing number of generative AI tools such as Canva, Gamma, Gemini, Heygen, Padlet, Leonardo, and Ping are being adopted in classrooms for a range of educational purposes, including administrative support, content development, and personalized instruction (Kyrpa et al., 2024). These tools offer distinct advantages: some enhance creativity (e.g., Gamma, Canva), others foster student engagement (e.g., Padlet, Leonardo, Heygen, ChatGPT, Curipod), and several assist in streamlining classroom management tasks (e.g., MagicSchool, Eduaide). While generative AI has the potential to improve teaching methodologies and promote interactive learning environments (Limna et al., 2022), its use is not without drawbacks. Challenges such as the occasional generation of inaccurate content and limitations in free access remain notable concerns (Kyrpa et al., 2024). The successful integration of generative AI in education is closely tied to teachers' awareness and willingness to adopt these technologies. Despite the growing availability of such tools, not all educators incorporate generative AI into their teaching practices (Kyrpa et al., 2024), and in many schools globally, AI integration remains either minimal or entirely absent (Cukurova et al., 2023). This underscores the need to investigate the factors influencing teachers' acceptance and usage of generative AI. Although previous research has examined various dimensions of AI in education such as its applications (Zawacki-Richter et al., 2019; K. Zhang and Aslan, 2021) and the challenges of implementation (Ji et al., 2023)—there remains a substantial gap in understanding the specific drivers that shape teachers' perceptions and adoption of AI technologies within classroom settings. while a number of studies have focused on AI adoption in higher education (Chatterjee and Bhattacharjee, 2020), empirical investigations into AI integration in secondary school contexts are still limited.

The adoption of AI in education is not without its challenges. Teachers' awareness towards AI play a critical role in determining the success of its integration into the classroom. Factors such as perceived usefulness, ease of use, and trust in AI systems influence educators' willingness to incorporate these technologies into their teaching practices. While substantial research has examined various dimensions of AI in education—including its applications (Zawacki-Richter et al., 2019; K. Zhang and Aslan, 2021) and implementation challenges (Ji et al., 2023)—a notable gap remains in understanding the underlying drivers of teachers' perceptions and willingness to integrate AI technologies into classroom instruction. Although studies on AI adoption in higher education have emerged (Chatterjee and Bhattacharjee, 2020), empirical investigations within the secondary school teachers in Osun state remain limited. This gap calls for a comprehensive and targeted exploration of both internal and external factors that shape teacher engagement with AI tools in school environments. Internal factors, such as self-efficacy and intrinsic motivation, have long been recognized as influential predictors of behavior across various domains (Ajzen, 1991; Lee and Lee, 2014; Ryan and Deci, 2000). However, limited research has focused on how these factors specifically impact teachers' adoption of AI in educational contexts (Bai et al., 2021). Self efficacy may influence educators' confidence in using AI technologies effectively, while intrinsic motivation driven by personal interest or a commitment to improving student learning outcomes may enhance their willingness to explore and implement these tools. External influences are equally critical but often underrepresented in existing literature. Factors such as the availability and credibility of information sources, as well as institutional support, play a pivotal role in shaping teachers' perceptions of AI. Reliable and accessible information can improve educators' understanding of AI's pedagogical benefits (Al Darayseh, 2023), while institutional support—through structured professional



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development, administrative encouragement, and adequate resource allocation is essential for cultivating a school culture that supports the meaningful adoption of Generative AI technologies (Kemp et al., 2019; Sánchez-Prieto et al., 2019).

In summary, addressing both internal and external determinants is vital for developing a comprehensive understanding of the factors that facilitate or impede AI adoption among educators. A holistic approach that considers psychological, informational, and institutional elements will be key to enabling successful and sustainable integration of AI in school teaching practices. Thus, the purpose of this study is to investigate the secondary teacher awareness on adoption of Generative AI in educational settings. With the use of AI, teacher can write lesson plan, evaluate the lesson and analyse learners' needs in the class and recognize those who are slow learners in understanding the topics and provide timely remediation. AI technology of machine vision using face surveillance would capture the learner's face and showcase it to the teacher for appropriate action to be taken by the teacher to improve learning. In addition, games learning platforms powered by AI make lessons fun, motivate the learners and sustain the interest of the learners during instructional delivery. Create a link in all paragraphs. Teacher needs to be ready to utilize AI for education by being provided with skills on how to use computers and ICT effectively and creatively. Teachers' readiness refers to their willingness to incorporate new technologies in performing tasks (Lai and Ong, 2010). Similarly, Serdyukov (2017) added that teachers' preparation and readiness for life-long learning will ensure their constant updating and renewal of knowledge which is necessary for them to be abreast with the recent and innovative technology to enable them use the technology

Teachers' readiness can be determined from their willingness to adopt AI in education and willingness to acquire ICT skills and knowledge since Artificial Intelligence is a result of innovation and advancement in ICT. Eristi and Kurt (2012) noted that teacher need sufficient time for preparation for them to use technology for teaching purposes as they face problems in determining how technology can be used effectively in the classroom. A teacher is a person who teachers in primary or secondary school. In education, the role of a teacher is that of a guide, mentor, facilitator, academic supervisor, and instrument to ensure comprehensive learning. The investigation of the readiness of teacher to utilize AI technologies is paramount since they are the key players in the successful utilization of Artificial Intelligence for education. Hence, the need to assess teachers' awareness on Integration of Artificial Intelligence Technology for instructional delivery among Secondary Schools in Osun State, Nigeria

Statement of the Research Problem

In the contemporary digital era, Artificial Intelligence (AI) plays a pivotal role in enhancing the educational experiences of both teachers and learners by introducing innovative approaches to teaching, learning, assessment, skill acquisition, communication, content creation, sharing, grading, analysis, and interaction with instructional materials. When AI is effectively integrated and optimally utilized within the teaching and learning process, it significantly contributes to the development of digital literacy and the cultivation of informed citizenship in the 21st century.

The responsibilities of teachers, particularly within Nigerian educational settings, are increasingly demanding due to challenges such as inadequate technological infrastructure and large class sizes comprising students with diverse learning needs. In this context, AI tools comprising devices,



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applications, and software can serve as highly effective support systems for teachers (Pokrivcakova, 2019). Despite the numerous advantages that AI offers in the realm of education, university teachers in Nigeria have yet to fully embrace its use in their instructional practices. This limited adoption may stem from a lack of awareness regarding the educational potential of intelligent devices, applications, and software systems. Additional barriers include teachers' attitudes toward technology, low self-efficacy, insufficient technical expertise, resistance to change, and inadequate preparation for integrating AI into educational contexts. Given these challenges, it becomes essential to assess the readiness of teachers to incorporate Artificial Intelligence into education within Nigerian schools. While previous studies have explored teachers' and lecturers' preparedness to adopt various forms of educational technology including ICT tools (e-learning platforms, electronic resources, instructional media, virtual learning environments), machine learning, mobile learning, nanotechnology, and Internet-based services there is a noticeable absence of empirical research specifically focusing on secondary school teachers' awareness on integration of Artificial Intelligence for educational purposes. Accordingly, this study seeks to address this gap by assessing teachers' awareness on Integration of Artificial Intelligence Technology for instructional delivery among Secondary Schools in Osun State, Nigeria

Research Objectives

- 1 To determine teachers' awareness level on integration of Artificial intelligence for an instructional delivery in secondary school in Osun state
- 2 To test differences in teachers' awareness level on integration of Artificial intelligence for an instructional delivery in secondary school based on gender
- 3 Assess the influence of training and exposure, self-efficacy, infrastructure, and ethics concerns on awareness and integration.

Research Question

The following research question was answered in this study

To what extent are secondary school teachers aware on integration of Artificial Intelligence technology for instructional delivery among secondary schools in Osun State?

Research Hypotheses

H₀₁: There is no significant difference in the mean response of male and female secondary school teachers' awareness on integration of Artificial Intelligence technology for instructional delivery among secondary schools in Osun State

Research Methodology

The research design adopted for this study is descriptive survey research design. Random Sampling technique was used to select six Secondary School from Osun west senatorial district in Osun state. The population of this study comprised 100 teachers from selected Secondary school in Osun west senatorial district. A structured questionnaire developed by the researcher titled Teachers' Awareness of Artificial Intelligence for Education (TAAIE) consists of 15 items, structured on five points rating scale of SA (Strongly agree = 5), A (Agree = 4), UD (Undecided 3) D (Disagree = 2) and SD (Strongly disagree = 1) was used for data collection. To ascertain the appropriateness of the questionnaire, it was validated by four experts, two senior lecturers from the Department of Educational Technology University of Ilesa. All the corrections, suggestions and modifications made were effected. To determine the internal consistency of the questionnaire, a one-shot pilot test was conducted. The data were subjected to statistical analysis using Cronbach Alpha Correlation Formula, and a reliability coefficient of 0.87 was obtained. Cronbach alpha scores greater than 0.70



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are considered as indicative of acceptable reliability (Taber, 2016). Hence, the instrument was considered reliable to collect the needed data.

Presentation of Results

Research Question 1:

To what extent are secondary school teachers aware on Integration of Artificial Intelligence Technology for instructional delivery among Secondary Schools in Osun State, Nigeria

Table 1: mean scores and standard deviations for each item measuring AI awareness and readiness

S/N	ITEMS	N	MEAN	STANDARD DEVIATION	DECISION
1	Awareness of AI concept	100	4.64	0.75	high
2	Heard of AI in education	100	4.50	0.73	high
3	Understanding of AI in T&	100	4.12	0.97	high
4	Familiarity with AI tools	100	4.18	0.98	high
5	Received AI training	100	3.67	1.21	low
6	Identifies AI-based apps	100	3.85	1.05	low
7	Used AI in lesson planning	100	3.70	1.15	low
8	Knows AI for grading	100	3.42	1.19	low
9	Attended AI seminars	100	3.60	1.35	low
10	Experimented with AI apps	100	3.87	1.08	low
11	Comfortable exploring AI	100	3.86	1.06	low
12	School encourages AI use	100	3.99	0.92	high
13	Believes AI personalizes learning	100	4.30	0.85	high
14	Knows AI for inclusive education	100	3.56	1.13	low
15	Familiar with AI ethics	100	3.71	0.99	low
16	Distinguishes AI from digital tools	100	3.61	1.05	low
17	Knows how to access free AI tools	100	3.58	1.09	low
18	Seeks emerging AI info	100	3.81	1.01	low
19	Feels aware for modern delivery	100	3.70	1.09	low

Gand Mean: 73.36

Interpretation of Descriptive Statistics

The analysis involved 100 secondary school teachers and aimed to assess their readiness to use AI in instructional delivery, based on their self-reported awareness and experiences.

Table 1 presents the mean scores and standard deviations for each item measuring AI awareness and readiness. The responses were rated on a 5-point Likert scale, SA (Strongly agree = 5), A(Agree = 4), UD(Undecided 3) D (Disagree = 2) and SD (Strongly disagree = 1)

Key Findings:

- The highest mean score was recorded for the item "I am aware of the concept of Artificial Intelligence (AI)" (M = 4.64, SD = 0.75), indicating that a majority of the respondents have a strong general awareness of AI.
- Similarly, high mean values were recorded for "I have heard about the use of AI in the education sector" (M = 4.50, SD = 0.73) and "I believe AI tools can be used to personalize learning for students" (M = 4.30, SD = 0.85), suggesting positive perceptions of AI's potential benefits.
- Items related to basic familiarity such as "I understand how AI functions in teaching and learning" (M = 4.12, SD = 0.97) and "I am familiar with AI-powered educational tools like ChatGPT, Google Assistant, or Quillionz" (M = 4.18, SD = 0.98) also show generally high awareness levels.



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(d) However, practical use and training aspects scored relatively lower. For instance: "I have received formal or informal training on how to use AI tools for instruction" (M = 3.67, SD = 1.21)

"I have used AI tools to support my lesson planning or delivery" (M = 3.70, SD = 1.15) "I know how AI can assist in grading and evaluating student performance" (M = 3.42, SD = 1.19)

(e) Ethical and accessibility awareness items like "I am familiar with the ethical considerations of using AI in education" (M = 3.71, SD = 0.99) and "I am aware of AI applications that support inclusive education" (M = 3.56, SD = 1.13) show moderate awareness.

(f) Encouragingly, the item "I am interested in attending training or workshops to improve my knowledge of AI in education" had a high mean (M = 4.30, SD = 0.94), reflecting a strong desire among teachers to learn more.

Hypothesis one

There is no significant difference in the mean response of male and female Secondary school teachers' awareness on Integration of Artificial Intelligence Technology for instructional delivery among Secondary Schools in Osun State, Nigeria

In testing hypothesis one, the mean response of male and female secondary school teachers awareness on the use of artificial intelligence for an instructional deliver was analysed using independent samples t-test as presented in Table 2.

Table 2: Independent samples t-test of male and female secondary school teacher awareness on the use of Artificial Intelligence for and instructional delivery

S/N	GENDER	N	Df	Mean	Std. Deviation	T-Value	Sig
1	Male	51	98	3.9333	.71859	0.547	0.41
2	Female	49		3.8622	.56913		

NS: Not Significant at 0.05 (p>0.05)

Table 2 shows the independent samples t-test results of male and female secondary school teachers awareness on the use of Artificial Intelligence for an instructional delivery. From the table, t = 0.547 and sig level is= 0.41 hence hypothesis two was not rejected. This shows that there is no significant difference in the mean response of male and female lecturers' awareness on the use of Artificial Intelligence for instructional delivery

Discussion of Findings

The findings of this study revealed that teachers were aware of AI for education in a Nigeria secondary school. This agrees with the findings of Kwafo [2019], who reported that students and faculty members are aware of AI in Finland. It also agrees with the Bindu [2017] study, which revealed that teachers' level of ICT awareness in classrooms was at an average level. Similarly, Basiru and Okwilagwe (2018) revealed that lecturers' awareness level of electronic databases was at an average level. In addition, the findings of Abba and Adamu (2017) revealed that the level of university lecturers' awareness of Internet Resource Service for academic activities was moderate. Also, Chigbu et al. (2020) revealed that teachers were moderately aware of the use of technology in the teaching and learning of the English language. The finding disagrees with that of Garba (2018), which reported a low level of awareness of the existence of turn-it-in software in detecting plagiarism. Similarly, a study by Ipsos MORI (2017) revealed that the public awareness of ML was low. Also, Adamu (2019) study found out that lecturers' level of awareness of edutainment was low. In addition, a study by



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Rathi (2018) discovered that the awareness level of students on AI and its related fields was low. Likewise, Guanah (2021) reported that the awareness level of the respondents about AI was low. However, the findings contradict those of Yusuf et al. (2018), who revealed that lecturers' awareness of the use of podcasts for teaching is high. Similarly, the findings emanating from this study also revealed that male and female teachers are aware of artificial intelligence for instructional delivery in Secondary School. This finding agrees with the finding of Farhan (2016), who reported no significant difference in the awareness of male and female teachers on mobile learning in Saudi Arabia. Also, Upadhyay (2022) study revealed no significant difference in the awareness of male and female primary school teachers towards Educational Technology in India. However, the finding contradicts the report of Khan (2016), whose result revealed that female teachers were more aware of the uses of ICT in their daily teaching and learning process than their male counterparts. Similarly, Khurshid and Zahur (2015) study revealed that male teachers' awareness of innovative teaching strategies is higher than that of their female counterparts. Ipsos MORI (2017) study revealed that male was more aware of Machine Learning than their female counterpart. A study by Bindu (2017) showed that male teachers were more aware of ICT in classrooms than their female counterparts. Similarly, a study by Falode et al. (2018) revealed that the level of awareness of male lecturers was higher than that of the female lecturers on the use of OER.

Conclusion

Artificial intelligence, one of the major technologies in the fourth educational revolution, has been integrated into education. The study concluded that most Secondary School teachers in Nigeria are aware of artificial intelligence for education. Gender equality is a factor to be considered in every aspect of human endeavor. It is clear from the study that male and female Secondary school teachers were aware of artificial intelligence for education.

Recommendations

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

1. Teachers are aware of AI; therefore, conferences, seminars and workshops should be organised for them to increase their level of awareness of the numerous opportunities that AI can provide in augmenting their educational activities.
2. Teachers should be encouraged to use AI to ease their demanding work and tasks; therefore, an enabling environment with adequate facilities that will enable them to acquire adequate knowledge on the use of AI should be provided by education stakeholders.

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Effects of Spider Concept Mapping Strategy on ... Hussaini, K., Et. al (2025)

Effects of Spider Concept Mapping Strategy on Performance and Attitude in Ecology Concept among secondary school students in Katsina State, Nigeria

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Abstract

Effective teaching strategies, such as concept mapping, play a crucial role in boosting academic performance and students' attitudes in biology. While concept mapping is known to aid understanding of complex topics such as ecology, little research has examined the specific impact of the spider concept mapping strategy in Nigerian secondary schools, particularly in Katsina State. This study examined the effect of the Spider Concept Mapping Strategy on students' performance and attitude toward ecology concepts among secondary school students in Katsina State, Nigeria. Four null hypotheses were formulated and tested at the 0.05 level of significance. The research adopted a pretest, posttest, quasi-experimental design with a control group. A total of 135 Senior Secondary School II (SSS II) biology students, randomly selected from two schools within the Katsina Zonal Education Quality Assurance, participated in the study. Data were collected using the Ecology Performance Test (reliability coefficient = 0.84) and the Ecology Attitude Scale (reliability coefficient = 0.82). The data were analyzed using Analysis of Covariance (ANCOVA). Findings revealed a significant main effect of treatment on students' performance in biology [$F(1,129) = 4.300; p < 0.05$], indicating that the spider concept mapping strategy effectively enhanced students' achievement. However, no significant main effect of treatment was found on students' attitude toward ecology [$F(1,129) = 1.918; p > 0.05$]. Similarly, gender had no significant main effect on students' performance in ecology [$F(1,129) = 0.945; p > 0.05$], suggesting that male and female students performed comparably.

Keywords: Spider Concept mapping; Performance; Attitude; Gender

Introduction

The persistent decline in students' performance in science subjects has become a major educational concern, demanding urgent intervention. In light of this, science educators need to seek suitable ways of tackling the current mass failure if they are to halt the drift of students to arts and social science subjects (Shaibu, 2020). This is particularly critical for biology, whose relevance among science subjects and its vital role in economic development, from healthcare to agriculture and environmental sustainability, cannot be overemphasized. Given the critical role of biology in academic and professional success, effective teaching of the subject in secondary schools is essential. Improved instructional methods can enhance students' performance in both internal and external examinations, thereby increasing their chances of securing admission into higher institutions. However, traditional teaching approaches, such as lectures, laboratory sessions, and recitations, are increasingly being recognized as insufficient (Skipper & Mintzes, 2023). These methods often prioritize passive learning over active engagement, limiting students' ability to master and retain key



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concepts. Moreover, they rarely cultivate critical thinking, creativity, or the ability to make meaningful connections (Salomi, Alexander, & Louis, 2021). The growing recognition of conventional teaching methods' limitations has prompted biology educators to adopt more effective, student-centered approaches. This pedagogical shift is especially important for teaching challenging topics like ecology, which is a core component of the biology curriculum. Ecology, derived from the Greek words "oikos" (house) and "logos" (study), represents a fundamental topic in biology that examines organisms in their environments (Odaibo, 2022). As Ajaja (2021) explains, this area of biological study focuses on both the structure of nature and the relationships between organisms and their surroundings. Many students struggle with ecological concepts due to their abstract and systems-oriented nature.

The spider concept mapping strategy offers particular benefits for teaching ecological concepts in biology. With its distinctive web-like structure, this visual tool places a central ecological concept at the core, surrounded by related biological principles (Martins et al., 2021). This format helps students organize complex ecological information while maintaining clear connections to broader biological knowledge. Multiple studies (e.g., Novak & Cañas, 2008; Nesbit & Adesope, 2013) have demonstrated that concept mapping strategies significantly enhance student performance in ecological topics within biology. Academic performance, operationally defined as students' ability to both recall key ecological concepts and apply them to biological problems (Shabani, 2020), shows measurable improvement when these visual tools are implemented, particularly for complex systems thinking required in ecology (Wu et al., 2021). Specifically, spider concept maps help students: (1) systematically organize trophic relationships and energy flow patterns, (2) visualize connections between abiotic factors and species distribution, and (3) transfer these ecological principles to broader biological contexts like evolution and adaptation (Yeh et al., 2020). However, as shown in recent meta-analyses (Schroeder et al., 2018), while cognitive gains are significant, affective factors including students' interest in ecological applications and self-efficacy in solving ecological problems remain crucial mediators of long-term knowledge retention. Attitude, described by Adesoji (2021) as a stable pattern of beliefs, emotions, and behaviors, plays a crucial role in learning ecological concepts. Its three components, affective (feelings about ecology), behavioral (application of ecological knowledge), and cognitive (understanding of ecological principles), collectively influence how students engage with this biological topic. When supported by visual strategies like concept mapping, positive attitudes can enhance ecological learning within the biology curriculum.

Statement of the Problem

Ecology is an essential component of the secondary school biology curriculum, helping students understand interactions between organisms and their environment. However, students frequently display poor academic performance and negative attitudes toward ecology concepts, which has been linked to traditional teacher-centered methods that emphasize rote memorization over active engagement (Novak & Cañas, 2008; Okeke, 2016). In Nigeria, especially in northern states like Katsina, studies have shown that many students struggle to retain ecological knowledge and often perceive the subject as abstract and difficult (Adebisi & Yusuf, 2019; Garba, 2020). Research indicates that learning strategies that promote active participation and meaningful organization of information can improve students' understanding and attitudes toward science subjects. One such strategy is the Spider Concept Mapping Strategy (SCMS), which involves creating a central concept connected to sub-concepts through branches, allowing students to visualize relationships and organize knowledge hierarchically (Novak, 2010; Agbaje & Afolabi, 2018). While studies in other Nigerian states suggest that concept mapping improves students' performance and retention in biology (Owolabi & Akinola, 2017), there is limited empirical evidence on the effectiveness of SCMS



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on students' performance and attitudes in ecology, specifically in Katsina State. The lack of research in this context means that secondary school teachers often continue using conventional methods that may not engage students effectively or foster positive attitudes toward ecology. Consequently, students' underperformance and negative attitudes persist, affecting not only academic achievement but also the development of environmentally responsible citizens (UNESCO, 2019). Therefore, this study seeks to investigate the effects of the Spider Concept Mapping Strategy on performance and attitude in ecology among secondary school students in Katsina State, Nigeria, providing evidence for innovative teaching practices that enhance learning outcomes.

Objectives of the study

The main objective of this study is to determine the effect of the spider concept mapping strategy on the performance and attitude of students toward ecology concepts among secondary school students in Katsina State. Specifically, the study aimed to:

1. Determine the main effect of treatment on secondary school students' performance in ecology
2. Find out the main effect of treatment on secondary school students' attitudes toward ecology
3. Investigate the main effect of gender on secondary school students' performance in ecology
4. Access the interaction effect of treatment and gender on secondary school students' performance in ecology

Hypotheses

The following null hypotheses were generated for the study:

- H₀₁: There is no significant main effect of treatment on secondary school students' performance in ecology
- H₀₂: There is no significant main effect of treatment on secondary school students' attitudes toward ecology
- H₀₃: There is no significant main effect of gender on secondary school students' performance in ecology
- H₀₄: There is no significant interaction effect of treatment and gender on secondary school students' performance in ecology

Methodology

The study employed a quasi-experimental pretest-posttest design with non-randomized, nonequivalent control groups to examine the effects of the spider concept mapping strategy on students' academic performance and attitudes in ecology. Participants were divided into two groups: an experimental group taught using the spider concept mapping approach and a control group instructed through conventional methods. Both groups underwent a pretest to assess their baseline knowledge and attitudes before the intervention. Following the treatment period, a post-test was administered to evaluate the impact of the instructional strategies. The target population consisted of all Senior Secondary School Two (SS II) students under the Katsina Zonal Education Quality Assurance in Katsina State. From this population, a sample of 135 students was drawn from selected coeducational schools, with four single-gender schools excluded to maintain consistency. The participating schools were chosen randomly from a list of 22 institutions, while intact classes within these schools were purposively selected to ensure uniformity in student groupings. Data collection relied on two primary instruments: the Ecology Performance Test (EPT) and the Ecology Attitude Scale (EAS). The EPT, adapted from past WAEC and NECO examination questions (2015–2020), comprised 30 multiple-choice items with one correct answer and three distractors per question. The EAS, designed to measure students' attitudes toward ecology, featured a four-point Likert scale (Strongly Agree to Strongly Disagree) with predominantly closed-ended items.



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To ensure the instruments' reliability, a pilot test was conducted in a coeducational school not included in the main study. The EPT's reliability was assessed using the Pearson Product-Moment Correlation Coefficient (PPMC), yielding a value of 0.84, indicating strong consistency. For the EAS, Cronbach's Alpha was employed due to its suitability for Likert-scale instruments, resulting in a reliability coefficient of 0.82, confirming internal consistency. Data collection began with the administration of pretests in the first week to establish students' initial understanding of ecological concepts. The intervention phase spanned four weeks (weeks 2–5), during which the experimental group received instruction via spider concept mapping, while the control group followed conventional teaching methods. The researcher conducted all sessions to maintain consistency in delivery. Post-tests were then administered to both groups to measure changes in performance and attitudes, providing quantitative data for analysis. This structured approach ensured methodological rigor while allowing for a clear comparison between the two instructional strategies.

Presentation of Results

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

Hypothesis One

There is no significant main effect of treatment on secondary school students' performance in ecology.

Hypothesis Two

There is no significant main effect of treatment on secondary school students' attitudes toward ecology.

Hypothesis Three

There is no significant main effect of gender on secondary school students' performance in ecology.

Hypothesis Four

There is no significant interaction effect of treatment and gender on secondary school students' performance in ecology.

Table 1:

ANCOVA of the Effect of Treatment and Moderating Variables on Students' Performance and Attitude in Ecology

Source	Type III Squares	Df	Mean Square	F	Sig.
Corrected Model	743.171 ^a	5	148.634	14.479	.000
Intercept	1118.332	1	1118.332	108.939	.000
Pretest	7.550	1	7.550	.735	.393
Treatment	44.144	1	44.144	4.300	.040
Attitude	19.693	1	19.693	1.918	.168
Gender	9.698	1	9.698	.945	.333
Treatment * Gender	9.398	1	9.398	.915	.340
Error	1324.266	129	10.266		
Total	58535.000	135			
Corrected Total	2067.437	134			

***Significant (p < 0.05)**

Hypothesis One: Table 1 indicates that treatment had a significant main effect on students' performance in ecology, $F(1,129) = 4.300, p < 0.05$. The null hypothesis is therefore rejected, implying that the Spider Concept Mapping Strategy significantly improved students' performance in ecology.

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Hypothesis Two: The result shows that treatment did not have a significant main effect on students’ attitude toward ecology, $F(1,129) = 1.918, p > 0.05$. The null hypothesis is thus retained, suggesting that the Spider Concept Mapping Strategy did not bring about a significant change in students’ attitudes.

Hypothesis Three: As shown in Table 1, gender had no significant main effect on students’ performance in ecology, $F(1,129) = 0.945, p > 0.05$. The null hypothesis is therefore retained, indicating that both male and female students performed comparably in ecology.

Hypothesis Four: The result further reveals that the interaction between treatment and gender was not significant, $F(1,129) = 0.915, p > 0.05$. The null hypothesis is therefore retained, implying that the effect of the Spider Concept Mapping Strategy on performance was similar for both male and female students.

Table 2

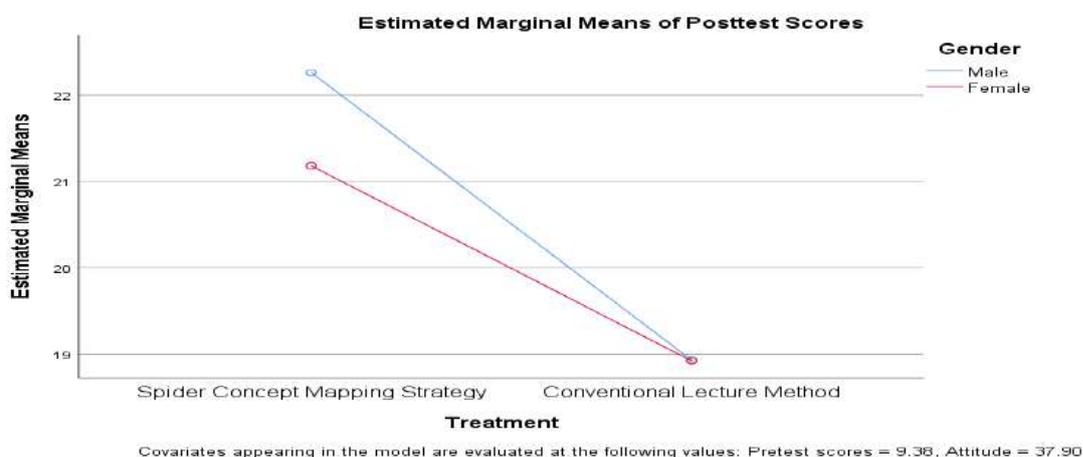
Univariate Tests of the Mean Scores of the Two Groups

	Sum of Squares	Df	Mean Square	F	Sig.
Contrast	44.144	1	44.144	4.300	.040
Error	1324.266	129	10.266		

***Significant ($p < 0.05$)**

The two-way interaction effect of treatment and gender does not affect students’ performance in ecology [$F_1, 129 = .915; p > 0.05$]. Since the main effect of treatment is significant but the interaction effect with gender is not significant, it means that the treatment does not depend on gender to be effective. In other words, the treatment is not gender sensitive and will be effective irrespective of students’ gender. In summary, all the null hypotheses are being retained except hypothesis one, which states: there is no significant main effect of treatment on students’ performance in ecology. In Table 2, there is a significant difference in the students’ mean scores between the two groups: the spider concept mapping strategy and the conventional lecture group [$F_1, 129 = .040; p < 0.05$]. Thus, students performed significantly at different levels in the two groups. This indicated that the students taught using the spider concept mapping strategy performed better than those exposed to the conventional lecture method.

The findings in Tables 1 and 2 above are graphically presented in Figure 1 as follows: In Figure 1 below, the spider concept mapping strategy is the best strategy for teaching ecology. Besides the lecture method, male students performed better than female students. However, the difference in male and female students’ performance is not significant according to the presentation in Table 1, which indicates that gender alone has no significant effect on students’ performance.





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F 1: Mean Plot of the Interaction Effect of Treatment and Gender.

Discussion of Findings

The analysis and results of this study showed that the spider concept mapping strategy brought about the most significant change in the performance of students. This might be due to the visual diagrammatic presentation and friendliness that the strategy provided for the students. Students in the spider group were better motivated to learn. Furthermore, the spider concept mapping strategy yielded a significant difference when compared with the conventional teaching method. The lecture method is the most widely used form of presentation and may be combined with other teaching strategies to give added meaning and direction. The students in this study are conversant with concept mapping as their teachers often used it because of their adaptability to many different settings. Wiseman (2020) gave an illustration of the selection of appropriate teaching methods for a science lesson. Teaching methods should be compared to a maintenance technician's toolbox. The instructor's tools are the teaching methods. Just as the technician uses some tools more than others, there will be times when a less-used tool will be the exact instrument needed for a particular situation. The instructor's success is determined to a large extent by the ability to organize materials and to select and utilize teaching methods most appropriate to a particular lesson. In selecting teaching methods and strategies for a science class, Ajaja (2021), the teacher/instructor considers the following factors: enjoined

- i. The learners' age, their previous knowledge on the topic, and their ability.
- ii. The method should be suitable for the topic being taught.
- iii. The science teacher should select the method he/she can effectively handle.
- iv. The time the lesson will take place.
- v. The size of the class where the lesson is being taught.
- vi. The resources that are at the disposal of the teacher.

Thus, the fact that a method is suitable for the teaching of ecology does not mean it will be a suitable topic for teaching another topic, even in the same subject. There are times a biology teacher may need to combine different methods to teach a particular topic. Omoniyi (2021) identified methods that can be used to teach science effectively. These methods include concept mapping, peer-tutoring, individualized, field-trip method, and computer-based instruction.

Conclusion

Spider concept mapping strategy has been found challenging, but can be evaluated as a rewarding exercise and an overall success as a result of its capability to help the students learn to develop the ability to think critically and analytically. The spider teaching strategy in this paper produces significantly better performance in ecology than the conventional teaching method. Thus, it is an effective mode of instruction for students in secondary schools. However, the findings of this study have revealed that this strategy is the most effective because it allows the students to study on their own. Thus, while making attempts to improve the utilization of the regular school hours of the students, the provision of learning by "doing" could be adequately employed in our classrooms. This paper concludes that the use of the spider concept mapping strategy should be embraced by all senior secondary school science teachers.

Recommendations

Given the results of these findings and the conclusions reached in this paper, the following recommendations are hereby offered:

1. Teachers occasionally should give students topics to relate the concepts, so that after the teacher teaches a new concept, students can link what they learn about the new concept.



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2. Teachers should be encouraged to go for regular workshops and seminars where they can be enlightened on the use of appropriate teaching strategies for different aspects of their subjects.
3. Activity-based learning should be included in the curriculum, thereby engaging and linking all related ideas; this will allow students to relate classroom concepts to real-life situations.

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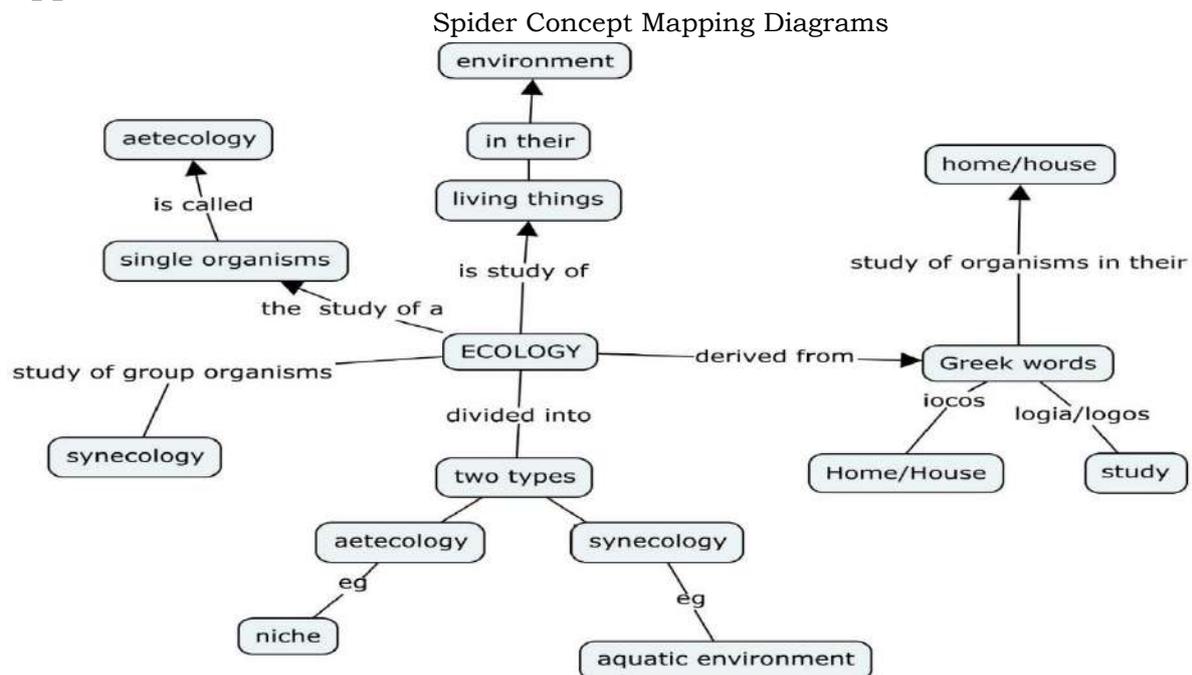
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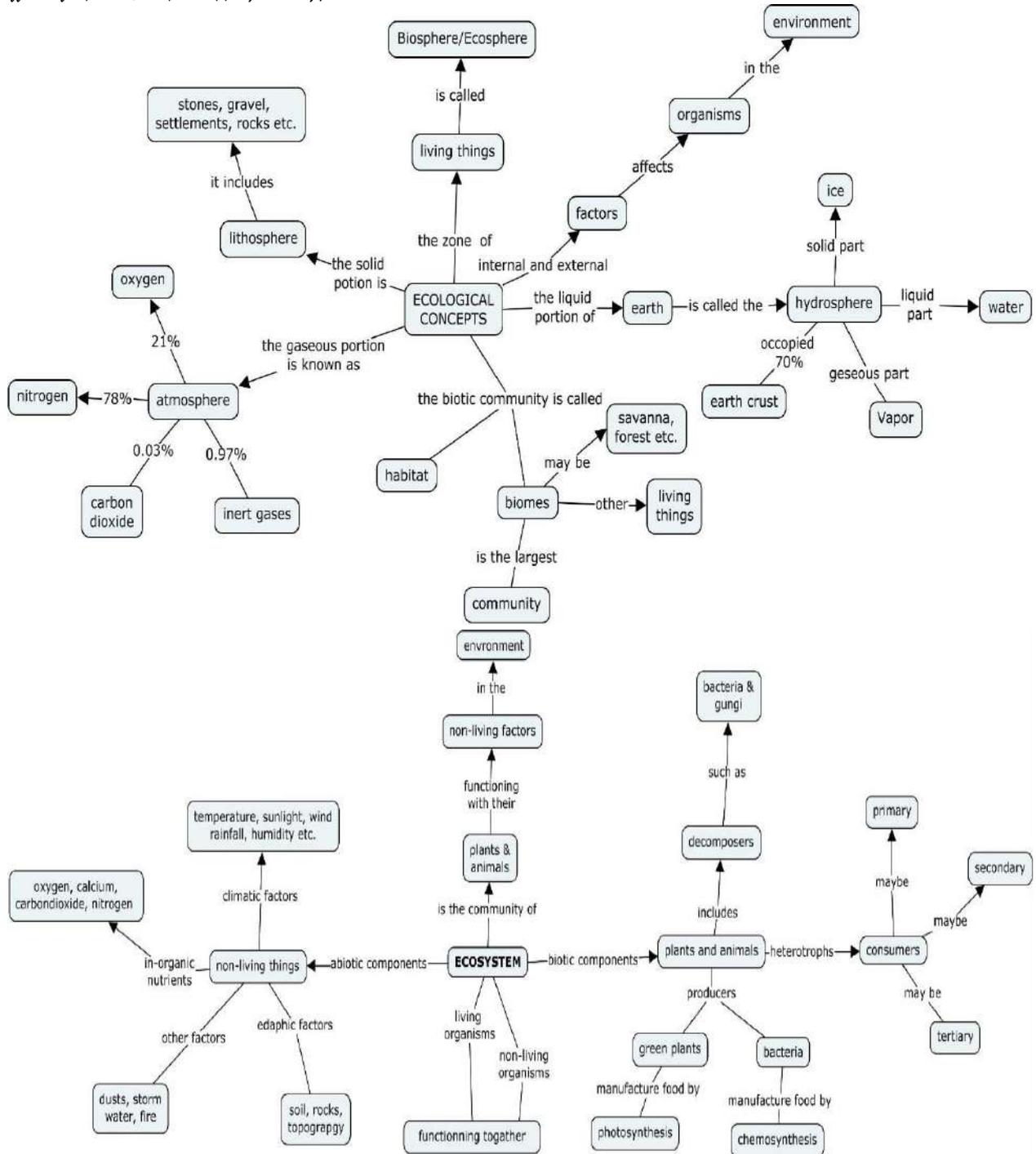
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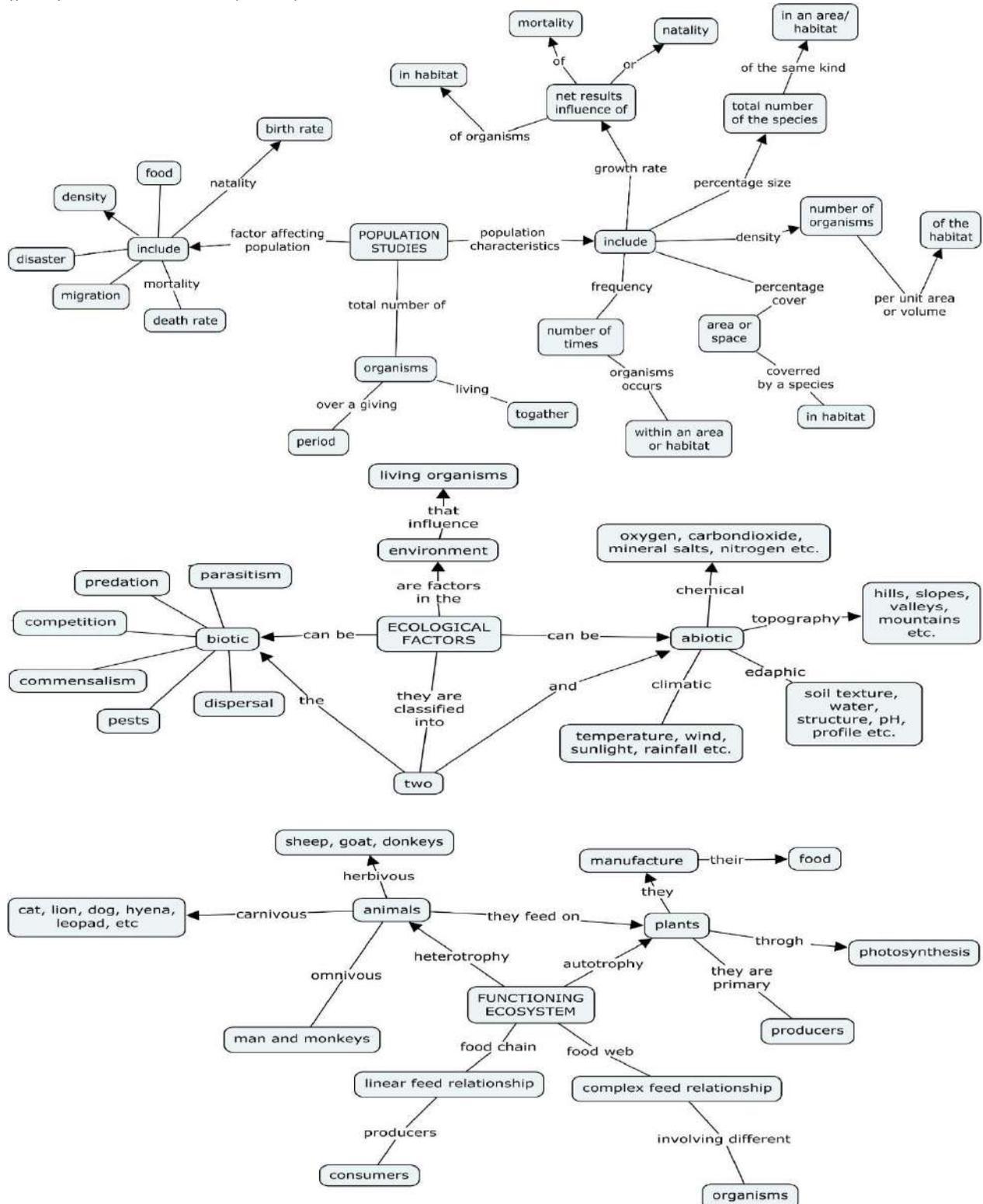
Appendices



Effects of Spider Concept Mapping Strategy on ... Hussaini, K., Et. al (2025)



Effects of Spider Concept Mapping Strategy on ... Hussaini, K., Et. al (2025)





Effect of Multimedia-Based Instructional Strategy on ... Musa, F., Et. al. (2025)

Effect of Multimedia-Based Instructional Strategy on Achievement in Genetics Concepts among Secondary School Biology Students in Niger State, Nigeria

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Abstract

The study examined the Effect of Multimedia-Based Instructional Strategy on Achievement in Genetics Concepts among Secondary School Biology Students in Niger State, Nigeria. A quasi-experimental design, specifically a pretest-posttest, non-equivalent control group design, was used for the research. The population of the study consist of all Senior Secondary School class two (SSII) Biology students during the 2024/2025 academic session in Niger state. A sample size of 519 students was selected from the target population using a multi-stage sampling technique for the study. Two research questions were posed, and two corresponding null hypotheses were formulated and tested at a 0.05 significance level. Two experts validated the research instrument. The test-retest method was used to determine the reliability coefficient of the Biology Achievement Test (BAT). The scores were analysed using the Pearson Product-Moment Correlation Coefficient, which yielded a reliability index of 0.78. Data were analysed using mean, standard deviation, with the Statistical Package for Social Sciences (SPSS) version 23.00. The findings indicated that secondary school biology students exposed to multimedia-based instructional strategies performed significantly better than those taught genetics only, as shown by the mean scores. The results further revealed that the experimental group performed better than the control group in the study, demonstrating the effectiveness of the multimedia approach. Based on the findings of the study, this recommendation is proposed: educational policymakers and school administrators should encourage the integration of multimedia-based instructional strategies into the biology curriculum to enhance teaching and learning outcomes.

Keywords: Achievement, Multimedia-Based Instructional Strategies and Biology.

Introduction

In contemporary Nigeria, greater emphasis is placed on science and technological development, which results in students being required to take science subjects in their senior secondary school classes. Based on this, science focuses on collecting data for the designated order that exists in natural phenomena and happenings around us (Sani, 2015). The core fundamental science subjects are typically offered and need to be introduced to prepare students for future scientific exploration and endeavours (Etobro and Fabinu, 2017). Biology is a prerequisite science subject for many fields of learning, significantly contributing to the nation's technological growth (Ahmed, 2021). These include medicine and surgery, veterinary science, Biotechnology, Agriculture, Pharmacy, and



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Microbiology, to mention a few. Biology encourages intellectual curiosity, increases awareness of fragile ecosystems, and equips students with the necessary skills for problem-solving, critical thinking, communication, and objective reasoning —21st-century skills that will make them applicable in future workplaces (Yilshik, 2020). The teaching and learning of biology at the secondary school level is aimed at increasing students' understanding of living systems, including human beings and other organisms in the natural environment. However, student achievement at this level is unsatisfactory (Salisu, 2018). Several factors identified by researchers contribute to this unsatisfactory achievement, including inappropriate instructional strategies, inadequate laboratory facilities, poorly trained or unqualified biology teachers, insufficient instructional materials, and low student motivation. The abstract nature of biological concepts, such as ecology, plant systems, energy transformation in nature, and genetics, also plays a role (Martens, 2018; Umar et al., 2020).

Many students exhibit high levels of apathy toward learning genetics because they perceive it as difficult and uninteresting (Jeremiah and Joy, 2019). They believe this perception stems from the invisible processes of cell division, such as mitosis and meiosis, which contribute to their lack of understanding and misconceptions about the concept. For instance, Visscher (2012) revealed that "a single gene controls a single trait." This is often oversimplified and misleading because: Polygenic Traits: Most traits (e.g., height, skin colour, intelligence) are influenced by multiple genes working together (polygenic inheritance). Pleiotropy: A single gene can affect multiple, seemingly unrelated traits (e.g., mutations in the CFTR gene cause cystic fibrosis, impacting the lungs, pancreas, and other organs). Environmental Influence: Traits often result from gene-environment interactions (e.g., diet affecting height, sun exposure altering skin pigmentation). Epigenetics: Gene expression can be modified by external factors (like stress or nutrition) without changing the DNA sequence. This misconception stems from early Mendelian genetics (e.g., pea plant traits like flower colour), which simplified genetic concepts for basic understanding. However, most real-world traits are far more complex.

Multimedia learning is the use of different types of media, such as text, images, audio, video, and animation, to enhance learning outcomes and engagement (Akinoso, 2018). Multimedia aids the instructor in delivering effective and diverse training, catering to various learning styles and preferences. Guan et al. (2018) multimedia is a combination of more than one media type, such as text (Alphabetic or numeric), symbols, pictures, audio, and animation, usually with the aid of technology to enhance understanding or memorisation. It supports verbal instruction with the use of static and dynamic images, utilising visualisation technology for enhanced expression and comprehension. Kapi et al. (2017); Alemdag and Cagiltay (2018) reported that multimedia technology is identified with some qualities such as integration, diversity and interaction that enable people to communicate information or ideas effectively with digital and print elements, which are referred to as multimedia-based applications or tools purposely used for delivering information to people for better understanding of the concept. Umar et al. (2020) opined that multimedia is a combination of instructional approaches that encourage learners to participate in learning through the mental representation of materials in words and pictures, making connections between pictorial and verbal presentations. Furthermore, multimedia can also be referred to as a combination of data carriers, such as video, CD-ROM, Floppy Disk, Flash Drive, the internet, and software, through which an interactive approach can be offered.



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Statement of the Research Problem

One of the greatest challenges facing secondary schools in Nigerian society over the years has been the relative decline in the academic achievement of students, particularly in the Sciences. Niger State Secondary Schools are not exempt. The academic achievement of students in science subjects, especially in Biology, has been inconsistent. Evidence from the previous biology examination results of NECO and WEAC, 2020, 2021, 2022, and 2023, respectively. Most research findings revealed that poor achievement in biology could be attributed to several factors, such as poor or inappropriate instructional strategy, inadequate or a lack of laboratory facilities, poorly trained or unqualified biology teachers, insufficient instructional materials, and lack of motivation in students (Martens, 2018 and Umar et al., 2020). This led to a shift to a constructivist instructional strategy that emphasises an active role for students, enabling them to create their understanding through interaction with their learning environment. It appears that there is a need to address the issue of instructional innovation. Hence, the researcher was compelled to extend her search to consider the use of multimedia-based instructional strategies to determine whether they can enhance the achievement of secondary school biology students in Niger State.

Objectives of the study

1. Find out the effect of multimedia-based instructional strategy on Secondary School Students’ academic achievement in biology.
2. Find out the effect of multimedia-based instructional strategy on Secondary School Students’ academic achievement in biology based on Gender.

Research Questions

1. What is the difference in mean achievement scores of secondary school students taught Biology using a multimedia-based instructional strategy and those trained with the Conventional Instructional Strategy?
2. What is the effect of multimedia-based instructional strategy on Secondary School Students’ academic achievement in biology based on Gender?

Methodology

The study also employed a quasi-experimental design (pre-test post-test non-equivalent, non-randomised, control group). The reason for choosing a quasi-experimental design is that the researcher used intact classes to avoid disrupting the school timetable at each of the sampled schools, and the rules and regulations governing secondary school affairs also helped eliminate the threat of biased selection.

Table 1 Schematic Diagram of Research Design

Group	Pretest	Treatment	Posttest
Experimental I	O ₁	X ₁	O ₂
Control	O ₁	-	O ₂

Where:

- O₁, O₁ - Pretest Scores of experimental and control groups.
- O₂, O₂ - Posttest Scores of experimental and control groups.
- X₁ – Treatment for the experimental group only.
- No Treatment for the Control group.

The population for this study comprises all the Senior Secondary School Biology Students in Niger State. There are three hundred and twenty (320) Senior Secondary Schools in the three (3) zones of Niger State. There are ten thousand three hundred and sixty-four (10,364) students who registered for Biology in the 2023/2024 academic session (Niger State Ministry of Education, 2023) with a Male



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and Female ratio of 6640:4300. The targeted population of the study were made up of the entire Senior Secondary School II (SS2) Biology students in Niger State with a total number of eight hundred and thirty-three (833) students which consisted Male 499 and Female 334. A multistage sampling technique was employed to select six (6) schools from the state to be used for the study. The first stage involves purposive sampling of two (2) schools from each of the senatorial zones of the state. The schools were purposively selected because the state government owns them, funds and supplies science equipment to these schools, controls teacher and student admission into these schools, and is all under the control of the same state government. Co-educational schools were used to include both male and female students in the sample, allowing for the determination of gender differences in student achievement of the concept of genetics in biology. The second stage involved the random assignment of one school from each zone to the experimental group, another to the control group, and the last school to the control group. The third stage involved random selection of one intact class for each of the nine selected schools. This instrument, also known as the Biology Achievement Test (BAT), was developed to measure students' achievement after treatment. The content of the test was based on the topics to be taught during the study for 3 Weeks. The test instruments were (50) multiple-choice question tests. Some of the questions were adapted from past WAEC and NECO examination questions, while the remaining questions were developed by the researcher from biology textbooks based on the SS11 syllabus. Each Biology Achievement Test (BAT) have options A to E as possible answers to the questions. This implies that there is one correct option and four distractors to measure the participants' knowledge of Biology in line with Bloom's cognitive taxonomy. The instrument (BAT) was used for pretest and posttest.

To ensure the validity of the research instruments for the set of students in the study, the face and content validity of the instrument were assessed. Two senior lecturers from the School of Science and Technology Education at the Federal University of Technology, Minna, a computer specialist or analyst, an English Language specialist, and two secondary school biology Teachers validated the instruments. They were requested to check the BAT items against the topic and content of the lesson plan. After which, the instruments were examined and certified by various experts to be used in the study. Their observations, corrections, and suggestions were then used to produce the final copy of the instruments used in the study. To ascertain the reliability and internal consistency index of the test instrument, a pilot test was conducted at the Government Secondary School in Lapai Local. The school is part of the study population, but it was not sampled for the main study. A total of forty (40) students (20 girls and 20 boys) were used. The test-retest approach was adopted at an interval of two weeks to enable the researcher to obtain two sets of scores for calculating the reliability coefficient of the test items using the Pearson Product-Moment Coefficient (r). A reliability Coefficient of 0.78 was obtained. The data was analysed using Mean and Standard Deviation to answer the research questions.

Presentation of Results

Research Question 1

What is the difference in mean achievement scores of secondary school students taught Biology using a multimedia-based instructional strategy and those trained with the Conventional Instructional Strategy? The descriptive statistics of mean and standard deviation were used to answer this research question, and a summary of the results is presented in Table 2 below:

Table 2: Summary of descriptive statistics of the mean and standard deviation of students' scores in the experimental and control groups at the pre-test and post-test

Groups	N	Pre-test	Post-test	Mean Difference
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		\bar{x}	SD	\bar{x}	SD	
Experimental	223	20.46	8.51	26.59	8.38	6.13
Control	296	20.63	8.58	21.76	7.99	1.13

Field Work, 2024

The data presented in Table 2 show that the experimental group (Multimedia-Based instructional strategy) had a mean score of 20.46 and a standard deviation of 8.51 in the Pre-test and a mean score of 26.59 and a standard deviation of 8.38 in the post-test, resulting in a pre-test to post-test difference in the experimental group taught with the Multimedia-Based instructional strategy to be 6.13. The control group had a mean score of 20.63 and a standard deviation of 8.58 in the pre-test, and a post-test mean of 21.76 with a standard deviation of 7.99, resulting in a pre-test to post-test difference of 1.13. With this result, the students in the experimental group (Multimedia-Based instructional strategy) performed better on the achievement test than the students in the control group, as indicated by the Mean Difference.

Research Question 2

What is the effect of multimedia-based instructional strategy on Secondary School Students' academic achievement in biology based on Gender? The descriptive statistics of mean and standard deviation were used to answer this research question, and a summary of the results is presented in Table 3 below:

Table 3: Mean and Standard Deviation of achievement scores of male and female biology students taught with Multimedia-Based

Group (Gender)	N	Pretest		Posttest		Mean Difference
		\bar{x}	SD	\bar{x}	SD	
Male	136	22.99	7.15	27.54	7.71	4.55
Female	87	16.51	8.99	25.11	10.37	8.60

Field Work, 2024

The data presented in Table 3 show that the Male students in experimental group (Multimedia Based) had a mean score of 22.99 and a standard deviation of 7.15 in the Pre-test and a mean score of 27.54 and a standard deviation of 7.71 in the post-test, resulting in a pre-test to post-test difference for the Male students in the experimental group taught with Multimedia learning instructional strategy to be 4.55. The Female students in the experimental group (Multimedia Based) had a mean score of 16.51 and a standard deviation of 8.99 in the Pre-test and a mean score of 25.11 and a standard deviation of 10.37 in the post-test, resulting in a pre-test to post-test difference for the Female students in the experimental group taught with the Multimedia learning instructional strategy to be 8.60. With this result, the Female students in the experimental group (Multimedia Based) performed better in the achievement test than the other gender, as indicated by the Mean Difference.

Conclusion

The study demonstrated that multimedia-based instructional strategies significantly enhanced the academic achievement of secondary school biology students in Niger State, particularly in the topic of genetics. The experimental group, which utilised multimedia tools, showed a marked improvement in post-test scores compared to the control group taught with conventional methods. Additionally, the findings revealed that female students benefited more from the multimedia approach, as evidenced by their higher mean difference scores. These results underscore the effectiveness of multimedia-based instruction in addressing the abstract nature of biology concepts and improving student engagement and understanding. The success of this instructional strategy underscores its



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potential to address challenges such as inadequate laboratory facilities, poorly trained teachers, and low student motivation, which have historically contributed to subpar academic performance in biology. By integrating multimedia tools into the curriculum, educators can create a more interactive and dynamic learning environment that caters to diverse learning styles and promotes a deeper understanding of complex biological concepts.

Recommendations

Based on the findings of the study, the following recommendations are proposed:

1. Educational policymakers and school administrators should encourage the integration of multimedia-based instructional strategies into the biology curriculum to enhance teaching and learning outcomes.
2. Gender-Inclusive Strategies: Educators should leverage the positive impact of multimedia instruction on female students by designing gender-inclusive learning materials that further bridge achievement gaps.

By implementing these recommendations, stakeholders in the education sector can foster a more engaging and effective learning environment, ultimately improving student achievement in biology and other science subjects.

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Impact of Financial Reporting on Accountability in Public Tertiary Institutions in Benue State Nigeria

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Abstract

This study investigates the impact of financial reporting practices on accountability within public tertiary institutions in Benue State. The study aims to examine the impact of financial reporting practices on accountability, explore the relationship between transparency in financial disclosures and stakeholder trust, and identify the challenges faced in implementing standard financial reporting. Using a survey method, data was collected randomly from 259 academic and non-academic staff of Public Tertiary Institutions in Benue State and analyzed using descriptive and inferential statistics. Findings reveal a significant positive impact of financial reporting on accountability, with transparency in disclosures strongly influencing stakeholder trust. Challenges, including insufficient technology, bureaucratic processes, limited resources, and inadequate training, were identified as barriers to implementing effective financial reporting. The study concludes that robust financial reporting practices are essential for enhancing accountability in Public tertiary institutions in Benue State and recommends improved investment in digital reporting tools, staff training, and resource allocation to strengthen financial transparency and accountability. Suggestions for further research include exploring the role of digital reporting tools in enhancing accountability and a comparative study across multiple institutions to examine variations in financial reporting impacts.

Keyword: Accountability, Reporting, Public Institutions, Transparency

Introduction

Financial reporting is a critical component in the management of tertiary institutions, especially in public sectors, where it serves as a tool for accountability and transparency. The effective application of financial reporting principles in Public tertiary institutions in Benue State has the potential to improve the stewardship of resources and instill trust among stakeholders (Bizavings., 2016). In these institutions, financial reporting refers to the systematic collection, analysis, and presentation of financial data, which enables stakeholders, including government agencies, donors, and the general public, to assess the performance and financial health of the institution. However, the effectiveness of financial reporting in promoting accountability within Public tertiary institutions in Benue State has been questioned due to instances of mismanagement, fraud, and lack of transparency. These issues, if unaddressed, threaten the institutions' sustainability and undermine public trust (Bizavings et al., 2016). With many stakeholders now demanding higher levels of accountability, understanding how financial reporting influences institutional integrity and accountability is essential for both policymakers and institutional managers. This study, therefore, seeks to explore the impact of financial reporting practices on accountability in Public tertiary institutions in Benue State, aiming to highlight the benefits and challenges associated with current practices. The concept of financial reporting as a tool for accountability has become increasingly relevant in Nigeria's tertiary education sector. Financial reporting provides essential information on



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income, expenditure, and resource allocation, which assists stakeholders in making informed decisions (Olayemi, 2022). According to recent studies, effective financial reporting practices not only help in evaluating the institution's financial performance but also contribute to preventing financial misconduct (Nwafor & Onah, 2021). In particular, Public tertiary institutions in Benue State, funded primarily through public resources, must exhibit a high level of accountability, given the limited resources allocated to the education sector. Previous research highlights that inadequate financial reporting practices in tertiary institutions often lead to poor accountability and financial irregularities (Ogunleye et al., 2020). The Nigerian government has initiated various reforms to strengthen financial reporting frameworks and encourage transparency in educational institutions (Ogundipe & Olufemi, 2021). Despite these efforts, the implementation of standard financial reporting practices remains inconsistent across public tertiary institutions in Benue State, indicating the need for further investigation into the underlying causes and effects. By examining the link between financial reporting and accountability, this study may contribute to understanding the extent to which these practices influence financial reporting and accountability within the Public Tertiary Institutions in Benue State.

Statement of the Research Problem

Despite the critical role of financial reporting in enhancing accountability within Public tertiary institutions in Benue State, Benue State University, for instance, face persistent challenges related to financial mismanagement, lack of transparency, and inadequate reporting practices. Financial irregularities in this sector have been widely reported, raising questions about the effectiveness of current financial reporting standards in promoting accountability (Mohammadi et al., 2014). The issues stem from inconsistencies in financial disclosures, poor internal controls, and limited adherence to regulatory requirements, which have collectively contributed to a decline in stakeholder trust. One major concern is the recurring misappropriation of funds, which hampers the institutions' ability to meet operational needs, affects the quality of education provided, and undermines the confidence of funding bodies and the general public (Edeh et al., 2023). According to Mohammadi (2014), the lack of reliable financial reporting mechanisms has allowed financial malpractices to persist, limiting the extent to which stakeholders can hold administrators accountable. This deficiency is especially problematic in a sector where public resources are predominantly used, requiring higher accountability standards to ensure proper use and management of funds.

Moreover, while the Nigerian government has introduced various reforms to address these issues, there is limited evidence of effective implementation in public tertiary institutions in Benue State, with many administrators and financial officers still circumventing established reporting procedures (Ogundipe & Olufemi, 2021). This gap between policy and practice exacerbates accountability issues and highlights the need for a more robust financial reporting framework to enforce transparency and accountability consistently. Thus, the problem this study seeks to address is the inadequacy of current financial reporting practices in promoting accountability within Public tertiary institutions in Benue State, which continues to impair the institutions' operational effectiveness and public trust.

Objectives of the study

The main objectives of the study was to examine the impact of financial reporting on accountability in Public Tertiary Institution in Benue State Nigeria; the study aims;

1. To examine the effect of financial reporting practices on accountability levels within Public tertiary institutions in Benue State Nigeria.
2. To assess the relationship between transparency in financial disclosures and stakeholder trust in Public tertiary institutions in Benue State Nigeria.



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3. To investigate the challenges faced by Public tertiary institutions in Benue State and implementing standard of financial reporting practices.

Research Questions

The study aims to provide answers to the following research questions;

1. How does financial reporting practices affect accountability within Public tertiary institutions in Benue State?
2. What is the relationship between transparency in financial disclosures and stakeholder trust in Public tertiary institutions in Benue State?
3. What challenges does Public tertiary institutions in Benue State face in implementing standard financial reporting practices?

Hypotheses

H₀₁: There is no significant impact of financial reporting practices on accountability within Public tertiary institutions in Benue State.

H₀₂: There is no significant relationship between transparency in financial disclosures and stakeholder trust in Public tertiary institutions in Benue State.

H₀₃: There is no significant challenges face by Public tertiary institutions in Benue State in implementing standard financial reporting practices?

Methodology

A research methodology is a research process adopted or employed to systematically and scientifically present the results of a study to the research audience viz. a vis, the study beneficiaries.

Research Design

Research designs are perceived to be an overall strategy adopted by the researcher whereby different components of the study are integrated in a logical manner to effectively address a research problem. In this study, the researcher employed the survey research design. This is due to the nature of the study whereby the opinion and views of people are sampled. According to Singleton & Straits, (2009), Survey research can use quantitative research strategies (e.g., using questionnaires with numerically rated items), qualitative research strategies (e.g., using open-ended questions), or both strategies (i.e., mixed methods). As it is often used to describe and explore human behaviour, surveys are therefore frequently used in social and psychological research.

Population of The Study

According to Udoyen (2019), a study population is a group of elements or individuals as the case may be, who share similar characteristics. These similar features can include location, gender, age, sex or specific interest. The emphasis on study population is that it constitutes of individuals or elements that are homogeneous in description. This study was carried out to examine the impact of financial reporting on accountability in Public Tertiary Institution within Benue State Nigeria, a case study of Benue State University, Makurdi.

Sample Size Determination

A study sample is simply a systematic selected part of a population that infers its result on the population. In essence, it is that part of a whole that represents its members and share characteristics in like similitude (Udoyen, 2019). In this study, the researcher adopted the convenient sampling method to determine the sample size.



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Sample Size Selection Technique and Procedure

According to Nwana (2005), sampling techniques are procedures adopted to systematically select the chosen sample in a specified away under controls. This research work adopted the convenience sampling technique in selecting the respondents from the total population. In this study, the researcher adopted the convenient sampling method to determine the sample size. Out of all the entire population of staff members of public tertiary institutions in Benue State (both academic and non-academic staff), the researcher conveniently selected 266 randomly out of the overall population as the sample size for this study. According to Torty (2021), a sample of convenience is the terminology used to describe a sample in which elements have been selected from the target population on the basis of their accessibility or convenience to the researcher.

Research Instrument and Administration

The research instrument used in this study is the questionnaire. A survey containing series of questions were administered to the enrolled participants. The questionnaire was divided into two sections, the first section enquired about the responses demographic or personal data while the second sections were in line with the study objectives, aimed at providing answers to the research questions. Participants were required to respond by placing a tick at the appropriate column. The questionnaire was personally administered by the researcher.

Method of Data Collection

Two methods of data collection which are primary source and secondary source were used to collect data. The primary source was the use of questionnaires, while the secondary sources include textbooks, internet, journals, published and unpublished articles and government publications.

Method of Data Analysis

The responses were analysed using the mean and standard deviation, which provided answers to the research questions. In analyzing data collected, mean score was used to achieve this. The four points rating scale will be given values as follows: SA = Strongly Agree (4), A = Agree (3), D = Disagree (2) & SD = Strongly Disagree (1)

Presentation of Results

The analysis and interpretation were derived from the findings of the study. The data analysis depicts the simple frequency and percentage of the respondents as well as interpretation of the information gathered. A total of two hundred and sixty-six (266) questionnaires were administered to respondents of which only two hundred and fifty-nine (259) were returned and validated. This was due to irregular, incomplete and inappropriate responses to some questionnaire. For this study a total of 259 was validated for the analysis.

Table 1: Demographic profile of the respondents

Demographic information	Frequency	Percent
Gender		
Male	72	27.8%
Female	187	72.2%
Age		
20-25	33	12.7%
25-30	56	21.6%
31-35	87	33.6%
36+	83	32.0%
Marital Status		



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Single	71	27.4%
Married	102	39.4%
Separated	67	25.9%
Widowed	19	7.3%
Education Level		
WAEC	56	21.6%
BS.c	62	23.9%
MS.c	67	25.9%
MBA	74	28.6%
Staff job description		
Academic staff	72	27.8%
Non-academic staff	187	72.2%

Source: Field Survey, 2024

The table presents the demographic profile of the respondents. Among the participants, 27.8% are male and 72.2% are female. Regarding age, 12.7% are between 20-25 years old, 21.6% are between 25-30 years old, 33.6% are between 31-35 years old, and 32.0% are 36 years and older. In terms of marital status, 27.4% are single, 39.4% are married, 25.9% are separated, and 7.3% are widowed. Concerning education level, 21.6% have WAEC qualifications, 23.9% have a BSc, 25.9% have an MSc, and 28.6% have an MBA. Finally, Among the participants, 27.8% are academic staff and 72.2% were non-academic staff members.

Research Question 1

How does financial reporting practices affect accountability within Public tertiary institutions in Benue State?

Table 2: Mean Responses on how financial reporting practices affect accountability within Public tertiary institutions in Benue State.

S/N	Variable Name	Mean	Std. Deviation	Decision
1	Financial reporting practices in this institution improve overall accountability.	4	2.75	Accepted
2	Regular and accurate financial reports increase accountability among staff in this institution.	3.4	2.55	Accepted
3.	The financial reporting system here enables effective monitoring of resource usage.	3.9	2.74	Accepted
4	There is a clear link between financial reporting practices and accountability in our institution.	3.4	2.56	Accepted
5	Financial reports in this institution hold management accountable for their decisions.	3.2	2.47	Accepted



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Source: Field Survey, 2024

The analysis of Table 2 shows that respondents generally agree that financial reporting practices positively impact accountability within Public tertiary institutions in Benue State. Each item statement received a mean score above the midpoint threshold of 2.5, indicating agreement with the statements and thus acceptance of each item. The first item, "Financial reporting practices in this institution improve overall accountability," received a mean score of 2.57, suggesting that respondents agree that these practices enhance accountability. Similarly, the second item, which focused on regular and accurate financial reports increasing accountability among staff, scored 2.55, reinforcing the perception that consistent reporting contributes to accountability. The third item, "The financial reporting system here enables effective monitoring of resource usage," received the highest mean score of 2.74, indicating strong agreement that financial reporting facilitates resource monitoring, a key component of accountability. The fourth item, addressing the clear link between financial reporting and accountability, had a mean score of 2.56, reflecting agreement among respondents about the importance of reporting practices. Finally, the fifth item, which examined whether financial reports hold management accountable for their decisions, received a mean score of 2.47, close to the threshold, suggesting that while there is agreement, it is slightly weaker than for other items. Overall, the results demonstrate that financial reporting practices are perceived to have a positive effect on accountability within Public tertiary institutions in Benue State, as reflected in the accepted mean scores across all items.

Research Question 2: What challenges does Public tertiary institutions in Benue State face in implementing standard financial reporting practices?

Table 3: Mean Responses on challenges Public tertiary institutions in Benue State face in implementing standard financial reporting practices

S/N	Variable Name	Mean	Std. Deviation	Decision
1	Financial reporting in this institution is hindered by a lack of adequate technology and tools	3.4	2.59	Accepted
2	Staff in this institution face difficulties understanding and adhering to standard reporting practices.	3.1	2.42	Accepted
3	The institution's management encounters challenges in maintaining transparency due to bureaucratic processes.	3.8	2.62	Accepted
4	Training and development on financial reporting standards are insufficient in this institution.	3.3	2.49	Accepted
5	Lack of resources is a major barrier to implementing	3.9	2.66	Accepted



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effective financial reporting
practices here.

Source: Field Survey, 2024

The analysis of Table 3 shows that respondents identify significant challenges faced by Public tertiary institutions in Benue State in implementing standard financial reporting practices. All items received mean scores above the midpoint of 2.5, indicating agreement with each statement, and thus each item was accepted. The first item, "Financial reporting in this institution is hindered by a lack of adequate technology and tools," received a mean score of 2.59. This suggests respondents agree that insufficient technology and tools pose a challenge to effective financial reporting. The second item, which states that "Staff in this institution face difficulties understanding and adhering to standard reporting practices," scored 2.42, reflecting moderate agreement but indicating a recognized challenge in knowledge and compliance with standards. The third item, "The institution's management encounters challenges in maintaining transparency due to bureaucratic processes," had a mean score of 2.62, suggesting strong agreement that bureaucracy complicates transparency efforts. The fourth item, which mentions insufficient training and development on financial reporting standards, scored 2.49. Although slightly lower, it still indicates that respondents view inadequate training as an obstacle to proper reporting. The fifth item, "Lack of resources is a major barrier to implementing effective financial reporting practices here," received the highest mean score of 2.66, showing strong agreement that resource constraints are a significant barrier. In summary, the responses highlight that lack of technology, difficulties in staff adherence, bureaucratic barriers, insufficient training, and limited resources are perceived as key challenges that impede the effective implementation of standard financial reporting practices in Public tertiary institutions in Benue State.

Discussion of Findings

The findings from this study reveal notable insight into the role of financial reporting practices, transparency in financial disclosures, and the challenges faced in implementing standard financial reporting practices within Public tertiary institutions in Benue State. For Research Question 1, respondents overwhelmingly agree that financial reporting practices positively affect accountability in these institutions, as evidenced by the mean scores on statements indicating the value of financial reporting in promoting accountability, enhancing staff responsibility, and enabling effective monitoring of resource usage. This consensus underscores the importance of financial reporting as a vital tool for fostering accountability among both management and staff in Public tertiary institutions in Benue State. In addressing Research Question 2, findings show a strong relationship between transparency in financial disclosures and stakeholder trust. Respondents generally perceive that transparent disclosures strengthen trust in institutional management and reduce suspicions of financial mismanagement. With items reflecting high agreement, it is evident that open financial reporting significantly contributes to stakeholder confidence, illustrating that greater transparency in financial dealings may enhance credibility and trust in the institution's administration. Research Question 3 identifies the primary challenges in implementing standard financial reporting practices, such as inadequate technology, limited understanding of reporting standards, bureaucratic processes, lack of training, and resource constraints. These obstacles, supported by high mean scores on each item, indicate considerable barriers that can undermine effective financial reporting and accountability. Addressing these challenges is crucial for improving the quality of financial reporting practices and meeting institutional accountability standards.



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The hypothesis tests further validate these findings. The test of Hypothesis 1 shows a significant effect of financial reporting practices on accountability, with a substantial 94% effect size and a P-value well below the significance level of 0.05. This suggests that robust financial reporting practices are crucial for enhancing accountability in Public tertiary institutions in Benue State. Similarly, Hypothesis 2 reveals a significant relationship between transparency in financial disclosures and stakeholder trust, with an effect size of 95% and a similarly significant P-value, confirming that transparent disclosures are essential for building trust among stakeholders. In summary, these findings emphasize the critical role of financial reporting and transparency in promoting accountability and trust in Public tertiary institutions in Benue State. Addressing the challenges identified may further improve financial integrity and strengthen stakeholder relationships in these institutions.

Conclusion

In conclusion, this study has highlighted the critical role of financial reporting in promoting accountability within Public tertiary institutions in Benue State. The findings indicate that financial reporting practices positively impact accountability by facilitating resource monitoring and fostering transparency. This transparency in financial disclosures directly correlates with increased stakeholder trust, as stakeholders are more likely to have confidence in an institution's management when financial practices are openly disclosed and adhere to standard reporting practices. However, the study also underscores several challenges that impede the implementation of effective financial reporting practices in Public tertiary institutions in Benue State. These challenges include inadequate technology, limited training on reporting standards, bureaucratic barriers, and resource constraints, which collectively hinder efforts to maintain high standards of financial reporting and accountability. To enhance accountability and stakeholder trust, it is essential that Public tertiary institutions in Benue State address these challenges by investing in adequate technological infrastructure, providing ongoing training for staff, reducing bureaucratic processes, and ensuring sufficient resources for implementing standard financial reporting practices. By addressing these areas, institutions can strengthen their accountability frameworks, ultimately leading to a more transparent, trustworthy, and effective management system that meets the needs and expectations of stakeholders.

Recommendations

Based on the findings of this study, the following recommendations are made to enhance financial reporting practices and accountability within Public tertiary institutions in Benue State:

1. Public tertiary institutions in Benue State should invest in modern financial reporting software and tools to improve the accuracy, efficiency, and transparency of their financial records. This would facilitate real-time reporting, better resource monitoring, and timely disclosures, which are critical for accountability.
2. Institutions should prioritize regular training programs to equip both academic and non-academic staff with the knowledge and skills necessary for understanding and adhering to standard financial reporting practices. Continuous professional development will ensure that staff remain updated on best practices.
3. To address the challenges posed by limited resources, Public tertiary institutions in Benue State should ensure that financial reporting departments are adequately funded. By allocating sufficient resources for tools, training, and personnel, institutions can strengthen their accountability mechanisms, enhance stakeholder trust, and improve overall institutional transparency.



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Digital Literacy in English Education: Developing Students' Skills for the 21st Century

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Abstract

This position paper explores the integration of digital literacy into English language education, with a focus on developing students' skills for the 21st century. The objectives of this study are to examine the importance of digital literacy in English education, investigate the impact of digital education tools on student engagement and learning outcomes, and provide recommendations for effective integration of digital literacy into English language instruction. The paper argues that incorporating digital education tools into English language instruction is essential for developing students' skills in critical thinking, creativity, and communication. Based on the findings, this paper recommends that English educators prioritize digital literacy in their teaching practices, incorporate multimedia resources into their instruction, and provide opportunities for students to develop their digital composition skills. By integrating digital literacy into English education, educators can better prepare students for success in an increasingly digital world.

Keywords: *Digital literacy, English education, 21st-century skills, student engagement, critical thinking, creativity, communication.*

Introduction

The rapid evolution of technology has transformed the way we communicate, collaborate, and access information, rendering traditional notions of literacy obsolete (Kress, 2010; Leu et al., 2017). As we navigate the complexities of the digital age, it has become increasingly evident that English education must adapt to equip students with the skills necessary to thrive in this new landscape (National Council of Teachers of English, 2013). The integration of digital literacy into English education is no longer a luxury, but a necessity, as it plays a critical role in developing students' literacy skills, creativity, and critical thinking abilities (Hicks & Turner, 2013). Moreover, digital literacy has been recognized as essential for full participation in civic, economic, and social life (Pew Research Center, 2019). This essay argues that incorporating digital literacy into English education is crucial for developing students' skills for the 21st century, and examines the ways in which digital literacy can enhance student engagement, develop 21st-century skills, and provide students with opportunities to engage in critical thinking, creativity, and communication.

Statement of The Problem

The integration of digital literacy into English education poses significant challenges. One major obstacle is the lack of teacher training and support. As a report by the National Education Association (NEA) highlights, many teachers feel unprepared to effectively integrate technology into their teaching practices (NEA, 2020). This lack of preparation can lead to a range of issues, including inadequate instructional design, insufficient technical support, and limited access to digital resources. Furthermore, the rapid evolution of digital technologies can make it difficult for educators to keep pace. As Kist (2010) notes, the speed and complexity of technological change can be overwhelming, making it challenging for teachers to develop the necessary expertise. This can result in a digital literacy gap between teachers and students, with students often possessing more advanced digital skills than their instructors.



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The consequences of neglecting digital literacy in English education are far-reaching. Students who lack digital literacy skills may struggle to effectively communicate, collaborate, and critically evaluate information in the digital age. As the Pew Research Center (2019) reports, digital literacy is essential for full participation in civic, economic, and social life. Without these skills, students may be at a disadvantage in their future academic, professional, and personal pursuits. Moreover, neglecting digital literacy can exacerbate existing educational inequalities. As Warschauer and Matuchniak (2010) argue that the digital divide is not just about access to technology, but also about the skills and knowledge needed to effectively use that technology. By failing to address digital literacy, educators may inadvertently perpetuate existing disparities in educational outcomes.

Understanding Digital Literacy

Digital literacy goes far beyond the basic operation of digital devices. The European Commission (2020) defines it as the ability to use information and communication technologies confidently, critically, and responsibly in various aspects of life, including work, learning, and leisure. Ng W. (2015) elaborates on this by categorizing digital literacy into three key dimensions: technical, cognitive, and socio-emotional. The technical component involves operational skills; the cognitive dimension refers to the capacity to evaluate and process digital information; and the socio-emotional aspect includes responsible and ethical behavior in online environments. This multidimensional understanding of digital literacy positions students not only as users of technology but also as informed and conscientious participants in digital culture.

Key Components of Digital Literacy

Technical Proficiency: Basic operational skills, such as typing, using productivity tools (e.g., word processors, spreadsheets), navigating operating systems, and managing digital files are foundational.

Information and Media Literacy: This refers to the ability to critically search for, assess, and verify digital information to avoid misinformation. It also includes understanding how media influences opinions through targeted content and algorithms (McDougall et al., 2018).

Communication and Collaboration: Effective digital communication, including writing emails, participating in video calls, and using collaborative tools like Google Docs - is a core component. It also involves understanding digital etiquette, tone, and audience awareness (OECD, 2021).

Digital Safety and Citizenship: As more activities shift online, understanding privacy, security (e.g., password management, phishing detection), copyright laws, and ethical behavior online becomes critical (Ribble, 2017).

Creativity and Problem-Solving: Digital literacy also involves the innovative use of digital tools to solve problems or create new products, such as digital storytelling, coding, or multimedia presentations.

Empirical Studies on the Significance of Digital Literacy in Education

Digital literacy has become a fundamental element of modern education. Numerous empirical studies have confirmed that it enhances not only academic performance but also inclusivity, critical thinking, and adaptability - qualities crucial for lifelong learning and participation in an increasingly digital society. Falloon (2020) conducted a study in New Zealand that explored the relationship between teachers' digital competence and their classroom practices. The findings revealed that educators with stronger digital skills were better equipped to integrate digital tools into their instruction, leading to increased student collaboration and engagement. This underscores the importance of including digital literacy training in teacher development programs. Ng. W. (2015) also explored the impact of digital literacy on teaching efficacy through a mixed-methods approach involving secondary school teachers. Her research demonstrated that teachers who possessed digital literacy skills were more



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confident in their teaching and could more easily adapt learning to suit diverse student needs. This points to the broader pedagogical value of digital literacy beyond mere technical proficiency. Further evidence is provided by Tondeur et al. (2020), who surveyed preservice teachers across Belgium and the Netherlands. They found a strong positive relationship between digital competence and effective use of ICT for lesson planning and classroom management. Their findings suggest that early integration of digital training into teacher education programs can improve future teaching outcomes. From the student perspective, research by Hatlevik and Christophersen (2019) in Norwegian secondary schools revealed that digital skills correlated strongly with better academic outcomes in subjects requiring comprehension and analysis. Their work suggests that digital literacy supports cognitive development, especially in content-rich areas like science and reading.

Digital literacy also plays a critical role in promoting responsible behavior online. McDougall et al. (2018), in their cross-European study, found that students who received structured digital literacy education displayed stronger critical thinking, especially regarding media messages. They were also more cautious in navigating online interactions, demonstrating increased resilience to misinformation and cyberbullying. A meta-analysis by Siddiq and Scherer (2019) that synthesized results from over 40 studies on ICT literacy found consistent links between digital skills and academic achievement. However, it also revealed gender disparities, with boys often expressing higher confidence in using digital tools, despite not always outperforming girls. The researchers recommend targeted strategies to reduce such confidence gaps and promote equal learning opportunities. On a broader international scale, UNESCO (2021) compiled findings from multiple countries and confirmed that digital literacy programs helped improve student confidence and educational continuity, particularly during the COVID-19 pandemic. The report emphasized that access to digital skills is increasingly seen as a right, essential for academic resilience and equitable learning opportunities. While the evidence confirms the value of digital literacy, challenges such as unequal access, insufficient training and infrastructure gaps continue to limit its full potential. Addressing these systemic barriers is vital for realizing the educational benefits of digital literacy worldwide.

Empirical Studies on the Challenges of Digital Literacy in Developing Countries

Despite growing recognition of digital literacy as a key component of modern education, its implementation in developing countries faces significant obstacles. Empirical research across various regions (Africa, Asia, and Latin America) highlights challenges including poor infrastructure, limited teacher training, socio-economic inequality and policy gaps. Understanding these challenges is crucial for designing targeted interventions that bridge the digital divide and promote equitable access to digital knowledge. One of the most persistent barriers is insufficient technological infrastructure. The International Telecommunication Union (ITU, 2021) reported that nearly half of the population in low-income nations lacks consistent internet access or access to digital devices. This digital exclusion is particularly pronounced in rural areas, where schools often operate without reliable electricity or network coverage. A study by Aduwa-Ogiegbaen and Iyamu (2020) found that many Nigerian secondary schools lacked basic ICT infrastructure, making the integration of digital skills into the curriculum a major challenge. Educator preparedness is another significant issue. UNESCO (2021) found that in many sub-Saharan African countries, teachers lacked both the training and confidence to effectively use digital tools in their classrooms. In Ghana, Amankwah et al. (2020) discovered that less than a quarter of surveyed teachers had received formal ICT training. As a result, many were hesitant or unable to incorporate technology into their teaching, impeding the transfer of digital skills to students.



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Financial limitations further exacerbate the issue. In a Tanzanian study, Mtebe and Raisamo (2016) observed that even when ICT facilities were present in schools, many students could not afford to continue practicing at home. This economic constraint led to uneven development of digital competencies, particularly among students from low-income families. Language also plays a critical role. Much of the digital content used in classrooms across Africa and parts of Asia is presented in global languages like English or French, which are not always the primary languages of students. Research by Oguche and Lawal (2019) in Northern Nigeria found that many students struggled to understand English-language digital resources, reducing the effectiveness of digital learning. They advocate for the development of localized content in native languages to make digital literacy more inclusive. Gender inequality has also emerged as a recurring theme. Siddiq and Scherer (2019) note that cultural and societal factors often restrict girls' access to technology in certain developing regions. UNESCO (2020) similarly reported that female students in South Asia had less access to digital learning tools and were underrepresented in ICT training programs. These disparities risk widening the gender gap in educational and employment opportunities.

Policy inconsistency and lack of enforcement further hinder progress. Although many countries have drafted ICT-in-education policies, they often lack the resources or institutional support for implementation. In Kenya, Odera and Ogott (2019) found a wide gap between national ICT policy goals and what was happening at the school level, mainly due to limited funding and inadequate teacher training. Overall, empirical evidence paints a clear picture: the challenges of digital literacy in developing countries are multifaceted and deeply rooted in broader social and economic inequalities. Overcoming these barriers will require comprehensive strategies that include investment in infrastructure, inclusive policy frameworks, teacher development, content localization, and equity-focused interventions.

Discussions

Incorporating digital literacy into English education can significantly enhance students' engagement as interactive and immersive digital tools can foster a more participatory and enjoyable learning environment. Studies have consistently shown that digital technologies can increase student motivation and engagement. For instance, a study by the National Center for Education Statistics (2020) found that students who used digital tools for writing and communication showed higher levels of engagement and motivation compared to those who did not. Similarly, research by the Pew Research Center (2019) revealed that 70% of teachers believed that digital tools had a major impact on students' engagement and motivation. The evidence suggests that digital literacy can enhance student engagement by providing interactive and immersive learning experiences. Digital tools such as multimedia presentations, online discussions, and collaborative writing platforms can facilitate student participation and creativity, leading to a more enjoyable and effective learning environment. Furthermore, digital literacy can help cater to different learning styles, allowing students to engage with course material in ways that suit their individual needs and preferences.

Developing 21st-Century Skills

Integrating digital literacy into English education is crucial for developing students' 21st-century skills, including critical thinking, creativity, communication, and collaboration. Research highlights the significance of digital literacy in fostering 21st-century skills. A study by the National Center for Education Statistics (2020) found that students who used digital tools for writing and communication demonstrated improved critical thinking and problem-solving skills. Similarly, research by the Pew Research Center (2019) revealed that 77% of teachers believed that digital tools helped students develop creativity and innovation skills.



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The evidence underscores the vital role of digital literacy in cultivating 21st-century skills. By incorporating digital tools and technologies into English education, educators can provide students with opportunities to engage in critical thinking, creative problem-solving, and effective communication. Moreover, digital literacy can facilitate collaboration and teamwork, helping students develop essential skills for success in the 21st-century workforce. Some critics may argue that incorporating digital literacy into English education can lead to distractions, decreased attention span, and a lack of deep thinking and critical analysis. They may claim that the over-reliance on digital tools can hinder students' ability to engage in meaningful and nuanced discussions about literary texts. However, research suggests that digital literacy can actually enhance students' critical thinking and analytical skills. A study by the National Council of Teachers of English (2019) found that students who used digital tools to analyze literary texts demonstrated higher levels of critical thinking and analytical skills compared to those who did not. Additionally, digital literacy can provide students with opportunities to engage in collaborative and interactive discussions about literary texts, which can foster deeper understanding and analysis.

Conclusion

Incorporating digital literacy into English education is crucial for developing students' skills for the 21st century. As this essay has argued, digital literacy can enhance student engagement, develop 21st-century skills, and provide students with opportunities to engage in critical thinking, creativity, and communication. The main points of this essay have highlighted the importance of digital literacy in English education. Firstly, digital literacy can enhance student engagement by providing interactive and immersive learning experiences. Secondly, digital literacy can develop 21st-century skills, including critical thinking, creativity, communication, and collaboration. Finally, digital literacy can provide students with opportunities to engage in critical thinking, creativity, and communication. In light of these findings, it is imperative that educators and policymakers prioritize digital literacy in English education. This can be achieved by providing teachers with professional development opportunities, investing in digital infrastructure, and developing curriculum standards that incorporate digital literacy. By taking these steps, we can ensure that students are equipped with the skills they need to succeed in the 21st century.

Recommendations for Educators

1. Integrate digital literacy into English education: Incorporate digital tools and technologies into teaching practices to enhance student engagement, develop 21st-century skills, and provide opportunities for critical thinking, creativity, and communication.
2. Provide professional development opportunities: Offer teachers training and support to develop their digital literacy skills and effectively integrate technology into their teaching practices.
3. Develop curriculum standards that incorporate digital literacy: Update curriculum standards to reflect the importance of digital literacy in English education.

Recommendations for Policymakers

1. Invest in digital infrastructure: Provide funding for schools to invest in digital technologies, including devices, software, and internet connectivity.
2. Develop policies that support digital literacy education: Create policies that promote the integration of digital literacy into English education and provide support for teachers and students.
3. Provide funding for professional development opportunities: Allocate funds for teachers to participate in professional development opportunities that focus on digital literacy education.



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Recommendations for Parents and Guardians

1. Encourage digital literacy practice at home: Support your child's digital literacy development by encouraging them to practice their skills at home.
2. Stay informed about digital literacy education: Stay up-to-date with the latest developments in digital literacy education and advocate for its importance in your child's education.
3. Participate in school initiatives: Participate in school initiatives that promote digital literacy education and support your child's learning.

Recommendations for Future Research

1. Investigate the impact of digital literacy on student outcomes: Conduct research to examine the impact of digital literacy on student outcomes, including academic achievement and career readiness.
2. Explore the role of digital literacy in promoting equity and access: Investigate the ways in which digital literacy can promote equity and access in education, particularly for marginalized and underrepresented groups.
3. Develop frameworks for assessing digital literacy skills: Create frameworks for assessing digital literacy skills and evaluating the effectiveness of digital literacy education programs.

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Rethinking Education: Aligning School Leadership and ... Agbesanya, F. O. & Ewuola, W. O. (2025)

Rethinking Education: Aligning School Leadership and Curriculum Design for Student Development in Osun State

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Abstract

This study investigated how school leaders and curriculum design can work together for well-rounded students in Osun state, Nigeria. The research employed a correlational survey design involving 7800 participants as the population of the study while 420 respondents comprise the sample of the study using stratified random sampling techniques across public secondary schools in the state. Three research hypotheses were tested using Pearson Product Moment Correlation and independent sample t-test. A self-designed questionnaire tagged: ‘Curriculum Leadership and Student Development Inventory’. (CLSDI) was used to collect the data for the study. Expert screened the tool to ensure its validity. The tests-retest approach was used to assess the instrument's reliability. Thirty teachers who weren't in the study region received the instrument twice over the course of two weeks. The Pearson's Products Moment Correlation was used to analyze the data that was collected. The obtained reliability coefficient of 0.84 was deemed sufficient to establish the instrument's reliability. Every hypothesis was examined at the significance level of 0.05. Findings reveal significant positive relationships between curriculum alignment and leadership practices, as well as between leadership strategies and students' holistic development. The study concludes that effective curriculum-leadership alignment is a key driver of student success across cognitive, affective, and psychomotor domains. Recommendations include policy reforms, leadership training, and collaborative curriculum development initiatives aimed at bridging the gap between planning and execution.

Keywords: Curriculum alignment, Strategic school leadership, Student development

Introduction

Everyone involved in education: teachers, policymakers, and researcher are constantly thinking about how to make education in Nigeria better and more inclusive. In Osun State, specifically, the education system has seen many changes aimed at improving how students learn and helping them develop in a more complete way. But we still see persistent issues with student performance and their overall growth, which suggests that these reforms haven't quite hit the mark. One big reason for this might be that the way the curriculum is designed isn't quite in sync with how school leaders actually run things. Think of the curriculum as the backbone of any education system; it's the blueprint for what's taught, how it's assessed, and how students are engaged in learning (Ololube, 2022). On the flip side, strategic leadership is all about how those in charge interpret, put into action, and improve those learning goals within the school environment. When these two leadership and curriculum operate separately, the whole educational experience can feel disjointed, and it often fails to meet the diverse and complex needs of students (Adeleke & Owolabi, 2023).



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Akinsolu (2022). When we talk about 'student development,' we mean nurturing every aspect of a learner: their minds, their emotions, their social interactions, and their ethical understanding. This broad approach to education recognizes that just doing well in exams isn't enough for success. Things like emotional intelligence, being good at working with others, and having a strong moral compass are just as crucial for a well-balanced life. To achieve this kind of development, you need a curriculum that's not only strong in its content but also implemented thoughtfully through forward-thinking leadership (Fafunwa, 2022). As noted by Nwosu (2024), though there is a growing global emphasis on aligning educational components, Nigeria still faces challenges with inconsistencies in how policies are carried out. Adeleke and Owolabi (2023). Observed that many school leaders simply do not have the training or the freedom to be innovative and adapt the curriculum to fit the ever-changing needs of their students. It was observed that the disconnect between policy, actual practice, and teaching methods continues to undermine the quality of education. So, this study aims to explore how school leaders and curriculum design can work together for students' development in Osun state

Statement of the Research Problem

Even though the Nigerian government has been working hard on educational reforms and updating school curricula, it seems like students, especially here in Osun State, are not really developing in a well-rounded way. We often see a lot of focus on academic results, like how well students do in exams. But what about their emotional intelligence, their social skills, their creativity, or their ethical values? These crucial aspects of development, often called the affective and psychomotor domains, tend to get overlooked. It looks like a big reason for this is a disconnect between how the curriculum is designed and the actual role school leaders play. Too often, school leadership is stuck in administrative tasks, with very little involvement in the actual teaching decisions or adapting the curriculum to fit the local context. This means that even a really well-thought-out curriculum might not achieve its goals if the leadership strategies does not complement with the educational objectives. When you look at the existing research, there was not much empirical analysis on how curriculum design and leadership practices align in Osun State.

So, this study is all about digging into this under researched connection. We want to shed some light on how strategic leadership can truly drive curriculum alignment and, in turn, promote a more holistic development for students.

Objectives of the study

The objective of the study was to investigate how school leaders and curriculum design can work together for students' development in Osun state, Nigeria. In particular, the study aims to:

1. determine how much curriculum design and strategic school leadership are connected in secondary schools across Osun State.
2. evaluate what kind of impact strategic school leadership has on the overall development of students.
3. investigate schools where the curriculum and leadership practices are well-aligned actually produce better student outcomes compared to those where they are not.

Research Hypotheses

The following hypotheses was formulated for the study

Ho₁: There is no significant relationship between curriculum design and Strategic leadership within schools.

Ho₂: There is no significant relationship between strategic school leadership and students' development.



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H₀₃: There is no significant difference between schools that had well-aligned curriculum and leadership practices and those that does not.

Research Methodology

Research Design

For this study, a correlational survey design was used. This approach allowed us to explore the extent to which different variables relate to each other, and also to compare differences between groups. Our focus was specifically on public secondary schools in Osun State, and we looked at how the design of the curriculum and the leadership within the schools work together to influence student development.

Population of the Study

The population for this study includes 7,800 teachers and administrators in public secondary schools in Osun State. (Osun State Ministry of Education, 2024).

Sample and Sampling Techniques

The sample for the study consisted 420 participants which were carefully selected from the larger population. To make sure our sample truly represented the diverse schools in Osun State, stratified random sampling techniques was used in selecting school administrators (Principal) and teachers.

Research Instrument

The research instrument used was a self-designed instrument title: “Curriculum Leadership and Student Development Inventory (CLSDI)”. This questionnaire was divided into three main parts: Section A: This part collected basic demographic information about the participants. Section B: This section focused on questions related to curriculum alignment and leadership practices, containing 20 items. Section C: This final section had 15 items that aimed to measure indicators of holistic student development. Participants responded to the questions using a 5-point Likert scale, where 5 meant ‘Strongly Agree’ and 1 meant ‘Strongly Disagree’.

Validity and Reliability

To ensure face and content validity of the instrument used. The instrument was given to expert for thorough scrutiny to ensure internal consistency. The instrument's reliability coefficient was determined using test-retest approach. The instrument was given twice over a two-week period to 40 participates outside the study sample area. Person Product Moment Correction statistics was used to evaluate the data. The instrument's reliability coefficient of 0.84 was deemed enough for reliability.

Data Analysis

Statistical software called SPSS (version 26) was used to analysis the data. All hypotheses were tested at 0.05 level of significance. The three hypotheses were tested using Pearson Product Moment Correlation (for H₁ and H₂) and Independent Sample t-test (for H₃). The data were analyzed using SPSS (version 26).

Pearson Correlation between Curriculum Design Alignment and Strategic School Leadership

Variable	N	Mean	SD	r	p-value
Curriculum Design Alignment	420	15.18	1.63	0.71*	0.000
Strategic School Leadership	420	98.57	7.25		

Interpretation: A strong positive correlation exists, significant at $p < 0.05$.

Table 1: The above table implies a strong positive relationship between how well the curriculum is aligned and the strategic leadership in schools. The p-value of 0.000 tells us this isn't just a coincidence; it's statistically significant.



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Pearson Correlation between Strategic Leadership and Student Development (H₂)

Variable	N	Mean	SD	r	p-value
Strategic Leadership	420	15.18	1.63	0.65*	0.000
Students Development	420	98.57	7.25		

Interpretation: There is a significant positive correlation between leadership and student development.

Table 2 shows a significant positive relationship between Strategic Leadership and Holistic Student Development. This suggests that when school leaders are strategic, it genuinely helps students develop in a more holistic way.

Independent Sample t-test comparing Student Development in Aligned vs. Non-Aligned Schools (H₃)

Variable	N	Mean	SD	Df	p-value
Aligned Schools	210	74.22	6.03	418	0.000
Non- Aligned Schools	210	68.45	5.98		

Interpretation: A statistically significant difference exists in student development between aligned and non-aligned schools.

Table 3 shows a statistically significant difference in how students develop between schools that have their curriculum and leadership practices aligned and those that don't. Essentially, students in aligned schools showed better overall development.

Discussion of Findings

The results from our study provide strong evidence that when curriculum design and strategic school leadership are aligned, it genuinely helps students in Osun State develop in a more complete way. This positive relationship in Hypothesis 1 truly highlights how much curriculum planners and school administrators depend on each other. It's clear that without strategic leadership, even the most brilliantly designed curriculum might not be put into practice effectively. This is in line with Ololube (2022). Think of the curriculum as the backbone of any education system; it's the blueprint for what's taught, how it's assessed, and how students are engaged in learning. Hypothesis 2 It suggests that principals who offer a clear vision, mentor their staff, and build strong support systems are the ones who create more welcoming and inclusive learning environments for everyone. This is in contrast with Adeleke and Owolabi (2023). Observed that many school leaders simply don't have the training or the freedom to be innovative and adapt the curriculum to fit the ever-changing needs of their students. As some experts have pointed out, the disconnect between policy, actual practice, and teaching methods continues to undermine the quality of education. Finally, the t-test results just underscore the huge benefit of this alignment. Schools that have adopted these integrated approaches, where leaders are actively involved in decisions about the curriculum consistently show better outcomes in how students develop. These findings not only support what other researchers like Akinsolu (2022) have found but also make a strong case for giving schools more freedom in their decision-making processes.

Conclusion

This study clearly shows a strong link between how curriculum is aligned, the leadership in schools, and how well students develop. In secondary schools across Osun State, we found that when leaders actively get involved in both planning and carrying out the curriculum, students show better growth in their thinking, social skills, and emotional well-being. The evidence points to one clear fact: curriculum design can't just exist on its own. It absolutely needs the strategic involvement of visionary school leaders who can adapt and tailor learning experiences to truly meet the needs of today's students.



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Recommendations

Based on the findings of the study. The following recommendations were made.

1. Bring Policies Together: The Ministry of Education should really make sure that school leaders are part of any new curriculum reform efforts right from the start.
2. Train Our Leaders Better: Professional development programs should focus more on teaching school leaders about curriculum planning, how to lead instruction effectively, and how to promote holistic education.
3. Let Schools Innovate: Schools should be given more freedom to tweak parts of the national curriculum to better fit their local situations, while still keeping within standard guidelines.
4. Keep an Eye on Progress: We need a system to regularly check how well leaders are doing in putting the curriculum into practice and how effective it is.
5. Work Together: Developing the curriculum should be a team effort, involving teachers, parents, students, and even community leaders.

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Legal and Policy Frameworks for Equitable Access to Education: A Critical Study of Resource allocation among Public Schools in Nigeria

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Abstract

This study explores whether existing legal and policy mechanisms are actually doing what they promise and where the cracks might be. The research pulled from a diverse group of stakeholders, including policymakers, public school teachers, and education administrators across all six geopolitical zones. From a pool of 3,500 individuals as population of the study while 600 respondents were selected as sample using a stratified random sampling method. Data came through a specially designed questionnaire called the 'Equitable Resource Allocation and Education Policy Assessment Questionnaire' (ERA-EPAQ). Which was validated by education policy experts and confirmed to be reliable with a Cronbach's Alpha score of 0.87? The results of this study make one thing clear: Nigeria does have legislative and policy structures in place to support equitable access to education but implementation remains patchy and inconsistent. And while the National Policy on Education and the Universal Basic Education Act set out noble intentions for equity, they often fall short due to limited funding, weak oversight, and political interference in how resources are shared. To move forward, the study recommends that teachers should be encouraged financially and professionally to work in underserved areas. That could mean providing housing, transportation support, hardship allowances, or faster career progression. Also, local communities know their needs best. Giving them a seat at the table in managing school resources will boost transparency, responsiveness, and long-term sustainability.

Keyword: Resource allocation, Public schools, Legal framework, and Policy implementation

Introduction

Education is not just a basic right; it's a powerful engine for change. It shapes lives, opens doors, and plays a vital role in reducing poverty and promoting inclusion. In countries like Nigeria, where inequality, governance challenges, and regional disparities are still major hurdles, making sure every



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child has a fair shot at quality education remains a critical goal. But equitable access goes beyond simply enrolling kids in school. It's about ensuring that every student—regardless of where they're from or what their background is has access to the resources they need to actually learn and thrive. This includes fair distribution of money, facilities, qualified teachers, and learning materials. This study zooms in on how Nigerian laws and policies aim to ensure fairness in education, especially through how resources are managed in public schools. According to UNESCO (2017), equity in education is all about justice and inclusion and making sure personal factors like gender, income level, ethnicity, or geographic location does not limit a person's educational opportunities or outcomes. It is important to note the difference between equity and equality. Equality assumes everyone needs the same thing, but equity acknowledges that people have different needs and circumstances, and support should be tailored accordingly. This is especially important in Nigeria, where disparities between rural and urban areas, and between the northern and southern regions, are still very pronounced. Despite having legal frameworks and education policies meant to address these imbalances, the reality on the ground tells a different story.

According to the UNDP (2020), Nigeria's low Human Development Index is closely tied to poor access to quality healthcare and education. The National Bureau of Statistics (NBS, 2021) also points out that school attendance and literacy rates are drastically lower in the northern parts of the country. These gaps are a reflection of deeper structural issues. On paper, Nigeria has committed to a range of international agreements that promote educational equity, like the Universal Declaration of Human Rights (1948), the Convention on the Rights of the Child (1989), and the Sustainable Development Goals (SDGs), particularly Goal 4, which calls for inclusive and equitable quality education for all by 2030 (UN, 2015). Domestically, the Nigerian Constitution (1999) puts education front and center. Section 18 mandates the government to eliminate illiteracy and make both primary and secondary education free and compulsory. This is backed up by the Universal Basic Education (UBE) Act of 2004, which lays out a legal framework for all children between 6 and 15 to receive free education. The National Policy on Education (NPE) also sets broad goals around inclusion, equity, and national unity (Federal Ministry of Education, 2014).

There are additional efforts too, like the National Teacher Education Policy, the UBE Intervention Fund, and the National Home-Grown School Feeding Program—that are meant to support these legal mandates. However, in practice, many of these policies don't deliver as intended. Political interference, weak institutions, corruption, and unreliable data for planning and monitoring often get in the way of real progress. One of the most glaring issues is how educational resources are allocated. In Nigeria's public schools, resources span everything from teaching staff and materials to buildings and funding. But these aren't shared out evenly. This leads to overcrowded classrooms, low student achievement, and alarmingly high dropout rates in some areas. Studies show that urban schools tend to be far better resourced than those in rural or underserved communities. A 2020 Human Rights Watch report revealed that many schools in northern Nigeria lack even the most basic necessities e.g. textbooks, desks, toilets etc. Likewise, UNESCO's 2019 report found major disparities in education spending across states, with some investing heavily while others fall short of the federal baseline. Another challenge is the uneven distribution of teachers. According to the Teachers Registration Council of Nigeria (TRCN, 2022), over 80% of qualified teachers are based in urban centers, leaving rural and conflict-prone areas severely understaffed. This widens learning gaps and leaves vulnerable students behind. While many researchers have analyzed Nigeria's education funding and policy implementation, there has not been enough attention paid to how well the legal and policy structures actually address these imbalances, especially those tied to resources. That's



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where this study comes in. It aims to fill that gap by digging into how policies are applied in real life and whether they're truly helping to make access to education more fair and inclusive for all.

Objectives of the study

To investigate legal and policy frameworks for equitable education and resource allocation in Nigerian public schools. In particular, the study aims to

1. examine how educational resources are currently being distributed across public schools in Nigeria especially when comparing different regions and socioeconomic groups.
2. identify the major challenges and underlying factors that shape the implementation of equitable education policies in Nigeria.

Hypotheses

The investigation is guided by the following hypotheses:

H₀₁: There is no significant relationship between equity in access to public education and Nigeria's existing legal or policy frameworks.

H₀₂: There is no significant difference in how public schools in urban and rural parts of Nigeria allocate educational resources.

Methodology

Research Design

This study adopted a descriptive survey research design, which is well-suited to exploring real-world conditions and gathering perspectives across a wide geographic spread. By surveying participants from all six geopolitical zones, the study aimed to paint a clearer picture of how resources are currently allocated and how education policies are actually playing out on the ground.

Population of the Study

Participants were drawn from three major groups: secondary school teachers in public schools, education administrators from state education boards, and policymakers working in ministries of education. Altogether, the estimated study population was about 3,500 individuals spread across Nigeria's diverse regions.

Sample and Sampling Techniques

To ensure fairness and a balanced representation across Nigeria's diverse regions, a total of 600 participants were selected altogether, 100 from each of the six geopolitical zones. This was done using a stratified random sampling method, which helped minimize bias while capturing a broad spectrum of voices. The breakdown of participants looked like this: 400 public school teachers, 120 education administrators, 80 policymakers. This mix allowed the study to draw insights from both those shaping policy and those experiencing its impact firsthand in schools.

Research Instrument

To collect data, the researchers designed a structured questionnaire called the 'Equitable Resource Allocation and Education Policy Assessment Questionnaire' (ERA-EPAQ). It was organized into three key sections: Section A: Gathered demographic information, Section B: Focused on evaluating existing legal and policy frameworks, Section C: Assessed the practical challenges and patterns in resource distribution across schools

Validity of the Instrument

To make sure the questionnaire was actually measuring what it needed to, it was reviewed by two experts in educational management and one policy analyst. Their feedback helped refine the wording and relevance of the questions, aligning the tool more closely with the study's core objectives.

Reliability of the Instrument

To test how dependable the instrument was, a pilot study was conducted with 30 participants from



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a state not included in the main study. The results were promising: using the Cronbach Alpha method, the questionnaire achieved an internal consistency score of 0.87, suggesting a high level of reliability.

Data Analysis and Presentation

The data was analyzed using both descriptive statistics (like mean and standard deviation) and inferential statistics, including Chi-square and ANOVA tests. The threshold for statistical significance was set at $p < 0.05$

Presentation of Results

These consist of descriptive statistics used to answer research questions; appropriate statistics used for testing hypothesis; Tables should be aligned to APA style; P-value compare with decision threshold – 0.05 significance if necessary. E.g.,

Hypothesis 1

State the hypothesis in clear, unambiguous and should reflect the first research question.

Present the statistical data analysis used in testing the null hypothesis 1 in the table as shown below:

H₀₁: There is no significant relationship between equity in access to public education and Nigeria’s existing legal or policy frameworks.

Resource Allocation in Urban vs. Rural Public Schools

Resource Type	Urban Schools (%)	Rural Schools (%)	Mean Difference	p-val.	Decision
Qualified Teachers	83	51	32	0.003	Significant
Classroom Infrastructure	78	44	34	0.001	Significant
Textbooks Availability	72	38	34	0.002	Significant
ICT Facilities	65	20	45	0.000	Significant Highly

$p < 0.05$. (Author’s computation, 2025)

H₀₂: There is no significant difference in how public schools in urban and rural parts of Nigeria allocate educational resources.

ANOVA Test – Legal Frameworks and Equitable Access

Sources of Variation	SS	df	MS	F	p-value	Decision
Between Groups	1.84	2	0.92	6.21	0.015*	Significant
Within Groups	5.93	597	0.102			
TOTAL	7.77	599				

Author’s computation 2025

Discussion of Findings

The results of this study make one thing clear: Nigeria does have legislative and policy structures in place to support equitable access to education but implementation remains patchy and inconsistent. As shown in Table 1, there are stark contrasts between urban and rural schools when it comes to resource distribution. From qualified teachers to textbooks, classrooms to ICT tools, rural schools are significantly under-resourced. These disparities are not just numbers but, they reflect lived realities for students who are often left behind. This is in line with UNESCO (2017). The concepts of equity and access are at the heart of modern education systems and they are more than just buzzwords. While access generally refers to the opportunity to attend school, equity digs deeper: it’s about fairness, not sameness. It means ensuring that students no matter their background, gender,



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income level, or where they live must get what they need to succeed, even if that looks different from person to person. Table 2 also highlights a statistically significant link between legal frameworks and equitable access. But here's the catch: those policies only seem to work when they're enforced and that's not happening evenly across the board. Weak accountability mechanisms and inconsistent state-level commitment are major roadblocks. One particularly troubling issue is teacher deployment. Too many qualified teachers are concentrated in urban areas, leaving rural schools struggling with shortages which trend also noted by TRCN (2022) and Afolabi (2020). Until that imbalance is addressed, true educational equity will remain out of reach for many students.

Conclusion

This study found that ensuring students no matter their background, gender, income level, or where they live must get what they need to succeed, even if that looks different from person to person. Also, one particularly troubling issue is teacher deployment. Too many qualified teachers are concentrated in urban areas, leaving rural schools struggling and migrating to urban center.

Recommendations

Based on the findings of the study. The following recommendations were made

1. Incentivize Rural Teaching; Teachers should be encouraged financially and professionally to work in underserved areas. That could mean providing housing, transportation support, hardship allowances, or faster career progression.
2. Enforce Counterpart Funding Requirements; States that fail to meet their funding obligations under UBE should face real consequences whether through budget restrictions or constitutional enforcement mechanisms.
3. Engage Communities in School Governance; Local communities know their needs best. Giving them a seat at the table in managing school resources will boost transparency, responsiveness, and long-term sustainability.

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Effect of Scaffolding Instructional Strategy on ... Usaini, J. & Sani, A. G. (2025)

Effect of Scaffolding Instructional Strategy on Performance in Ecology Concepts among Secondary School Students in Gumel, Jigawa State, Nigeria

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Abstract

This study investigated the effects of Scaffolding Instructional Strategy on performance in Ecology concept among secondary school students in Gumel Education Zone, Jigawa State, Nigeria. The study adopts a Quasi-Experimental Design, particularly the pretest, posttest, quasi-experimental and control group design. The population comprised all 3239 SS2 Biology students from 17 public Senior Secondary Schools in Gumel Education Zone. A sample of 124 students from two randomly selected out of 4 co-educational schools was used for the study. The study involves two groups experimental and control. The experimental group was taught Ecology concept using Scaffolding Instructional Strategy while the Control Group was exposed to the same concept using lecture Method. One instrument were used for data collection, namely, Ecology Performance Test (EPT). The instrument were validated by experts in Ahmadu Bello University, Zaria and have reliability coefficients of 0.88 and estimated using Pearson Product Moment Correlation (PPMC). Two research objectives, two research questions and two null hypotheses were formulated to guide this study. Research questions were answered using Mean and Standard Deviation, while null hypotheses were tested using Independent Sample t-test at 0.05 level of significance. The major findings revealed a significant difference between the mean scores of experimental and control groups in their performance, in favour of the experimental group. It is therefore recommended among others that secondary school Biology teachers should frequently employ Scaffolding Instructional Strategy in teaching difficult and abstract concepts in Biology like Ecology

Keywords: Scaffolding Strategy, Ecology, Performance and Students

Introduction

Science is an organized body of knowledge which consists of unbiased and empirical findings obtained from observation and experiment. Science could be seen as a problem solving in order to enhance the living standard of man. There are different definitions of science by different scholars, Shuaib (2014) defined science as a complex human activity that leads to the productions of a body of the universal statement called laws, theories or hypotheses which serve to explain the observable behavior of the universe or part of it which in themselves have predictive characteristics. In addition, science deals with nature by observing it and phenomena to experimental investigation. Science as a discipline has many branches such as Biology, Chemistry, and Physics. Therefore, the importance of science in our society made the federal government of Nigeria, through the Federal Ministry of Education to introduce science education in the Nigerian Schools. Thus, science education is the field concerned with sharing science content and process with individuals not traditionally considered parts of the scientific community. Okeke (2007) described Science Education as an integrated field of study which considers both the subject matter of science disciplines such as



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Biology, Chemistry, and Physics. Alongside the processes involved in the teaching and learning of science. The term “Biology” was coined from two Greek words: bios and logos which simply mean life and study respectively. Biology according to Michael (2012) can simply be defined as the study of life. Biology is the scientific study of plant and animal. According to FRN (2013), Biology as a science subject occupies a central position in the Nigeria Science curriculum. Biology as a course of study embraces the study of living organisms with regards to their structure, functions, growth, evolution, distribution, identification and taxonomy. Umaru (2017) explains that the study of Biology enables human to understand the diversity of life forms, conservation and sustainable use of natural resources. Biology plays a key role as a prerequisite subject for most science and related professions like Physiology, Anatomy, Botany, Zoology, Ecology, Molecular biology, Entomology, Microbiology, Biochemistry, Pharmacy, Medicine, Nursing, Genetics and population dynamic. Umoru and Onoja, (2017) assert that basic knowledge and skills acquired from the subject can be of tremendous help to the society. For instance, in human society, it gives an understanding of how life is formed and how it works, changes and responds to environmental influences like human health, reproduction, quality of life, nutrition, biodiversity in changing climate and almost effect of human everyday life. According to Ugwuadu and Joda (2015) the impact of Biology on the life of living organisms is wide; all ensuring that the required standard of living for both plants and animals are maintained.

According to Obochi (2018) Biology is divided into many concepts such as photosynthesis, nutrition, genetics, evolution, ecology among others. In spite of the importance of Biology as a science subject empirical studies such as Lawal (2009), Etobro and Fabinu (2017) and Obochi (2018), WAEC Chief Examiners Reports (2014-2022) show that students perform poorly in Biology especially in areas like ecology, genetics, evolution and Biological drawing. Ecology is one of the branches of biology and is defined as the relationship of living organisms with one another and with the environment in which they live. Umeh (2011) defines Ecology as the study of interactions of organisms with their physical environment and with each other. Ecology is described as environmental biology. According to Obochi (2018), Ecology provides knowledge and understanding of the mechanism of change brought about by the interaction of the living things and its effects on their external environment. Ecology gives students the opportunity to relate with some of the most important ecological issues affecting the environment. These include the influence of human activity in altering human ecological relationships and difficulties arising from the stress of modern-day life. In secondary school biology curriculum, Obochi (2018) observed that ecology concept plays a very important role in scientific advancement that affects the lives of mankind. For instance, in the areas of understanding energy allocation, conservation of environment, discovery and production of medicine, disease and pest control, food production and sustaining biodiversity in a changing climate. However, Reports from WAEC (2014-2022) and other researchers such as Anyanwu, Obochi and Isa, (2015) show that there is still poor performance in Biology in external examination. The poor performance in biology in Nigeria has been attributed to many factors; Lawal (2009) identified the use of poor teaching methods. Okoro (2011) found lack of interest and low self-concept. Atadoga and Lakpini, (2013) found teacher’s instructional strategies, attitude and learning style preferred among others. Thus, instructional strategies used by teachers in teaching and learning process, have significant influence on learner’s academic performance. Jafar (2024) found poor performance was due to constant use of lecture method which is teacher-centered encouraging rote learning or memorization and not encouraging formal reasoning of the students. Lecture method is where a teacher does most of the talking, while students listen and take note. According to Nwagbo and Chukelu (2011) lecture method is a teaching method in which teacher present a verbal discourse on a particular subject,



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theme or concepts to the learners, the teacher delivers a preplanned lesson to the students with little or no instructional aides. Danmole (2011) added that teachers need to employ different learning methods and strategies to ensure students understanding of scientific concepts. In pursuance of the objectives, content, and context of Biology curriculum developers recommended teaching approaches which are learner-centered for effective teaching and learning of the subject so as to bring the expected desired learning outcomes. Ugwuadu, (2015) and Obochi, (2018) found that the persistent low performance of students in Biology specifically in Ecology concepts at senior secondary certificate examination raises doubt about the effectiveness of current teaching approaches in use by Biology teachers. Etobro and Fabinu (2017) found that ecology concepts are perceived as difficult concepts by secondary school Biology students. Thus, it becomes imperative to investigate other methods of teaching Biology. In this context, scaffolds may offer favourable support. However, Wolf, (2000) Saye and Brush, (2002) assert that Scaffolding are teaching strategy that guide or help students to gain higher levels of understanding during the teaching process.

In education, Scaffolding refers to different teaching strategy employed by a teacher to help students have deep understanding of concepts during teaching and also participate actively in the learning process. According to Hartman, (2002) Scaffolding is the teaching strategy that emphasizes the teaching of new skills by engaging students collaboratively in tasks that would be too difficult for them to complete on their own. However, Sawyer (2006) stated that instructional scaffolding is the provision of support to promote learning when concepts and skills are being first introduced to the students. Sawyer (2006) further expatiated that these supports may include resources, a compelling task, templates and guidance on the development of cognitive and social skills. Sawyer (2006) added that these supports are gradually removed as the students develop autonomous learning strategies. Thus, promoting their own cognitive, affective and psychomotor learning skills and knowledge. Nonye and Nwosu, (2011) stated that scaffolding strategy emphasizes on the role of teachers and other more skillful persons in supporting the learner's development and providing support structures to get to that next stage or level. Therefore, there is need for considering scaffolding strategy as an instructional way to teach and learn of biology so as to enhance better performance. Another factor to performance in science and biology education is gender. Okeke, (2008) Gender refers to the socio-culturally constructed or created characteristics and roles which are ascribed to male and female in any society. Before now science was preserved for males with little participation of female students. This is due to the fact that girls did not embrace formal education and specifically science education early enough as to their male counterparts. As a result, Okeke, (2008), opined that women and girls grapple with a lot of discrimination and difficulties in science learning. Not withstand in any academic setting such as science learning, there is always the participation of male and female students. This brings to play the issue of gender to educationist and researchers. There is bound to be interaction between male and female students in the cause of learning. It becomes paramount to understand the rate to which both genders can achieve in what is taught as well as their interest towards learning. However, researchers on gender and academic performance such as those of Olorukooba, Lawal and Umar (2013) and Akani (2015) reveal that boys achieved academically better than girls. On the other hand, studies by Lawal (2009) pointed out that female students achieved academically better than their male counterparts. However, a number of other studies like Sangowawa (2019) reveal no significant difference in the academic performance of male and female students. Therefore, the researcher seeks to determine the Effects of Scaffolding instructional Strategy on Performance in Ecology Concepts among Secondary School Students' in Gumel, Jigawa State, Nigeria.



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This study is based on social learning theory of Lev Vygotsky (1978) specifically, the socio-cultural theory and his concept of Zone of Proximal Development (ZPD). Socio-cultural theory spelt out that social interaction plays an important role in cognitive development. In his view, the learner does not learn in isolation, rather learning is strongly influenced by social interactions, which take place in meaningful contexts. The Zone of Proximal Development (ZPD) is that area between what a learner can do independently (mastery level) and what can be accomplished with the assistance of a competent adult or peer (Instructional level). It is believed that any learner could be taught any concept effectively using scaffolding techniques by applying the scaffolding at the ZPD.

Statement of the Problem

There has been a continuous poor academic performance of students in Biology generally and ecology in particular as reported by Etobro and Fabinu (2017). WAEC Chief Examiner's Reports on senior secondary school students' academic performance has consistently revealed poor performance at Biology in Nigeria from (2014-2022). Poor performance of students in Biology have been attributed to different factors, by several researchers for instance, Lawal (2009), Atadoga and Lakpini (2013) found that the persistent low performance in science education were attributed to teachers' instructional strategies such as lecture method in which the learners remain passive while the teacher is always active. Furthermore, Okoro (2011) and Osuafor and Okonkwo, (2013) found that the poor instructional strategies adopted by Biology teachers, inadequate laboratory equipment, lack of creativity in the part of teachers, poor Biology instructional materials, large class size, among others contribute to student's poor performance and lack of interest in Biology. Having identified all these factors responsible for poor performance in ecology, there is the need to explore other ways of presenting Biology to students to enhance meaningful learning and performance. This calls for teachers to use learner-centered strategies such as instructional scaffolding. However, Akani (2015) found that scaffolding strategy steps up students' performance in chemistry than the lecture method of instruction. It is on this note that, this study seeks to determine the Effects of Scaffolding instructional Strategy on Performance in Ecology Concepts among Secondary School Students' in Gumel, Jigawa State, Nigeria.

Objectives of the Study

The objectives of the study are to:

1. determine the effect of scaffolding instructional strategy on academic performance of SS 2 students taught ecology concepts and those taught using lecture method.
2. find out the difference between the academic performance of male and female students in ecology concepts taught using scaffolding instructional strategy.

Research Questions

The following questions are set to guide the study:

1. What is the difference between the mean academic performance scores of students taught ecology concepts using scaffolding instructional strategy and those taught using lecture method?
2. What is the difference between the mean academic performance scores of male and female students taught ecology concepts using scaffolding instructional strategy?

Null Hypotheses

The following null hypotheses are formulated for the study:

H₀₁: There is no significant difference between the mean academic performance scores of students taught ecology concepts using scaffolding instructional strategy and those taught using lecture method.



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Ho₂: There is no significant difference between the mean academic performance score of male and female students taught ecology concepts using scaffolding instructional strategy.

Methodology

The study adopted the quasi-experimental design, specifically the pre-test, post-test, quasi-experimental and control group design. Pre-test was administered before treatment to measure the students' initial level of Interest and academic performance in Ecology Concept. The students in the experimental group were taught using Scaffolding Instructional Strategy while those in the control group were taught using Conventional Method. Treatment lasted for six weeks each. The concept Ecology Concept as derived from the Senior Secondary school Biology Curriculum (NERDC, 2012) was taught in six lessons (one topic per week for each group). After the treatment post-test, was administered to both groups to measure their Interest and performance ability of learnt concepts. Two (2) instruments were used for data collection, namely, Ecology Performance Test (EPT) and Ecology Interest Questionnaire (EIQ). EIQ is a 25-item questioner with a reliability coefficient of 0.80 while EPT is a 40-item multiple-choice test with a reliability coefficient of 0.88. One hundred and twenty four (124) SS2 Secondary school Biology students constituted the sample for this study and were derived from two (2) co-educational schools sampled from the seventeen (17) public senior secondary schools in Gumel Education Zone. The population of this study is made up of three thousand, four hundred and ninety-six (3,496) SS2 Secondary school Biology students in the study area. The data collected were analyzed using Descriptive statistics of Means and Standard Deviations to answer the research questions as well as Independent Sample t-test and Mann whitney U-test to test the null hypotheses at $p < 0.05$ level of significance. All analyses were done using the Statistical Package for Social Sciences (SPSS) IBM Version 26.

Presentation of Result

Research Question One: What is the difference between mean performance scores of Secondary school students taught Ecology Concept using Scaffolding Instructional Strategy and those taught using lecture method?

To answer research question one, the data obtained from posttest were subjected to descriptive statistics using mean and standard deviation. The summary of the findings is presented in Table 1

Table 1: Mean, Standard Deviation Statistics Posttest EPT scores for Students in Experimental and Control Groups

Group	N	Mean	STD	Mean difference
Experimental	61	33.02	1.78	13.96
Control	63	19.06	3.03	

In Table 1, the result of the analysis shows that there was difference in the mean performance scores of students taught Ecology Concept using Scaffolding Instructional Strategy and those taught using lecture method. Their mean Academic Performance Scores were 33.02 and 19.06 in posttest experimental and posttest control respectively. The computed mean difference was found to be 13.96 in favour of the experimental group. The Mean Academic Performance Scores of Students in experimental group is higher than their counter parts, in the control group.

Hypothesis One: There is no significant difference between the mean performance scores of SSII Secondary school students taught Ecology Concept using Scaffolding Instructional Strategy and their counterparts taught using lecture method.



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To test null hypothesis one, the posttest scores of students in EPT for the experimental and control groups were subjected to Independent Samples t-test statistic and a summary of the analysis is presented in Table 2.

Table 2: Summary of Independent Sample t-test of Mean Posttest EPT Scores for Experimental and Control Groups.

Group	N	Mean	STD	Mean diff.	Df	t value	p value	Remark
Experimental	61	33.02	1.78					
				13.96	122	31.1	0.001	Sig
Control	63	19.06	3.03					

Significant at P≤0.05

Table 2 shows a p-value of 0.001, observed at degree of freedom Of 122. This p-value is less than the 0.05 level of significance, indicating that there is significant difference between the mean performance scores of SSII Secondary school Biology students taught Ecology Concept using Scaffolding Instructional Strategy and their counterparts taught same concept using lecture method. The observed difference is in favour of the experimental group who were exposed to the scaffolding instructional strategy. Hence, the null hypothesis is rejected, implying that Scaffolding Instructional Strategy significantly enhanced secondary school Biology students’ academic performance in Ecology than lecture method.

Research Question Two: What is the difference between the mean performance scores of male and female students taught Ecology Concept using Scaffolding Instructional Strategy?

To answer research question two, the data obtained from posttest scores for male and female were subjected to descriptive statistics using mean and standard deviation. The summary of the findings is presented in Table 3.

Table 3: Mean, Standard Deviation Statistics of Posttest EPT scores for Male and Female Students in Experimental Group

Gender	N	Mean	STD	Mean difference
Male	34	33.00	1.74	
Female	27	33.03	1.87	0.03

Table 3 shows that the Mean Academic Performance scores of Male Students in experimental group was 33.00 and standard deviation of 1.74 was observed. Female students in the experimental group also have a mean score of 33.03 with standard deviation of 1.87. The mean difference in performance is 0.03, this shows that both male and female students have a very close mean performance when taught Ecology Concept using Scaffolding Instructional Strategy.

Hypothesis Two: There is no significant difference between the mean performance score of male and female SSII students taught Ecology Concept using Scaffolding Instructional Strategy.

To test null hypothesis, the posttest EPT scores for male and female students in the experimental group were subjected to Independent Samples t-test statistic and a summary of the analysis is presented in Table 4:



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Table 4: Summary of Independent Sample t-test of Mean Posttest EPT Scores for Male and Female in Experimental Group.

Gender	N	Mean	STD	Mean diff.	Df	t value	P value	Remark
Male	34	33.00	1.74	-0.37	59	-0.080	0.91	NS
Female	27	33.03	1.87					

Not Significant at $P \geq 0.05$.

Table 4. Shows a p-value of 0.91 observed at degree of freedom Of 59. This p-value is greater than the 0.05 level of significance, indicating that there is no significant difference between the mean performance scores of male and female SSII students taught Ecology Concept using Scaffolding Instructional Strategy and their counterparts taught using lecture method. Hence, the null hypothesis is retained, implying that gender does not significantly influence secondary school Biology students’ academic performance in Ecology when taught using scaffolding Instructional strategy.

Discussion of Findings

The results of the findings show that students in the experimental group had a higher mean performance score than those in the control group. The difference was significant as indicated by the t-test analysis in Table 1. This signifies that students taught Ecology Concept using Scaffolding Instructional Strategy had a significantly higher mean performance score than those taught using lecture Method. By implication, the Scaffolding Instructional Strategy was able to foster a significant higher performance than the lecture Method. The significant difference implies rejection of null hypothesis and retaining alternate hypothesis. Therefore, null hypothesis that states that there is no significant difference in the mean performance score of SSII students taught Ecology Concept using Scaffolding Instructional Strategy and their counterparts taught using lecture method is rejected. The significant difference indicates that students in experimental group recorded a higher mean score than those in the lecture Method. This finding supports that of Okechukwu and Udo (2019). These researches revealed that students exhibited significant improvements in performance as a result of treatment with Scaffolding Instructional Strategy as compared to the lecture method. The findings of this study also agree with findings of Mohammed (2019) and Sangowawa (2019). The finding of this study also concurs with the assertion of Nonye, and Nwosu (2011) that effective use of Scaffolding Instructional Strategy facilities in teaching should be employed as it will enhance student’s performance of in JSS level of education. The finding also provides support to the research findings of Ogunseemi (2013) that students exhibited significant improvements in performance as a result of treatment with Scaffolding Instructional Strategy as compared to the lecture method. From the findings in Table 2 and 4, it was revealed that no significant difference in the performance of male and female students when exposed to Scaffolding Instructional Strategy. This showed that the strategy is gender friendly in terms of performance. This is in harmony with the findings of Ogunseemi (2013) who found that boys in heterogeneous groups do not dominate their female counterparts in performance. Okechukwu and Udo (2019) in their independent studies revealed that gender has no significant on performance among secondary school students when exposed to Scaffolding Instructional Strategy.

Conclusion

From the results and the findings of this study, it could be concluded that:



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1. The use of Scaffolding was found to enhance performance of secondary school students in Ecology concept.
2. The scaffolding instructional strategy is gender friendly as it is very effective for the enhancement of both male and female students' performance in Ecology concepts.

Recommendations

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

1. The teaching of Ecology concept should be carried out by biology teachers with tasks that involve using Scaffolding that promotes interaction among students and teachers.
2. Biology teachers should be encouraged to attend seminars, workshop, conference and in-service training programme specifically on Ecology teaching using Scaffolding Instructional Strategy.
3. Secondary school Biology teachers should frequently employ the Scaffolding Instructional Strategy in teaching difficult and abstract concepts in Secondary school Biology like Ecology Concept.
4. Professional bodies like STAN in collaboration with the Federal and State Ministries of Education should embark on nationwide re-training of Secondary school Biology teachers to design and implement classroom instructions based on the Scaffolding Instructional Strategy through regular national, state and local seminars, workshops and conferences.

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Impact of Insecurity on Agripreneurship Development in Niger State, Nigeria

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Abstract

This study investigated the impact of insecurity on agripreneurship development in Niger State, Nigeria, a region rich in agricultural potential but increasingly destabilized by violent conflicts. Agripreneurship, which blends agriculture with entrepreneurship, has been widely promoted as a driver of rural development, youth employment, and food security. Yet, persistent insecurity particularly banditry, cattle rustling, and kidnapping continues to disrupt farming activities, limit investments, and threaten the survival of agribusiness ventures. A survey research design was adopted, with data collected through a structured questionnaire administered to 240 agripreneurs drawn via a multi-stage sampling technique from four Local Government Areas (Rafi, Shiroro, Kontagora, and Mariga) in Agricultural Zones II and III of Niger State. The questionnaire was subjected to expert review for content validity, while reliability was confirmed through Cronbach's alpha test, which showed acceptable internal consistency. Data analysis involved descriptive statistics and regression techniques. Results indicated that 87.1% of respondents had experienced insecurity, with 65% affected by banditry and 57.1% reporting loss of farm assets. Critical agribusiness elements such as income generation, land access, and business expansion were severely constrained, with mean scores of 4.3, 4.2, and 4.0, respectively. Regression analysis revealed a significant negative effect of insecurity on agripreneurs' income ($\beta = -0.482, p < 0.01$), while access to markets and inputs showed positive and statistically significant impacts. Coping strategies included reducing farm size, diversifying income, and relying on community security groups, though institutional support was weak. The study concludes that integrated measures on security, infrastructure, and agricultural support are vital for sustaining agripreneurship. Enhancing resilience through better credit, input supply, and market access remains essential to protect livelihoods and promote rural development in conflict prone areas.

Keywords: Agripreneurship, Insecurity, Rural development, Agricultural marketing, Niger State.

Introduction

Agripreneurship a term that merges agriculture and entrepreneurship has emerged as a transformative force in rural development, poverty reduction, and food security in many developing countries, particularly in sub-Saharan Africa (Sanchez, 2015). In Nigeria, where agriculture employs over 70% of the labor force and contributes significantly to GDP (National Bureau of Statistics [NBS], 2022), agripreneurship is increasingly recognized as a strategic avenue for empowering youths, reducing unemployment, and enhancing the commercialization of agriculture (Adeola & Oyelere, 2020). However, in recent years, the growth and development of agripreneurship in various parts of Nigeria, including Niger State, have been severely threatened by rising insecurity. In Nigeria Insecurity has manifested in multiple forms, including banditry, farmer herder conflicts, cattle rustling, kidnapping, and communal clashes (Okoli & Iortyer, 2014). Niger State, located in North Central Nigeria, has been a hotbed for several of these violent activities. The consequences of insecurity in the region go beyond loss of lives and property it severely disrupts agricultural activities, weakens rural economies, and erodes the confidence of existing and potential agripreneurs



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(Chukwuma & Ume, 2020). Many farmers are forced to abandon their farmlands and relocate entirely to urban areas that is relatively safe, while agricultural value chains are truncated due to transportation risks and market access limitations.

Agripreneurship depends on an enabling environment characterized by land security, stable markets, access to capital, and functional infrastructure (Kahan, 2013). When these factors are undermined by insecurity, the spirit of enterprise is dampened, and the capacity of agriculture to act as a development catalyst is diminished. For instance, insecurity limits access to farmlands, reduces investment in agriculture, discourages youth participation, and restricts innovation and adoption of new technologies (Bamidele & Oginni, 2021). These disruptions threaten not only agricultural productivity but also long-term development goals tied to rural industrialization and food sovereignty. The concept of agripreneurship transcends traditional subsistence farming. It encompasses innovation, value addition, and risk taking in the agricultural sector with the goal of creating sustainable enterprises (FAO, 2016). Agripreneurs engage in crop and livestock production, agro-processing, input supply, marketing, and agri-tech innovations. In Niger State, with its vast arable land and strategic position within the North Central region, agripreneurship holds immense potential. Yet, persistent insecurity has created a hostile environment where entrepreneurs in agriculture face elevated risks of investment loss, physical harm, and operational disruption (Ibrahim *et al.*, 2022). Youth involvement in agripreneurship has been widely advocated by national and international development organizations as a viable strategy for addressing unemployment and revitalizing the agricultural sector in Nigeria (Oladeji, 2019). However, insecurity challenges has proven to be a major deterrent. Youths are less likely to invest their time and limited resources in uncertain and high risk ventures, especially in areas prone to violence. Consequently, the vision of modernizing agriculture through youth led enterprises is being delayed, if not derailed. Several studies have addressed the effects of insecurity on agriculture in general (Okeke & Eze, 2021; Omobowale & Olutayo, 2022), yet there remains a paucity of empirical research focused specifically on how insecurity affects agripreneurship particularly in the context of Niger State. Most existing studies tend to aggregate all agricultural actors, without isolating the experiences, constraints, and coping mechanisms of agripreneurs who often bear both the risk of farming and the challenges of enterprise development. Understanding the specific impact of insecurity on this group is crucial for designing targeted interventions, policies, and support systems.

This study, therefore, aims to bridge this gap by empirically investigating the effect of insecurity on agripreneurship development in Nigeria. Identify the types and forms of insecurity affecting agripreneurs in Niger State. Examine the impact of insecurity on agripreneurs' access to land, markets, finance, and inputs. Assess the effect of insecurity on agripreneurs' productivity, income, and business sustainability. Explore the coping strategies adopted by agripreneurs in response to insecurity. Recommend appropriate policy interventions to mitigate the effects of insecurity on agripreneurship in the study area.

Objectives of the Study

The study was designed to:

- i, Identify the types and forms of insecurity affecting agripreneurs in Niger State.
- ii. Examine the impact of insecurity on agripreneurs' access to land, markets, finance, and inputs in the study area.
- iii. Explore the coping strategies employed by agripreneurs in response to insecurity in the study area.



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Research Questions

- i What types of insecurity are experienced by agripreneurs in Niger State?
- ii. How does insecurity affect agripreneurs' access to land, markets, inputs, and finance in the study area?
- iii. Which coping strategies are adopted by agripreneurs to mitigate the effects of insecurity in the study area?

Research Hypotheses

The following hypotheses guided the study:

H₁: There is a significant association between the type of agribusiness and insecurity experience in the study area.

H₀: Insecurity incidence has no significant effect on agripreneurial income in the study area.

Methodology

The study employed a survey research design, which is appropriate for assessing the perceptions, experiences, and coping mechanisms of agripreneurs within an insecure environment. This design allowed for the collection of both quantitative and qualitative data that captured the complex interactions between insecurity and agripreneurship development in Niger State. The target population comprised all agripreneurs engaged in various agricultural enterprises across Niger State. From this population, a sample of 240 respondents was drawn. The choice of this sample size was informed by the need to ensure adequate representation of agripreneurs across zones prone to insecurity, while maintaining feasibility in terms of data collection. Multi stage sampling technique was adopted. At the first stage, Agricultural Zones II and III of Niger State were purposively selected due to their high prevalence of agripreneurial activities alongside recurring insecurity incidents. In the second stage, four Local Government Areas (Rafi, Shiroro, Kontagora, and Mariga) were randomly selected two from each zone. At the third stage, three communities were randomly chosen from each LGA, yielding a total of 12 communities. Finally, 20 agripreneurs were randomly selected from each community, resulting in a sample of 240 respondents. This approach ensured adequate representation of the study area. Primary data were collected using a structured questionnaire and interview schedule administered with the assistance of trained enumerators from the Niger State Agricultural Development Project (NSADP). The questionnaire covered socio-economic characteristics, experiences of insecurity, effects on agribusiness, coping strategies, and policy needs. The instrument's content validity was established through expert review by academics and extension officer's familiar with agripreneurship and rural security issues. To ensure consistency, the instrument was pre-tested in a pilot study conducted in a community outside the selected LGAs. Reliability was determined using Cronbach's alpha coefficient, which yielded values above the recommended 0.70 threshold, confirming acceptable internal consistency. The data collected were analyzed using both descriptive and inferential statistics. Descriptive statistics such as frequencies, percentages, and mean scores were used to summarize the socioeconomic characteristics of respondents and the perceived effects of insecurity. Likert scale analysis was employed to rank severity levels of insecurity impacts. Inferential statistics included Chi-square tests, used to determine relationships between agripreneurial characteristics and insecurity experiences, and multiple regression analysis, which estimated the effect of insecurity incidence, market access, input access, and land access on agripreneurial income. All analyses were conducted at 1% and 5% levels of significance.



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Presentation of Results

The socioeconomic characteristics analysis of respondents' presented in table one reveals that agripreneurial activities in Niger State are predominantly practiced by middle aged 60.0%, married men 85.0% with moderate levels of education, particularly 65% engaged in crop production. These demographic factors significantly influence the extent to which individuals are affected by insecurity, as well as their capacity to adopt effective coping strategies. The predominance of crop farming implies that a majority of agripreneurs are highly vulnerable to the adverse effects of insecurity, particularly during critical stages such as planting and harvesting. Security challenges like banditry, farm raids, and market disruptions often lead to losses in productivity, displacement, and reduced access to agribusiness opportunities (Adesina & Ibitoye, 2017).

Table 1: Socio-economic Characteristics of the Respondents

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	173	72.1
	Female	67	27.9
Age Group (Years)	18–35	48	20.0
	36–50	144	60.0
	51 and above	48	20.0
Marital Status	Married	204	85.0
	Single	24	10.0
	Widowed/Divorced	12	5.0
Educational Level	No formal education	72	30.0
	Primary	24	10.0
	Secondary	96	40.0
	Tertiary	48	20.0
Main Agripreneurial Activity	Crop production	156	65.0
	Agro-processing	48	20.0
	Livestock	24	10.0
	Marketing	12	5.0

Source: Computed from survey data, 2025.

Additionally, the relatively low participation of women 27.9% and youth 20.0% suggests underlying structural barriers, possibly worsened by safety concerns and limited empowerment opportunities in insecure environments. Therefore, addressing insecurity in agripreneurship requires targeted interventions such as the protection of farming communities, improvement of rural infrastructure, and capacity building programs for marginalized groups. Educational empowerment and inclusive security policies are essential in enhancing the resilience and sustainability of agripreneurship in conflict prone areas.

Research question 1: What types of insecurity are experienced by agripreneurs in Niger State?

Table 2 presents the respondents' experiences with various forms of insecurity, the data clearly highlight the widespread and multifaceted nature of insecurity affecting agripreneurs in Niger State.

Table 2: Insecurity Experience Among Respondents (N = 240)

Variable	Category	Frequency (n)	Percentage (%)
Insecurity Experience	Yes	209	87.1
	No	31	12.9
Types of Insecurity			



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Experienced*	Banditry	156	65.0
	Kidnapping	115	47.9
	Cattle rustling	72	30.0
	Armed robbery	67	27.9
	Communal conflict	48	20.0
Frequency of Insecurity Occurrence	Very often	79	32.9
	Often	98	40.8
	Sometimes	48	20.0
	Rarely	15	6.3
Displacement Due to Insecurity	Yes	96	40.0
	No	144	60.0
Loss of Farm Assets or Produce	Yes	137	57.1
	No	103	42.9
Physical Harm to Self/Workers	Yes	53	22.1
	No	187	77.9

Source: Computed from survey data 2025, *Multiple Responses were allowed.

Table 2 reveals that 87.1% of agripreneurs in Niger State experienced insecurity for some number of years past, with banditry (65%), Kidnapping 47.9% and Cattle rustling (30.0%) as the most common threats. Over 70% faced insecurity frequently, while 40% were displaced, 57.1% lost farm assets, and 22.1% suffered physical harm. These findings highlight the widespread and severe impact of insecurity on rural livelihoods. And echo calls by researchers and development agencies for integrated security, economic, and humanitarian interventions to stabilize conflict-affected agricultural zones (World Bank, 2020; FAO, 2021).

Research question 2: How does insecurity affect agripreneurs' access to land, markets, inputs, and finance?

The results in table three clearly demonstrate that insecurity poses a multidimensional threat to agripreneurship in Niger State.

Table 3: Effects of Insecurity on Agripreneurship (N = 240)

Agribusiness Component	Mean Score	Interpretation
Access to farmland	4.2	Severely affected
Access to inputs	3.8	Moderately affected
Access to markets	4.1	Severely affected
Labor availability	3.5	Moderately affected
Cost of production	3.9	Moderately affected
Income generation	4.3	Severely affected
Business expansion	4.0	Severely affected
Investment willingness	4.2	Severely affected

Source: Computed from survey data 2025, *Multiple responses were allowed

Components most severely affected are access to farmland with 4.2 Mean Score (MS), market access 4.1 (MS), income 4.3 (MS), business expansion 4.0 (MS), and investment willingness 4.2 (MS) as shown in table 3 are critical pillars of agribusiness sustainability. When agripreneurs cannot access land or sell their produce, and when they fear expanding or reinvesting due to insecurity, the entrepreneurial ecosystem weakens, food supply declines, and rural poverty increases. These findings align with the findings of Adesina & Ibitoye, (2017) which notes that prolonged insecurity



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limits economic activity, shrinks agricultural investment, and causes youth and skilled labor to abandon farming for safer livelihoods.

Research question 3: Which coping strategies are adopted by agripreneurs to mitigate the effects of insecurity?

Table 4 highlights the coping strategies adopted by agripreneurs in Niger State in response to insecurity. The most prevalent strategy was reducing farm size (55%), reflecting efforts to minimize exposure to risky areas, consistent with (FAO, 2021). Diversification into less risky livelihoods such as trading and livestock keeping (48%) was the next most common response, aligning with IFPRI’s (2019) resilience framework. About 37% of respondents relied on community-based security measures, such as vigilante groups, indicating limited trust in formal security systems (Okoli & Ugwu, 2019).

Table 4: Coping Strategies and Support Received by Respondents (N = 240)

Coping Strategy / Support Source	Frequency (n)	Percentage (%)
Reduced farm size	132	55.0
Diversified into less risky activities	115	48.0
Formed/joined community watch groups	89	37.0
Relocated business/farm	53	22.0
Hired private security	43	18.0
Received support from Government	29	12.1
Received support from NGOs	19	7.9
Received support from Cooperatives	12	5.0

Source: Computed from survey data 2025, *Multiple responses were allowed

Other coping mechanisms included relocation of farms/businesses (22%) and hiring private security (18%), typically accessible to better resourced individuals. Institutional support was notably limited: only 12.1% reported receiving government assistance, while support from Non-governmental organisations (NGOs) (7.9%) and cooperatives (5%) was even lower. These findings underscore the scarcity of structured support systems for agripreneurs in insecure areas, as also noted by the World Bank (2020).

Research Hypothesis 1:

H₁: There is a significant relationship between type of agribusiness and insecurity experience in the study area.

Table 5 shows a statistically significant relationship between the type of agribusiness and insecurity experience ($\chi^2 = 14.52$, $p = 0.002$).

Table 5: Chi-Square Test: Insecurity Experience and Type of Agribusiness

Type of Agribusiness	Experienced Insecurity	Not Experienced	Total
Crop farming	145	11	156
Livestock	22	2	24
Agro-processing	32	16	48
Marketing	10	2	12

Source: Computed from survey data 2025, Chi-square statistic (χ^2) = 14.52. p-value=0.002



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Most cases of insecurity were reported by crop farmers in the study area by the respondents (145 out of 156), indicating that land based agricultural activities are more exposed to security risks, likely due to their open and fixed operational nature. In contrast, agro-processing and marketing often conducted in more secure or urban settings recorded lower insecurity experiences. This finding suggests that insecurity disproportionately affects primary production, aligning with Akinyemi (2020) and FAO (2021), who noted that farmers working directly on the land are most vulnerable in conflict-prone areas.

Hypothesis 2:

H₀: Insecurity incidence has no significant effect on agripreneurial income in the study area.

Regression analysis was conducted to assess how key independent variables; incidence of insecurity, access to farmland, market access, and input access influence the agripreneurial income of respondents in the study area. The dependent variable, agripreneurial income, represents the total seasonal derived from agribusiness ventures such as crop production, livestock rearing, agro-processing, and marketing.

Table 6: Multiple Regression Analysis Determinants of Agripreneurial Income

Independent Variable	Coefficient (β)	t-value	p-value
Insecurity incidence	-0.482	-4.21	.000**
Market access	0.301	2.78	.006**
Input access	0.215	2.10	.037*
Land access	0.174	1.82	.070

Note:implies statistically significant in 1% level and *statistically significant in 5% level**

Source: computed from survey 2025

The regression analysis in table 6 reveals that insecurity incidence has a statistically significant and negative impact on agripreneurial income ($\beta = -0.482, p < 0.01$), highlighting the disruptive effect of violent conflict, banditry, and kidnapping on agribusiness profitability in the study area. This confirms earlier findings that insecurity erodes economic productivity by limiting mobility, access to farmland, and market participation (Akinyemi, 2020; Adepoju & Oyewole, 2014). Conversely, market access ($\beta = 0.301, p < 0.01$) and input access ($\beta = 0.215, p < 0.05$) show statistically significant positive effects on agripreneurial income, indicating that farmers who can reach markets and obtain essential resources are more resilient against insecurity shocks. This supports the argument that well functioning input supply and output market systems can mitigate income loss in conflict prone areas (Wiggins & Keats, 2014; Olwande & Mathenge, 2012). Although land access exhibited a positive but statistically insignificant effect ($\beta = 0.174, p = 0.070$), its limited impact may reflect the reality that land alone does not guarantee productivity unless it is accompanied by peace, capital, and adequate inputs (FAO, 2021). Overall, these results suggest that policy interventions must address the root causes of rural insecurity while also investing in market infrastructure and input systems to support agripreneurial resilience and income stability (World Bank, 2020; IFPRI, 2019).

Conclusion

The study concludes that insecurity especially banditry, cattle rustling, and kidnapping severely hampers agripreneurship in Niger State by restricting access to land, markets, and inputs, while



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increasing costs and discouraging investment. Crop producers are most affected due to their field based exposure.

Recommendations

The study recommends;

- i. Strengthening rural security through collaboration between government agencies, community groups, and traditional leaders to reduce the risks faced by agripreneurs.
- ii Improving rural infrastructure, particularly roads, electricity, and storage facilities, is necessary to enhance market access and reduce post harvest losses.
- iii Access to affordable credit and agricultural insurance should be expanded to help agripreneurs cope with insecurity related losses and sustain their businesses.
- iv. Capacity building through extension services and targeted training for youth and women will enhance resilience and encourage greater participation in agripreneurship.
- v Finally, integrated policies and multi-stakeholder partnerships are required to provide comprehensive support that links security, infrastructure, finance, and agricultural development.

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Stress Management and Coping Mechanism through Health Education at Tertiary Level of Education in Zamfara State, Nigeria

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Abstract

The paper examines stress management and coping mechanism through health education at tertiary level of education in Zamfara state, Nigeria. The aim of the paper is to identify the strategies, procedures for stress management and coping mechanisms through health education in Zamfara state. In order to achieve this aim therefore, the paper review related literature such as introduction that provide a brief caption of what the paper is all about, the concept of health education as a process of enlighten peoples about their health in physical, mental, emotional and psychological wellbeing through health advocacy, sensitization and awareness, stress and it types such as acute and chronic stress. Biological need for stress equilibrium, signs and causes of stress, stress management techniques and stress coping mechanisms as well as healthy ways to cope with stress, roles of health education in stress management were discussed. Meanwhile, the paper recommended some of the following suggestions, Health education should be given priority through enlightenment and advocacy on stress management strategies and coping mechanism as well as pros and cons involve towards mitigating self-care when dealing with difficult stress situations. Individuals should be enlightened through health education to developed and adopt the spirit of engaging in an exercise thereby securing at least hour and a quarter (1:15 minutes) per week could help to reduce the risk of early death, cardiovascular diseases, stroke and cancer.

Keywords: Health Education, Stress management.

Introduction

The level of diseases among the people in a community is mostly due to their cultural, social behavior and life style. The control of the occurrence of these diseases, therefore depends on the health education intervention strategies that may lead to positive change in health behavior and life style, meanwhile emphasizes is raised on the expansion of health facilities, the regular training of medical and health personnel without giving adequate consideration to health education in order to create awareness, advocacy and sensitization programme on the need for change in health related behavior from detrimental life styles that affects both personal and community hygiene. The aim therefore, is



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the attainment of minimal health incidence of illness. In this regard health education becomes an appropriate alternative and panacea for the improvement of community and individual health behavior. Health education is an essential phenomena in developing countries for creation of awareness to individuals, families, groups and communities on the importance associated to healthcare, reduce family wastage and create a sense of self reliance on healthy living, population control, helping individuals, families, groups and communities to recognize those harmful habits, beliefs, customs and aspirations that are detrimental to health and improve people health, knowledge, attitude and practice towards healthy life style (Leubner & Hinterberger, 2017).

Concept of Health Education at Tertiary Level of Education in Zamfara State

Health education is a profession of educating people about health (McKenzie, et al 2009). Areas within this profession encompass environmental health, physical health, social health, emotional health, intellectual health, spiritual health, sexual and reproductive health education (Donatelle, 2009). It can also be defined as any combination of learning activities that aim to assist individuals and communities to improve their health by expanding knowledge or altering attitudes toward health. Health education has been defined differently by various sources. The National Conference on Preventive Medicine in 1975 defined it as a process that informs, motivates and helps people to adopt and maintain healthy practices and lifestyles, advocates on environmental changes as needed to facilitate this goal and conducts professional training and research to the same end (UNESCO, 2018). Joint Committee on Terminology, (2001) defined Health Education as any combination of planned learning experiences based on sound theories that provide individuals, groups and communities the opportunity to acquire information and the skills needed to make quality health decisions. Health Education can also be defined as a process consisting of consciously constructed opportunities for learning involving some form of communication designed to improve health literacy and develop life skills which are conducive to individual and community health.

Concept of Stress at Tertiary Level of Education in Zamfara State

Stress is a feeling of emotional or physical tension. It can come from any event or thought that makes you feel frustrated or angry. Stress is body's reaction to a challenge or demand while stress can be positive such as when it helps you avoid danger or meet a deadline. But when stress lasts for a long time, it may harm your health.

Shadiya, (2015), Outline two main types of stress as follows:

i. Acute Stress: This is short term stress that goes away quickly. You feel it when you slam on the brakes, have a fight with your partner or ski down a steep slope. It helps you manage dangerous situations, it also occurs when you do something new or exciting and all people possess acute stress at one time or another.

ii. Chronic Stress: This is a stress that lasts for a longer period of time. You may have chronic stress if you have money problems, an unhappy marriage, trouble at work, or significant health concerns. Any type of stress that goes on for weeks or months is regarded as chronic stress. Individual can become so used to chronic stress without realizing it is a problem, if you don't find ways to manage stress it may lead to health problems of concern such as depression, brain diseases, hypertension to mention a few.

Stress and Your Body

Your body reacts to stress by releasing hormones. These hormones make your brain more alert, cause your muscles to tense and increase your pulse. In short term, these reactions are good because they can help you handle the situation causing stress. Perhaps is your body way of protecting itself. When you have chronic stress your body stays alert even though there is no danger but over time



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this may put you at risk of health problems that including: high blood pressure, heart disease, depression, anxiety, menstrual problems among others and if you already have an existing health condition chronic stress can make it worse (Ahmad, et al, 2016).

Biological Need for Stress Equilibrium

Homeostasis is a concept central to the idea of stress. Most biochemical processes strive to maintain equilibrium (homeostasis) a steady state that exists more as an ideal and less as an achievable condition. Environmental factors, internal or external stimuli continually disrupt homeostasis meanwhile an organism present condition is a state of constant flux moving about a homeostatic point that is organism optimal condition for living. Factors causing an organism condition to diverge too far from homeostasis can be experienced as stress. Life threatening situation such as major physical trauma or prolonged starvation can greatly disrupt homeostasis. On the other hand an organism attempt at restoring conditions back to or near homeostasis often consuming energy and natural resources can also be interpreted as stress.(Goldstein & Kopin, 2007).

Signs of Too Much Stress

According to Carney, et al, (2022), Stress can cause many types of physical and emotional symptoms. Sometimes individual may not realize these symptoms are caused by stress. Here are some of the signs of stress such as forgetfulness, frequent aches and pains, headaches, lack of energy or focus, sexual problems, stiff jaw or neck, tiredness, trouble sleeping or sleeping too much, upset stomach, use of alcohol or medicines to relax, weight loss or gain to mention a few.

Causes of Stress

The causes of stress are different for each individual where one can have stress from good challenges as well as bad ones. Some common sources of stress include Getting married or divorced, starting a new job, the death of a spouse or close family member, getting laid off, Retiring, having a baby, money problems, moving, having a serious illness, problems at work, problems at home (Ahmad, et al, 2016).

Stress Management at Tertiary Level of Education in Zamfara State

Stress management consist wide spectrum of techniques and psychotherapies aimed at controlling a person level of psychological stress especially chronic stress, generally for the purpose of improving the function of everyday life, stress produces numerous physical and mental symptoms which vary according to each individual situational factor. These can include a decline in physical health, such as headaches, chest pain, fatigue, sleep problem and depression. The process of stress management is a dilemma that can lead to a happy and successful life in modern society and these can solely depend on health education intervention programmes employed to suits for better improvement of health of the community such as health literacy, advocacy, sensitization, individual and community facilitation or involvement in provision of meaningful health outcome such as maintenance of environmental safety through afforestation to mitigate pollution and control erosion among others by community members for a better society. Stress management provides numerous ways to maintain overall wellbeing (Lehrer, et al, 2007).

Stress Management Techniques at Tertiary Level of Education in Zamfara State

There are several models of stress management each with distinctive explanations of mechanisms for controlling stress. Many stress management techniques cope with stresses peoples may find themselves. Some of the following ways listed help to reduce higher than usual stress levels temporarily or to compensate the biological issues involved and include the following.

i. Exercise: is a physical activity that enhances or maintains fitness and overall health which is performed for various reasons, including weight loss or maintenance, to aid growth and improve



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strength, develop muscles and the cardiovascular system, prevent injuries, hone athletic skills, improve health or simply for enjoyment (Kylasov & Gavrov, 2011). Many people choose to exercise outdoors where they can congregate in groups, socialize and improve wellbeing as well as mental health (Deslandes, et al, 2009). In terms of health benefits usually 150 minutes which is equivalent to two and half hours (2 ½) of moderate intensity exercise per week is recommended for reducing the risk of health problems such as diabetes, depression, hypertension etc. At the same time even doing a small amount of exercise is healthier than doing none. Only doing hour and a quarter (1:15 minutes/day) of exercise could reduce the risk of early death, cardiovascular disease, stroke and cancer (Garcia, et al, 2023).

ii. Social Activity: In social psychology an interpersonal relation (or interpersonal relationship) describes a social association, connection or affiliation between two or more people. It overlaps significantly with the concept of social relation which is the fundamental unit of analysis within the social sciences. Relations vary in degrees of intimacy, self-disclosure, duration, reciprocity, and power distribution (Jinhui & Xiaoting, 2020). The main trends of the interpersonal relations are family, kinship, friendship, love, marriage, business, employment, clubs, neighbourhood, ethical values, support and solidarity, Interpersonal relations may be regulated by law, custom, or mutual agreement and form the basis of social groups and societies. They appear when people communicate or act with each other within specific social contexts and they thrive on equitable and reciprocal compromises, meanwhile this form of interaction excessively help in managing tress level due to the intermingling nature existing between members of the community which can be adopted through health literacy and advocacy (Linda et al, 2007).

iii. Hobby: is considered to be a regular activity that is done for enjoyment typically during ones leisure time. Hobbies include collecting themed items and objects, engaging in creative and artistic pursuits, playing sports or pursuing other amusements or avocations all for the purpose to maintain wellbeing. Participation in hobbies encourages acquiring substantial skills and knowledge in that area and more importantly in health education because, during whatever process individuals might use their body parts to perform one or more task which in turn aid in development of muscles, intellectual ability, muscles strengthening which are very paramount in maintenance of personal wellbeing which is ultimate concern of health education. A list of hobbies changes with renewed interests and developing fashions by making it diverse and lengthy (Robert, 2015).

iv. Meditation: is a practice in which an individual uses a technique to train attention and awareness and detach from reflexive, discursive thinking, achieving a mentally clear and emotionally calm and stable state (Walsh & Shapiro, 2006).

v. Relaxation Technique: (known as relaxation training) is any method, process or activity that helps a person to relax and attain a state of increased calmness or otherwise reduce levels of pain, anxiety, stress or anger. Relaxation techniques are often employed as one element of a wider stress management program and can decrease muscle tension, lower blood pressure and slow heart and breath rates among other health benefits (Toussaint, et al, 2021).

vi. Relaxation Therapy: is the application of relaxation techniques in various settings to complement treatment for stress, anxiety, depression and pain. It addresses both psychological and physiological effects of stress such as increased heart rate, sweating and muscle tension. Whereas relaxation techniques may include progressive muscle relaxation, autogenic training, guided imagery, biofeedback assisted relaxation and other techniques (Toussaint, et al, 2021).

Stress Coping Mechanisms at Tertiary Level of Education in Zamfara State

According to Emad, & Gupta, (2023), Coping is defined as the thoughts and behavior mobilized to manage internal and external stressful situations. It is a term used distinctively for conscious



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and voluntary mobilization of acts, different from defense mechanisms that are subconscious or unconscious adaptive responses, both of which aim to reduce or tolerate stress. When individuals are subjected to a stressor the varying ways of dealing with it are termed coping styles which are a set of relatively stable traits that determine the individual behavior in response to stress. These are consistent over time and across situations. Coping is divided into reactive coping (a reaction following the stressor) and proactive coping (aiming to neutralize future stressors). Proactive individuals excel in stable environments because they are more routinized, rigid and are less reactive to stressors, while reactive individuals perform better in a more variable environment. Emad's further categorized coping style into four (4) main types:

- i. Problem focused:** Addresses the problem causing the distress. Examples of this style include active coping, planning, restraint coping and suppression of competing activities.
- ii. Emotion focused:** Aims to reduce the negative emotions associated with the problem. Examples of this style include positive reframing, acceptance, turning to religion, and humour.
- iii. Meaning focused:** An individual uses cognitive strategies to derive and manage the meaning of the situation
- iv. Social coping (support-seeking):** An individual reduces stress by seeking emotional or instrumental support from their community.

Healthy Ways to Cope with Stress at Tertiary Level of Education in Zamfara State

According to Centre for disease control, (2024), learning to cope in a healthy way can help reduce your stress via health education panacea. Taking small steps in your daily life to manage stress can have a big impact and as well everyone manages stress differently. You can find and manage what triggers your stress and the right combination of healthy techniques that work for you.

Take care of your mind.

- i. Take breaks from news and social media. It's good to be informed but constant information about negative events can be upsetting.
- ii. Make time to unwind.
 - a. Take deep breaths, stretch or meditate.
 - b. Keep a journal.
 - c. Spend time outdoors either being active or relaxing.
 - d. Try to do some other relaxing activities you enjoy.
- iii. Practice gratitude daily. Remind yourself of specific things you are grateful for and write them down.
- iv. Connect with others.
 - a. Talk with people you trust about your concerns and how you are feeling.
 - b. Connect with your community based or faith based organizations.

Take care of your body

- i. Get enough sleep. Go to bed and wake up at the same time each day to help you sleep better. Adults need 7 or more hours per night.
- ii. Move more. Staying physically healthy can improve your emotional wellbeing. Every little bit of physical activity helps.
 - a. Start small and build up to 2 ½ hours a week.
 - b. Break it into smaller amounts such as 20 to 30 minutes a day.
- iii. Eat healthy. Have fruits and vegetables, lean protein, whole grains and low fat or no fat dairy. Limit foods with unhealthy fats, salt and added sugars.
- iv. Limit alcohol intake. Choose not to drink or drink in moderation. For example
 - a. Drinks twice or less a day for men.



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- b. Drink ones or less for women.
- c. Find out more at drink less will be the best.
- v. Avoid using illegal drugs or prescription drugs in ways other than prescribed and don't take someone else's prescription.
- vi. Avoid smoking and the use of other tobacco products.
- vii. Continue with regular health appointments, tests, screenings and vaccinations.

Roles of Health Education in Stress Management at Tertiary Level of Education in Zamfara State

Health education play crucial roles in stress management at tertiary level of education in Zamfara state by providing knowledge, skills and support for individuals to effectively cope with stress and enhance their wellbeing. Health education informs people about the nature of stress, its impact on health and effective stress management techniques to be employed, among which include:

- i. Raising awareness:** Health education campaigns educate individuals about the physiological and psychological effects of stress on the body and mind.
- ii. Promoting healthy lifestyle choices:** Health education emphasizes the importance of activities such as exercise, healthy eating, sufficient sleep and mindfulness in reducing stress.
- iii. Teaching stress management techniques:** Health education programs teach practical skills such as exercise, relaxation techniques, time management, problem solving and assertive communication.
- iv. Facilitating self-care:** Health education encourages individuals to prioritize self-care activities that promote wellbeing and resilience, example adherence to health precautions.

Conclusion

Learning to cope in a healthy way can help tremendously in reducing stress likewise the management of stress can have a significance impact in everyday life of individuals particularly in maintenance of homeostasis despite the fact that everyone manages stress differently. But you can find and manage what triggers your stress and the right combination of healthy techniques that work for you through health education. Health education informs people about the nature of stress, its impact on health and effective stress management techniques to be employed and if health education is properly adopted to ensure prevention of stress management by the community members and in all perspective of health-related issue therefore, stress and other health problems will be minimized or overcome.

Recommendations

The paper recommended the following suggestions:

1. Individuals should employ the use of distinct techniques such as exercise, relaxation technique, hobby, social activities and meditation among so many others in stress Management.
2. Health education should be given priority through enlightenment and advocacy on stress management strategies and coping mechanism as well as pros and cons involves toward mitigating self-care when dealing with difficult stress situations.
3. Individuals should be enlightened through health education on how to developed and adopt the spirit of engaging in an exercise thereby securing at least hour and a quarter (1:15 minutes) per week could help to reduce the risk of early death, cardiovascular diseases, stroke and cancer.
4. Government should properly implement the policy that will make individuals in community to abstain from any forms of intoxicant that will gear stress level and hinder their well-being.



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5. Government, nongovernmental organizations and stakeholders should provide an avenue for health education intervention that will enhance a sustainable societal engagement in stress management activities.

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Comparative assessment of Wood work and Paper Approach on Self Efficacy in Biological Model Development among Pre-Service Teachers in Zamfara State, Nigeria

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Abstract

Biology education in Nigeria faces significant challenges, including inadequate resources and a shortage of skilled educators, often limiting the use of crucial biological models for visual learning. Many pre-service teachers lack the requisite skills and confidence to create effective models. This study investigated the Comparative assessment of Wood work and Paper Approach on Self Efficacy in Biological Model Development among Pre-Service Teachers in Zamfara State, Nigeria. A quasi-experimental design was employed, and 84 pre-service biology teachers were sampled from selected tertiary institutions. Participants were assigned to two groups; an experimental group trained in woodwork approach, and a control group trained in paper moulding practice in model creation. Data were collected using validated researcher designed instruments: the Self-Efficacy Questionnaire for Woodwork and paper instructional strategies in Biological Model Development (BMDSQ). Reliability indices were established at 0.89. Three research questions guided the study, and three null hypotheses were tested at a 0.05 level of significance. The study found NCE III pre-service biology teachers demonstrated significantly higher self-efficacy in developing models using both woodwork and paper instructional strategies compared to their NCE II counterparts, confirming that higher training correlates with improved self-efficacy. Additionally, the wood work approach significantly enhanced self-efficacy more than the paper approach. Recommendations suggest integrating practical skills like woodwork into teacher training programmes to encourage pre-service teachers' confidence and improve the quality of biology education in resource limited settings.

Key words: Woodwork, Paper Approach, pre-service teachers, biological models, self-efficacy.

Introduction

Biology teaching is central to science education, enabling learners to understand the natural world (Tatka et al., 2023). However, in Nigeria, challenges such as inadequate infrastructure, limited resources, and a shortage of skilled teachers hinder effective instruction (Sokoto State Ministry of Education, 2020). To enhance comprehension, teaching methods must be engaging and hands-on, with biological models serving as critical tools for illustrating complex concepts (Clark et al., 2020; Joyner & Goel, 2015). Models aid in visualizing abstract biological structures and processes, yet many Nigerian biology teachers lack the skills and confidence to construct them effectively (Yilmaz et al. 2016). The ability to design and interpret models enhances students' learning and critical thinking (Tatka et al., 2023), but teachers often struggle due to insufficient training (Farhana &



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Chowdhury, 2019). Comprehensive models such as wooden structures of plant cells require technical competencies like carpentry (Yilmaz et al. (2016). Incorporating wood work into science education fosters creativity, problem solving, and craftsmanship (Al-husaini & Amayreh, 2021). It bridges the gap between theory and practice, improving students' retention and self-efficacy (Menon & Azam, 2021). The paper approach remains popular for its accessibility and effectiveness in developing visual and diagrammatic skills (Adeoye, 2020). However, its limitations in durability and depth underscore the need for additional hands-on skills (Adeoye, 2020). Pre-service teachers, as future science educators, must possess both the self-efficacy and technical skills necessary to create accurate, engaging biological models (Hetherington & Mead, 2024). Woodwork enhances essential competencies such as measurement, design, and spatial reasoning (Al-husaini & Amayreh, 2021), while high self-efficacy boosts instructional effectiveness (Martin et al., 2020).

Statement of the Research Problem

The absence of specialized training for constructing teaching aids especially models during pre-service teacher education programs creates a significant barrier to effectively incorporate any skill in biology education. In biology education, the use of teaching aids such as biological models is essential for enhancing visualization, simplifying complex concepts, and improving students' understanding. However, in many Nigerian teacher education programs, the predominant improvisation method employed by pre-service biology teachers is paper practice, due to its affordability and availability of materials.

While paper practice has provided a simple and accessible option, it is often limited by poor durability, lack of precision, and insufficient resemblance to real biological structures. These shortcomings restrict its effectiveness in classroom teaching and fail to adequately develop the psychomotor competence of pre-service teachers. Moreover, reliance on paper practice does not sufficiently boost the confidence and self-efficacy of trainees, as the models produced are due to damage and less effective for long term instructional use. Woodwork offers the potential to produce more durable, realistic, and functional models while simultaneously engaging pre-service teachers in hands on skill acquisition. This approach is anticipated to enhance their skills by strengthening measurement, cutting, joining, and finishing skills, while also improving their self-efficacy through the successful creation of lasting models. If this study is not conducted, pre-service biology teachers in Zamfara State would likely continue relying on paper moulding practice as the dominant method of improvisation, despite its limitations in producing durable and realistic biological models. As a result, many pre-service biology teachers would remain with low self-efficacy in their skill to develop models, thereby reducing their willingness to improvise and use teaching aids in the classroom. This breach in training not only slow down the professional development and self-efficacy of pre-service biology teacher's but it also potentially limits the quality of science education provided to students in the state. The continued dependence on less effective methods would also weaken the quality of biology education, as students would have fewer opportunities to visualize abstract concepts through well-constructed models. Introducing woodwork practice into biological model development presents an opportunity to address these gaps. This study therefore sought to investigate on the Comparative assessment of Wood work and Paper Approach on Self-Efficacy in Biological Model Development among Pre-Service Teachers in Zamfara State, Nigeria

Objectives of The Study

The main objective of this study is to compare the Comparative assessment of Wood work and Paper Approach on Self Efficacy in Biological Model Development among Pre-Service Teachers To achieve this the following objectives were set to find out:



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1. The difference between self-efficacy of pre-service biology teachers' exposed to woodwork and those expose to paper approach on development of biological models in Zamfara State, Nigeria.
2. The difference between self-efficacy of NCE II and NCE III pre-service biology teachers' exposed to woodwork on development of biological models in Zamfara State, Nigeria.
3. The difference between self-efficacy of NCE II and NCE III pre-service biology teachers' exposed to paper approach on development of biological models in Zamfara State, Nigeria.

Hypothesis

1. There is no significant difference in self-efficacy between pre-service biology teachers' exposed to the woodwork and those exposed to the paper Approach on development of biological models in Zamfara State, Nigeria.
2. There is no significant difference between the self-efficacy of NCE II and NCE III pre-service biology teachers exposed to woodwork on development of biological models in Zamfara State, Nigeria.
3. There is no significant difference between the self-efficacy of NCE II and NCE III pre-service biology teachers exposed to paper Approach on development of biological models in Zamfara State, Nigeria.

Methodology

This study employed pre-test and post-test Quasi-experimental design, which is appropriate as it involves creating two groups, an experimental group receiving woodwork training and a control group receiving the paper Approach training. Both groups were pre-tested and post-tested on their self efficacy to develop biological models. Following the interventions (woodwork training) for the experimental group, both groups will be post-tested to measure the influence of the training. The population of this study comprises of 107 NCE II and NCE III pre-service biology teachers in the two colleges of education that enroll teacher education programs in Zamfara State which are Federal College of Education Technical, Gusau (FCET GUSAU) and College of Education, Maru (COE MARU). A sample size of 84 is chosen using Raosoft research advisor 2025. The sampling technique used was purposive sampling technique to choose NCE II and NCE III preservice biology teachers in the second and third year of their training because NCE II have not gone for teaching practice but preparing to and NCE III they have gone for teaching practice which make them to be conversant with learners and teaching aids which means they most have used one or two industrial made biological models in teaching biological concepts. Hence the need to use them in this study and guide them on how to develop these models by themselves using woodwork as a skill. Thus, simple random sampling was used to choose the main participants of the study in which a numbered list of the preservice biology teachers was written on sheets of papers and placed in a contained shuffle and are picked randomly by the participants. One research instrument; Titled Biological Model Development (BMDSQ). The Self-Efficacy Questionnaire was developed and used for data collection. It was divided into two sections sought for demographic information of the participants and section B comprises 16-item that assesses an individual's self-efficacy in creating biological models. Respondents rate their level of agreement with each statement on a 5-point Likert scale, ranging from Strongly Disagree (1), Disagree (2), Neutral (3), Agree (4) to Strongly Agree (5). The instrument aims to evaluate participants' self-efficacy in woodwork and paper Approach to develop biological models, integrating these skills with teaching methods and enhancing student learning. To ensure the validity of the instrument four experts were involved, three of which are from the department of science education Sokoto State University and one from the woodwork and joinery department of Government Technical College (GTC) Farfaru Sokoto State. A draft copy of the instrument was served



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to them for face, content and criterion validity. Their feedbacks are used to calculate the Content Validity Index (CVI). The validity index for the instrument is greater than the standard index required for any instrument to be valid for academic research, the CVI obtained for the Self-Efficacy Questionnaire for Wood Work strategy and Paper Approach in Biological Model Development (BMDSQ) is 0.77. To ensure that the instruments are reliable a pilot study was conducted and the instruments are pilot tested to a non-sampled institution within the population and administered to 20 education biology preservice teachers. Their responses were put into SPSS software to compute the Cronbach’s alpha value for each of the instruments, which is 0.89. The method of data collection was a general introduction to the management of the selected institutions. The researcher with the help of two trained assistants started by administering a pre-test instrument which is Biological Model Development Self Efficacy Questionnaire then the experimental was trained on how to make physical biological models such as flower and plant leaf using woodwork approach while control groups were trained using paper approach. The training lasted for six weeks. Lastly, the Biological Model Development Self Efficacy Questionnaire was administered for the second time as a Pos- test. The method of data analysis used to test the null hypotheses, one, two and three is Man Whitney U test and median. All the analyses were conducted using Statistical Package for Social Sciences (SPSS).

Presentation of Results

Null hypothesis 1

There is no significant difference in self-efficacy between pre-service biology teachers exposed to the woodwork and those exposed to the paper Approach on development of biological models in Zamfara State, Nigeria

Table 1: Difference in self-efficacy between woodwork and paper moulding practice

Group	N	Median Rank	Mean Rank	Sum of mean Rank	Mean Difference	U	Z	P-Value	Decision
Woodwork	44	53.50	61.44	105.44	6.50	47.5	65.34	.000	Rejected
Paper Moulding Practice	40	47.00	21.69	61.69					

Source: field work 2025

$\alpha=0.05$

The result of Mann–Whitney U test shows the self-efficacy of pre-service biology teachers exposed to woodwork and those exposed to the paper Approach. Participants in the woodwork group has a higher median rank of 53.50, with a mean rank of 61.44 and a sum of mean ranks of 105.44, while those in the paper Approach group has a lower median rank of 47.00, a mean rank of 21.69, and a sum of mean ranks of 61.69. The mean difference between the two groups was 6.50, in favour of the woodwork group. The results revealed a statistically significant difference between the two groups, $U = 47.5$, $Z = 65.34$, $p = .000$. Therefore, the null hypothesis is rejected. This finding indicates that pre-service biology teachers exposed to woodwork demonstrated significantly higher self-efficacy in developing biological models than those taught using the paper Approach.

Null hypothesis 2

There is no significant difference between the self-efficacy of NCE II and NCE III pre-service biology teachers exposed to woodwork on development of biological models in Zamfara State, Nigeria.

Table 2: Difference in self-efficacy between NCE II and NCE III woodwork experimental group in developing models.



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Group	N	Median Rank	Mean Rank	Sum of Ranks	Mean Difference	U	Z	p-value	Decision
NCE II	24	45.00	12.65	32.65					
					10.50	437.0	18.17	.000	Rejected
NCE III	20	55.50	30.71	50.71					

Source: field work 2025

$\alpha=0.05$

The results showed that the NCE III group has a higher mean rank of 30.71 and a median rank of 55.50, compared to the NCE II group, which has a mean rank of 12.65 and a median rank of 45.00. The sum of ranks was 50.71 for NCE III and 32.65 for NCE II, with a mean difference of 10.50. The test yielded a U value of 437.0, a Z score of 18.17, and a p-value of .000. Since the p-value is less than the significance level of .05, the null hypothesis was rejected. This indicates a statistically significant difference in self-efficacy between the two groups. Specifically, NCE III pre-service teachers demonstrated significantly higher self-efficacy in developing biological models using woodwork than their NCE II counterparts. The finding suggests that the level of training positively influences self-efficacy among pre-service biology teachers.

Null hypothesis 3

There is no significant difference between the self-efficacy of NCE II and NCE III pre-service biology teachers' exposed to paper Approach on development of biological models in Zamfara State, Nigeria.

Table 3: Difference in self-efficacy between NCE II and NCE III in paper moulding practice control group on developing models.

Group	N	Median Rank	Mean Rank	Sum of Ranks	Mean Difference	U	Z	p-value	Decision
NCE II	22	41.00	10.50	30.50					
					4.50	320.0	25.31	.000	Rejected
NCE III	18	45.50	28.50	52.50					

Source: field work 2025

$\alpha=0.05$

The analysis results show a statistically significant difference between the two groups, $U = 320.00$, $Z = 25.31$, $p = .000$, indicating that the null hypothesis should be rejected. NCE III pre-service teachers have a higher median rank of 45.50 and a mean rank of 28.50, while NCE II teachers have a median rank of 41.00 and a mean rank of 10.50. The mean difference between the groups was 4.50. These findings suggest that NCE III pre-service biology teachers demonstrated significantly higher self-efficacy in developing biological models using the paper Approach compared to their NCE II counterparts. The result implies that a higher level of training is associated with improved self-efficacy, even when using traditional instructional methods.

Discussion of Findings

The findings related to hypothesis one revealed a statistically significant and positive difference in self-efficacy between pre-service biology teachers who were exposed to the woodwork and those who underwent training through the paper Approach method. This suggests that the woodwork based instructional model was more effective in enhancing students' self-belief to develop biological models. The outcome supports the conclusions drawn by Adeoye et al. (2022) and Abdon-Liwanag (2023),



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who observed that learning strategies involving tactile and interactive experiences significantly enhance learners' engagement and comprehension. When students interact physically with learning materials, as in the case of constructing models through woodwork, they are more likely to develop a deeper understanding of the subject matter. This enhanced understanding contributes to a stronger belief in their capacity to complete similar tasks independently, which is a core component of self-efficacy. Moreover, the woodwork inherently provides a learning environment that encourages risk taking, experimentation learning. According to Harun et al. (2019), the development of self-efficacy is closely attached to motivational factors and individual personality traits. When pre-service teachers engage in constructive, hands-on tasks, they are not only developing practical skills but are also nurturing intrinsic motivation and a belief in their potential as effective educators. The active nature of the woodwork method fosters a sense of accomplishment and agency, which can be particularly powerful for pre-service teachers still forming their professional identity. Therefore, the significant improvement in self-efficacy observed in this study can be attributed to both the experiential nature of the woodwork method and its capacity to promote meaningful psychological engagement among learners.

The findings of hypothesis two indicate a significant interaction between the levels of training in relation to self-efficacy in developing biological models. Specifically, pre-service biology teachers at the NCE III level who were exposed to the woodwork approach demonstrated significantly higher self-efficacy scores than their NCEII. This suggests that the impact of the woodwork instructional method on self-efficacy and level is not uniform across academic levels; rather, it becomes more pronounced as students advances in their training. The woodwork method, with its emphasis on active engagement, problem solving, and hands on practice, appears to better support the developmental needs and learning maturity of higher level trainees, such as those in NCE III. This finding aligns with the work of Harun et al. (2019), who emphasized that self-efficacy, motivation, and teaching effectiveness are deeply influenced by both the method of instruction and the learner's level of training or experience. As students progress in their education, they may be more prepared to take advantage of complex, constructive learning strategies that demand higher order thinking and practical application. The woodwork method, which requires learners to design, measure, construct, and evaluate physical models, directly nurtures these skills and builds the confidence needed to replicate and teach biological concepts effectively. It also underscores the importance of integrating practical, skill based instructional methods such as woodwork model making into biology education, particularly at advanced levels of teacher training. Doing so can strengthen pre-service teachers' self-belief to create and use instructional models, which is vital for effective science teaching. Enhanced self-efficacy not only boosts a teacher's willingness to engage learners with diverse instructional tools but also improves classroom performance, adaptability, and innovation in teaching practices. For pre-service biology teachers, especially those in their final year of training, the findings highlight the value of experiential learning methods that go beyond theoretical instruction. As they prepare to enter the teaching profession, exposure to authentic, hands-on activities like woodwork based modeling can empower them with the skills, confidence, and creativity needed to deliver engaging and effective biology lessons.

The findings from hypothesis three showed that NCE III pre-service biology teachers demonstrated significantly higher self-efficacy in developing biological models using the paper Approach when compared to their NCE II counterparts. This observation strongly supports the foundational work of



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Harun et al. (2019), who underscored the critical link between self-efficacy and teacher motivation and effectiveness, suggesting that a more comprehensive background in pedagogy naturally fosters greater confidence in instructional tasks. It further aligns with the research by Yıldız, EmreÜrünArıcı (2021), which indicated that pre-service science teachers' self-efficacy beliefs are positively influenced by their training and preparedness. This significant difference is attributable to the NCE III pre-service biology teachers' more advanced level of training, extended practical experience, and broader academic exposure within the Nigerian educational system, all of which contribute to a more thoughtful confidence in applying established, conventional model making techniques. On the contrary, these findings precisely diverge from the primary emphasis found in studies such as Molino-Magtolis (2013) and Abdon-Liwanag (2023). While Molino-Magtolis demonstrated the effectiveness of model making in enhancing student understanding, and Abdon-Liwanag highlighted the positive impact of 3D models on student learning, neither explicitly glance into the pre-service teacher's self-efficacy in the process of constructing these models, particularly examining how it varies with differing levels of professional training. This differing focus indicates a crucial distinguishing factor of the current study, which zeroes in on the foundational confidence and practical readiness of educators themselves, providing insights into the human element behind instructional material development.,

Conclusion

The findings of this study conclude that the used woodwork instructional approach is more effective in enhancing self-efficacy to develop biological models among pre-service biology teachers in Zamfara State, Nigeria. The study's results support the notion that hands-on activities and applied learning experiences can improve learning outcomes and self-efficacy. The level of study of pre-service biology teachers influences their ability and self-efficacy to develop biological models. This highlights the importance of considering the level of training in instructional design.

Recommendations

1. Educational policy makers should support the integration of hands-on activities and applied learning experiences into teacher education programs.
2. Teachers of tertiary institutions should incorporate hands-on activities and applied learning experiences, such as woodwork, into their curriculum to enhance self-efficacy and ability to develop biological models among pre-service biology teachers in the institutions.
3. Tertiary institutions should consider the level of training of pre-service biology teachers by providing resources and materials necessary at each level during the teacher training programme.

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Impact of Socio-Economic Conditions on ... Ugbabe, A. O. & Otse, M. O. (2025)

Impact of Socio-Economic Conditions on Diabetic Patents Mortality Rate in Nigeria

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Abstract

Diabetes mellitus is a growing public health concern, contributing to a significant number of premature deaths worldwide. In low- and middle-income countries such as Nigeria, socio-economic inequalities have been identified as major barriers to effective diabetes management and survival. This study assesses the impact of socio-economic conditions—specifically income, education, occupation, and access to healthcare—on diabetes mortality rates. A cross-sectional mixed-methods approach was adopted, utilizing quantitative analysis of hospital mortality records from 2019 to 2024 and qualitative interviews with healthcare providers and relatives of deceased patients. Statistical analyses, including logistic regression and Chi-square tests, were conducted to determine associations between socio-economic indicators and mortality outcomes. The results revealed that lower income, limited educational attainment, and inadequate healthcare access were strongly associated with higher diabetes mortality rates. The study concludes that socio-economic disadvantages significantly exacerbate diabetes-related deaths, highlighting the urgent need for targeted interventions such as subsidized treatment, community-based education, and improved healthcare infrastructure in underserved areas.

Keywords: Diabetes mellitus, socio-economic conditions, mortality rate, healthcare access, Nigeria, non-communicable diseases.

Introduction

Diabetes mellitus is a chronic metabolic disorder characterized by persistent hyperglycemia resulting from defects in insulin secretion, insulin action, or both. Globally, it has emerged as one of the leading causes of mortality and disability, with the International Diabetes Federation (IDF, 2023) estimating that over 6.7 million deaths were attributable to the disease in 2021. Low- and middle-income countries bear the highest burden of these deaths due to inadequate healthcare infrastructure, poor awareness, and socio-economic disparities.

In Nigeria, the prevalence of diabetes has been increasing steadily over the past two decades, alongside rising mortality rates. Socio-economic conditions, such as income level, education, occupation, and access to healthcare, play a critical role in determining the capacity of individuals to manage the disease effectively. Poor socio-economic status often limits access to quality healthcare, healthy diets, and consistent medication adherence, which are essential for reducing complications and premature death. Furthermore, social determinants of health—such as environmental conditions, literacy levels, and employment opportunities—shape health behaviors and outcomes. Studies have shown that individuals from low-income backgrounds are more likely to present with advanced stages of diabetes and are less likely to access regular medical care, thereby increasing their risk of death (Fawole & Owoaje, 2021). Understanding how these socio-economic



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variables affect diabetes mortality rates is crucial for designing interventions and policies aimed at improving survival outcomes and promoting health equity.

Statement of the Problem

Despite medical advances in diabetes management, mortality rates remain disproportionately high in Nigeria, especially among socio-economically disadvantaged groups. Limited access to affordable healthcare services, poor health literacy, and inadequate public health interventions exacerbate the problem. Existing health policies have not fully addressed the intersection between socio-economic conditions and non-communicable disease outcomes, leaving a significant gap in mortality reduction strategies. Without targeted interventions, the burden of diabetes-related deaths will continue to rise, further straining the healthcare system and reducing national productivity.

Objectives of the Study

General Objective

To assess the impact of socio-economic conditions on diabetes mortality rates in Nigeria.

Specific Objectives

1. To determine the relationship between income levels and diabetes mortality rates.
2. To examine the influence of educational attainment on diabetes management and survival outcomes.
3. To assess the effect of occupation type on access to diabetes care.
4. To evaluate the role of healthcare accessibility in diabetes mortality rates.

Research Questions

1. What is the relationship between income levels and diabetes mortality rates?
2. How does educational attainment influence diabetes management and survival?
3. In what ways does occupation type affect access to diabetes treatment?
4. To what extent does healthcare accessibility contribute to diabetes mortality rates?

Research Hypotheses

H₀: There is no significant relationship between socio-economic conditions and diabetes mortality rates.

H₁: Socio-economic conditions have a significant impact on diabetes mortality rates.

Literature Review

Conceptual Framework

The socio-economic conditions of individuals significantly shape health outcomes, particularly for chronic diseases like diabetes mellitus. Socio-economic factors—such as income, educational attainment, occupation, and access to healthcare—affect the ability to afford treatment, adopt healthy lifestyles, and comply with medical advice.

Income influences dietary choices, the ability to purchase medications, and access to regular medical checkups. Educational attainment affects health literacy, enabling individuals to understand disease management protocols. Occupation often determines income stability, exposure to health risks, and eligibility for health insurance. Healthcare access involves the availability, affordability, and quality of medical services, which can directly influence survival rates among diabetic patients. The conceptual framework for this study was guided by the Social Determinants of Health model (WHO, 2010), which posits that health outcomes are shaped by the conditions in which people are born, grow, live, work, and age, influenced by the distribution of resources and opportunities.



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Theoretical Framework

The Health Belief Model (HBM); The Health Belief Model explains how personal beliefs about health conditions influence health-related behaviors. It emphasizes perceived susceptibility, perceived severity, perceived benefits, and perceived barriers to taking action. In the context of diabetes, socio-economic conditions can influence how individuals perceive their vulnerability and the benefits or challenges of adhering to treatment.

Social Determinants of Health Theory

This theory suggests that health inequalities arise from social, economic, and environmental conditions. It links macro-level factors, such as poverty and education systems, to micro-level health behaviors, such as medication adherence. This theory underpins the rationale that addressing socio-economic disparities can improve diabetes survival rates.

Empirical Review

Income and Diabetes Mortality; Research by Mbanya et al. (2010) revealed that lower income is strongly correlated with higher diabetes mortality rates due to reduced access to healthy foods, inadequate health services, and delayed diagnosis. Similarly, Fawole and Owoaje (2021) found that individuals in low-income brackets in Nigeria are less likely to access specialist care, leading to increased mortality risk.

Educational Attainment and Diabetes Outcomes

Educational attainment is closely linked to health literacy. According to Agardh et al. (2011), individuals with lower education levels have poorer glycemic control and higher mortality risk. Education enhances understanding of disease management and fosters healthier lifestyles.

Occupation and Health Access

Occupational status determines income and, in many cases, access to employer-sponsored health benefits. A study by Lee et al. (2019) showed that manual laborers and informal sector workers are more likely to have uncontrolled diabetes due to inconsistent healthcare access.

Healthcare Access and Mortality

The availability and affordability of healthcare services play a direct role in diabetes survival. WHO (2022) reported that patients with limited access to primary healthcare have higher rates of complications such as kidney failure, cardiovascular diseases, and premature death.

Conceptual Gaps in Literature

While previous studies have examined individual socio-economic factors and their association with diabetes mortality, few have taken a comprehensive approach that analyzes multiple socio-economic conditions simultaneously within the Nigerian context. Additionally, there is limited empirical data combining quantitative hospital mortality records with qualitative perspectives from healthcare providers and affected families. This study addresses these gaps by adopting a mixed-methods approach to generate a more holistic understanding. The literature highlights that socio-economic disparities significantly contribute to diabetes mortality. Income levels, education, occupation, and healthcare access are interrelated determinants that influence health behaviors, treatment adherence, and ultimately, survival outcomes. Guided by the Health Belief Model and Social Determinants of Health theory, this study aims to integrate both statistical and narrative data to provide actionable insights for reducing diabetes-related deaths in socio-economically disadvantaged populations.



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Research Methodology

This study will adopt a cross-sectional mixed-methods research design, integrating both quantitative and qualitative approaches. The quantitative component will involve the collection and statistical analysis of hospital mortality records and patient socio-economic data. The qualitative component will involve semi-structured interviews with healthcare providers and relatives of deceased diabetes patients to provide deeper insights into the influence of socio-economic conditions on mortality outcomes. Population of the Study. The study population consist all registered adult diabetes patients within the selected geographical area in Nigeria (to be specified) whose medical records cover the period 2019–2024. Relatives of deceased diabetes patients. Healthcare providers involved in diabetes management in the study area. The sample size for the quantitative component determined using Yamane’s formula. For the qualitative component, purposive sampling was use to select 15–20 healthcare providers and 20–25 relatives of deceased patients until data saturation is achieved. Sampling Technique. Quantitative Stratified random sampling was use to ensure representation across socio-economic categories. Primary Data, Semi-structured interviews with healthcare providers and relatives of deceased patients.

Questionnaires for surviving diabetes patients to gather socio-economic information. Secondary Data. Hospital mortality records of diabetes patients. Health department reports and national diabetes statistics. Qualitative: Purposive sampling will target participants with direct knowledge of the subject matter. Research Instruments. Structured questionnaire: For collecting quantitative socio-economic data. Interview guide: For qualitative insights into challenges faced by patients and healthcare providers. Data extraction sheet: For capturing relevant hospital mortality data. Validity and Reliability of Instruments. Instruments will be reviewed by three experts in public health and epidemiology to ensure content validity. Reliability: A pilot study involving 10% of the sample will be conducted, and Cronbach’s Alpha coefficient of ≥ 0.70 will be accepted as reliable. Descriptive statistics: frequencies, percentages, means, and standard deviations. Inferential statistics: Chi-square tests to determine associations; logistic regression to identify socio-economic predictors of diabetes mortality. Software: Statistical Package for the Social Sciences (SPSS) version 26. Thematic analysis: coding and categorizing responses into emerging themes. Software: NVivo for qualitative data management.

Presentation of Results

The findings from both the quantitative and qualitative components of the study. The data are analyzed to determine the influence of socio-economic conditions—specifically income, education, occupation, and healthcare access—on diabetes mortality rates. Quantitative results are presented using tables, charts, and statistical tests, while qualitative findings are summarized thematically. Out of the 250 questionnaires distributed to surviving diabetes patients and relatives of deceased patients, 238 were returned and valid for analysis, giving a response rate of 95.2%.

Table1: Socio-Economic Characteristics of Respondents

Variable	Category	Frequency (f)	Percentage (%)
Gender	Male	110	46.2
	Female	128	53.8
Age Group	30–39 years	40	16.8
	40–49 years	60	25.2



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50–59 years	78	32.8
60+ years	60	25.2
Monthly Income (₦)		
< ₦50,000	120	50.4
₦50,000–₦99,999	70	29.4
₦100,000+	48	20.2
Education Level		
No formal education	54	22.7
Primary education	68	28.6
Secondary education	70	29.4
Tertiary education	46	19.3
Occupation		
Unemployed	58	24.4
Informal sector	90	37.8
Formal sector	90	37.8

Source: Field Survey (2025)

Relationship between Income and Diabetes Mortality

Null Hypothesis (H₀): There is no significant relationship between income levels and diabetes mortality rates.

Alternative Hypothesis (H₁): There is a significant relationship between income levels and diabetes mortality rates.

Table 2: Chi-Square Test on Income Level and Mortality Outcome

Income Level	Mortality Recorded	No Mortality	x ² -value	p-value
< ₦50,000	95	25	12.54	0.002*
₦50,000–₦99,999	42	28		
₦100,000+	20	28		

p < 0.05 indicates statistical significance.

The Chi-square analysis shows a significant relationship between lower income levels and higher diabetes mortality rates (p = 0.002).

Influence of Education on Mortality Rates

Null Hypothesis (H₀): There is no significant relationship between educational attainment and diabetes mortality rates.

Alternative Hypothesis (H₁): There is a significant relationship between educational attainment and diabetes mortality rates.

Table 3: Logistic Regression Output

Predictor Variable	β	SE	Wald	p-value	Exp(β)
No formal education	1.85	0.60	9.50	0.002*	6.36
Primary education	1.20	0.52	5.32	0.021*	3.32
Secondary education	0.65	0.48	1.83	0.176	1.91
Tertiary education	Ref.				

Individuals with no formal education are 6.36 times more likely to die from diabetes complications compared to those with tertiary education.

Discussion of Findings

Qualitative Data Analysis

Thematic analysis of interview transcripts revealed three main themes:

1. Financial Barriers to Treatment

Many participants reported inability to afford continuous medication and regular medical checkups.



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Quote from a healthcare provider: "Some patients stop treatment once their money runs out, and this often leads to fatal complications."

2. Low Health Literacy

Relatives of deceased patients often mentioned that their loved ones did not fully understand the severity of diabetes or the importance of consistent treatment.

3. Poor Accessibility to Healthcare Services

Respondents from rural areas complained about long distances to health facilities and lack of diabetes specialists.

Lower income levels and limited education are strongly associated with higher diabetes mortality rates. Informal sector and unemployed individuals are at greater risk due to lack of health insurance. Limited healthcare access in rural areas worsens mortality outcomes.

Summary

This study assessed the impact of socio-economic conditions on diabetes mortality rates in Nigeria, focusing on four key variables: income, education, occupation, and healthcare access. A mixed-methods approach was employed, combining quantitative analysis of hospital mortality records from 2019 to 2024 with qualitative interviews involving healthcare providers and relatives of deceased patients. The quantitative analysis revealed significant associations between low socio-economic status and higher mortality rates. Income was a strong predictor, with individuals earning less than ₦50,000 monthly showing the highest mortality rates. Education also played a critical role, as those without formal education were over six times more likely to die from diabetes complications compared to those with tertiary education. Occupation influenced mortality through access to health benefits, while healthcare accessibility emerged as a major determinant, especially for rural residents. The qualitative findings reinforced these results, highlighting financial barriers, low health literacy, and poor accessibility to healthcare services as recurring challenges faced by diabetes patients.

Conclusion

The study concludes that socio-economic conditions have a profound and statistically significant impact on diabetes mortality rates in Nigeria. Low income, limited education, unstable employment, and poor healthcare access collectively contribute to delayed diagnosis, inconsistent treatment, and higher risk of fatal complications. Addressing these socio-economic disparities is essential for reducing preventable diabetes-related deaths and achieving better health outcomes for vulnerable populations.

Recommendations

Based on the findings, the following recommendations are made:

Policy Interventions

1. Subsidized Healthcare: Implement government-sponsored subsidies for diabetes medications and routine checkups for low-income patients.
2. Health Insurance Expansion: Extend affordable health insurance schemes to cover informal sector workers and the unemployed.

Healthcare Access Improvement

3. Decentralized Diabetes Clinics: Establish diabetes care units in rural areas to reduce travel distances and improve specialist access.
4. Mobile Health Units: Deploy mobile health services for remote communities to facilitate regular monitoring and education.

Public Health Education



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5. Health Literacy Campaigns: Develop nationwide community-based programs to improve understanding of diabetes prevention and management.
6. Workplace Health Programs: Encourage employers to provide diabetes screening, awareness sessions, and medical support for employees.

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Influence of Funding on Lecturers Productivity in... Ayeni, A. O., Et. al. (2025)

Influence of Funding on Lecturers Productivity in Public Polytechnics in South West, Nigeria

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Abstract

Studies have shown that lecturer productivity in Public Polytechnics in south west Nigeria is low. Previous studies focused more on funding of universities and learning outcomes of undergraduates than in the polytechnics and less attention was on lecturer productivity of polytechnic lecturers. This study therefore, was carried out to determine the pattern of funding and lecturer Productivity in Public Polytechnics in South West Nigeria. Descriptive research design was used. Four states (Ondo, Ogun, Osun and Lagos) that have federal and state polytechnics were purposively selected, while the four federal polytechnics were enumerated and non-proportional to size technique was used to select six polytechnics in the states. Ten Bursars were purposively selected from the public polytechnics used for the study. Funding ($r=0.80$) questionnaires for Lecturer and Bursars respectively, while Rectors of public polytechnics were In-depth interviewed. Quantitative data were analysed using descriptive statistics. The community service ($\bar{x}=2.34$) was low, 74.1% of lecturers did not publish in textbooks, this showed low Research Output, while Teaching Quality ($\bar{x}=2.68$;) and lecturers' commitment to students project supervision ($\bar{x}=2.85$) as rated by lecturers were moderate in Public Polytechnics. Funding ($\bar{x}=2.14$) was low. Funding enhanced lecturer productivity in public polytechnics in South West, Nigeria. Therefore, government should increase subvention and research grants to public polytechnics' lecturers for improved productivity.

Keywords: Funding, Lecturer productivity & Public Polytechnics

Introduction

Public polytechnics play a vital role in technical and vocational education, preparing students with practical skills necessary for national development. In order to achieve this objective of establishing polytechnic education, there is



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need for lecturers to be efficient and productive (Olatunji & Abayomi, 2019). Lecturer productivity is a desirable maximum output on the part of lecturers by using all available resources within their reach towards the achievement of polytechnic education objectives where they work and within the polytechnic environment. There has been a major concern by different stakeholders in the education sector on the perceived low productivity of lecturers in public polytechnics in Nigeria. It appears that polytechnic education which is not only an instrument of change but also an important tool for economic growth and national development has not been given proper attention by the government of the Federal Republic of Nigeria (Audu, Kamin, & Balash, 2013) cited in (Oyewole, Ayeni & Popoola, 2025). Hence, this appears to have resulted in low lecturer productivity in these institutions. It should be noted that the aim of establishing polytechnics in Nigeria is to train technologists, technicians and provide management skills in courses leading to the award of National Diploma (ND) and Higher National Diploma (HND) which are relevant to the needs, aspirations and development of the nation's diverse economy. It is with that hope, that such acquired training would lead to transformation of the country's economic and industrial development (Ibrahim, 2017; Oyewole, 2024). However, it seems that low lecturer productivity has made it difficult for the objectives to be met.

This statement was supported by Ayeni (2003) who revealed that the neglect of scientific and technical aspects of education have greatly affected the production of both middle and high level manpower vis-à-vis the industrial development in Nigeria. Therefore, the main expectation of lecturers engaged in polytechnic education should revolve around teaching, research, community service and project supervision which are the main indices for measuring lecturers productivity in Polytechnics. These indices of productivity appear to be under threat in the public polytechnics in Southwestern Nigeria in particular and Nigeria in general (Halilu & Wilson, 2018; Oyewole, 2024). Therefore, lecturers productivity can be attributed to funding of tertiary education in Nigeria. Funding is a crucial determinant of lecturers' productivity in public polytechnics, as it directly influences teaching quality, research output, and professional development. Adequate financial resources enable institutions to provide modern teaching facilities, research grants, competitive salaries, and training opportunities, all of which contribute to improved lecturer performance and student learning outcomes (Ogunode, 2020). According to Olatunji and Abayomi (2019) lack of financial investment in education results in outdated curricula, limited access to modern technology, and reduced lecturer engagement in research and innovation. In addition, inadequate funding affects lecturers' ability to attend conferences, publish scholarly work, and participate in capacity-building programmes, ultimately reducing their productivity (Adebayo, 2018).



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Funding is central and germane to success at all levels of education in order to achieve national transformation through the objectives of establishing various levels of education in Nigeria (Ayeni, 2007; Ayeni & Babalola, 2009; Oyewole, 2024). However, funding appears to be the major challenge of the education sector, most especially, higher education institutions of which polytechnic is one. According to Isah and Akinwumi (2016), the evolution of Tertiary Education Trust Fund (TETFund) seems to have significantly reduced the problems experienced by higher education in terms of infrastructure. In addition, Bamiro and Adedeji (2010) corroborated the claim that inadequate financing is one of the major challenges facing higher education institutions in Nigeria. In the same vein, Kayode and Adedeji (2015) revealed that higher education in Nigeria is facing multi-dimensional crises of which funding is the major one. In fact, being the backbone of education generally (primary, secondary and tertiary), it seems that sufficient fund has not been allocated to higher education in Nigeria, most especially, polytechnics. Ayeni and Omobude (2018) that the insensitivity of the government's budgetary allocation to education, which is inadequate when compared to other developing countries around the world, has also contributed to the low Gross Domestic Product (GDP) in the country.

A government that is committed to human development and economic growth is expected to invest in education. However, this is not the case in Nigeria, where education receives only 6.3 percent of annual budget in year 2021 (Ahmodu, Egbewole & Salaam, 2022). Obi and Onyewuchi (2019) revealed in their study, underfunding of Federal polytechnics in Nigeria and perceived impacts on administration. A quantitative research methodology was adopted to examine the Federal Polytechnic, Oko as a case study. The study revealed that polytechnic administrators at Oko require training on securing alternative resources. The study also identified administrative practices that help federal personnel, on broader scale, to function in an environment of financial uncertainty. Ojo (2011) revealed in the study Influence of Funding and Funding Utilization and Student Academic Performance in Public Universities in Nigeria. The survey adopted was selected through stratified sampling technique from three geo-political zones, namely South-West, North-Central and North-West. The study participants comprised key university administrator including Bursars, Directors of Academic Planning and Director of Students' Affairs of selected universities. Funding utilization in public universities on academic related matters had a positive but not significance relationship with students' academic performance; direct and indirect academic expenses and library as well as Information and Communication Technology (ICT) development expenses have direct relationship on students' academic performance. The combination of the predictors explains 17.6% of the total variance observed in the students' academic performance. The students' enrolment in public universities had significant negative relationship



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with their students' academic performance (Ojo, 2011). Dairo (2014) revealed that the amount of fund allocated to the higher education institutions yearly was not commensurate with the enrolment rate; there was no significant difference between class-size of Ibadan Polytechnic and that recommended by NBTE policy. Result also revealed that the manpower development undertaken through the institutions funds was either infinitesimal on nonexistent. Ugwumba (2019) revealed that commercial ventures, alumni fees and rates constituted the major sources of internally generated revenue to the Polytechnic. The money generated helped in the maintenance of facilities and purchase of fuel to power the generating plants of the polytechnic. It was also revealed that internally generated revenue of the polytechnic has not been fully developed to provide at least 10% of the fund required for the smooth running of the Polytechnic as advised by the government that every tertiary institution in the country should generate at least 15% of the fund required to run the School.

OyetaKin and Yahya (2017) revealed that there was negative and significant relationship between internally generated revenue and amount spent on infrastructural development ($r = 0.38, P < 0.05$). Ofoegbu and Alonge (2016) revealed that there was a significant relationship between internally generated resources and the management and development of universities in southern Nigeria. The study investigated only on indicator of funding. Therefore, there is need to consider other indicators of funding alongside training and job security as determinants of lecturers' productivity in polytechnics. Obi & Obi (2014) revealed that though a positive relationship subsists between education expenditure and economic growth, but a long run relationship does not exist over the period under study. The study observed that this puzzle is attributable to labour market distortions, redundancy of the work-force, industrial dispute and job discontinuities as well as leakages in the Nigerian society such as brain drain among others. In conclusion, the above study has shown that educational sector has not been productive as expected. This is evidenced by the poor quality of graduates and high rates of drop-outs.

Azi (2017) revealed that there is serious inadequate funding to universities. This affected the provision of academic staff offices, lecture halls for students, recruitment of appropriate lecturers and adequate ratio of teaching to non-teaching staff. This impacted negatively on the performance and productivity of various groups at the universities. The study did not consider other sources of funding that affect productivity of lecturers. Therefore, this study is intended to fill the identified gap by conducting the study in polytechnics. It appears that the effect of poor funding on quality of education in Nigeria is worrisome and this might have affected the quality of graduates produced by higher institutions in the country. According to Okebukola (2003), the over enrolment of poor quality students into satellite campuses and remedial programmes



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primarily to generate revenue from tuition fees may be linked to gross inadequacy of funding. In spite of the identification of funding as a key factor of meaningful management of education sector, most African countries including Nigeria have surprisingly not given significant attention to funding of education in the region.

Statement of the Problem

In public polytechnics across the South West, Nigeria, lecturer productivity is critical to the delivery of quality technical education. However, inadequate and inconsistent funding remains a persistent challenge, affecting essential aspects such as research opportunities, teaching resources, staff training, and conducive working environments. These funding gaps may hinder lecturers' ability to deliver effectively, engage in innovative practices, and contribute to institutional development. Despite policy efforts to improve tertiary education financing, there is limited empirical evidence on how funding levels influence lecturer productivity in this region. The gap necessitates a focused investigation to understand the extent and nature of the relationship between funding and lecturers productivity in public polytechnics in South West, Nigeria.

Objectives of the Resaerch

The objectives of the study were to:

1. determine the level of lecturer productivity in South West, Nigeria; and
2. examine the extent of adequate of funding in public polytechnics in South West, Nigeria.

Research Questions

The following research questions were answered to guide the study:

1. What is the level of lecturer productivity in public polytechnics in South West Nigeria?
2. To what extent is fundi.ng adequate in public polytechnics in South West, Nig.ria?

Methodology

This study adopted descriptive research design. The population of this study comprised the entire seventeen (17) public polytechnics in the six states in South West, Nigeria. The States are Ekiti, Lagos, Ogun, Ondo, Osun and Oyo States. A total of ten (10) polytechnics were made up the sample size. The study adopted the use of purposive sampling technique and proportional to size was used to select ten Bursars and Nine hundred and twenty three (923) lecturers as respondents for this study. In the first stage, four (4) states: Lagos, Ondo, Ogun, and Osun representing sixty percent (60%) of the six (6) states in South West Nigeria was selected for the study. Apart from sixty percent (60%) representation, the four states also have federal and state polytechnics. In the second stage, the four federal polytechnics were enumerated and non-proportional to size sampling technique was used to select six out of the eight polytechnics in the states, that is, two (2) polytechnics each were chosen from Lagos and Ondo states while three (3) polytechnics each were chosen from Ogun and Osun states. In the third stage, proportionate sampling technique



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was used to select seventeen percent (17%) of lecturers in the ten (10) polytechnics were used for data collection. Two research instruments were constructed for this study. The first instrument is a structured adapted questionnaire for lecturers titled ‘Lecturers Questionnaire on on Productivity’. The second instrument is a questionnaire for Bursar titled “Bursar’s Questionnaire on Funding of Polytechnic”. The data obtained from the field were analysed using descriptive statistics of frequency counts, simple percentages, mean and standard deviation for respondents’ demographic data and the research questions section of the instruments. The mean score of 2.5 was regarded as low and less true of the respondents while mean score above 2.5 was regarded as moderate and high.

Presentation of Results

The study investigated funding and productivity of lecturers in public Polytechnics in South West Nigeria. This aspect presents the results of findings. The research questions were answered with descriptive statistics of frequency count distribution, mean score and standard deviation.

Level of lecturer productivity in public polytechnics as Rated by Lecturers

Items	VH	H	M	NH	Mean	S.D
Teaching						
Attendance of lectures as and when due	307 (63.7)	109 (22.6)	33 (6.8)	33 (6.8)	3.43	0.891
Teaching in line with the content of the lecture plan	204 (42.3)	179 (37.1)	66 (13.7)	33 (6.8)	3.15	0.902
Teaching with appropriate teaching aids and/or device	234 (48.5)	149 (30.9)	33 (6.8)	66 (13.7)	3.14	0.841
Interest of students during lectures	209 (43.4)	174 (36.1)	66 (13.7)	33 (6.8)	3.16	0.906
Students are allowed to ask questions during and after lectures on the topic delivered	136 (28.2)	247 (51.2)	66 (13.7)	33 (6.8)	3.01	0.833
Students participation in lectures	203 (42.1)	170 (35.3)	76 (15.8)	33 (6.8)	3.13	0.916
Given attention to students during consultation time	20 (4.1)	120 (24.9)	182 (37.8)	160 (33.2)	2.00	0.865
Time allocated to teach course is inadequate to cover the syllabus.	40 (8.3)	100 (20.7)	189 (39.2)	153 (31.7)	2.06	0.925
Lecturers do extra teaching if it is necessary	170 (35.3)	117 (24.3)	119 (24.7)	76 (15.8)	2.79	0.901
Lecturers cover syllabus on the course(s) assigned to them before the commencement of end of semester examinations	150 (31.1)	200 (41.5)	66 (13.7)	66 (13.7)	2.90	0.994
AM= 2.68						
Project Supervision						
Students assigned to me for project supervision are given adequate attention.	300 (62.2)	73 (15.1)	76 (15.8)	33 (6.8)	3.33	0.974
My supervisees are allowed to consult me anytime they see me in office.	223 (46.3)	160 (33.2)	33 (6.8)	66 (13.7)	3.12	0.921
I am always available to attend to my supervisees.	94 (19.5)	182 (37.8)	173 (35.9)	33 (6.8)	2.70	0.860
My supervisees are given priority over my secondary assignment.	20 (4.1)	180 (37.3)	216 (44.8)	66 (13.7)	2.32	0.759



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I motivate my students to devote time to their study.	138 (28.6)	212 (44.0)	99 (20.5)	33 (6.8)	2.94	0.874
I help my supervisees to publish their work.	30 (6.2)	163 (33.8)	269 (55.8)	20 (4.1)	2.42	0.672
I establish benchmarks to be achieved by my supervisees without delay,	201 (41.7)	172 (35.7)	66 (13.7)	43 (8.9)	3.10	0.950
Average Mean=2.85						
Community Service						
As a member of staff of this Polytechnic, I participate in community service	127 (26.3)	195 (27.1)	63 (13.1)	97 (20.1)	2.73	0.903
I have participated in community improvement programmes as a member of this Polytechnic.	30 (6.2)	246 (51.0)	96 (19.9)	110 (22.8)	2.41	0.908
I am involved in offering training substitution and mobilization services to communities.	30 (6.2)	146 (30.3)	229 (47.5)	77 (16.0)	2.27	0.801
I am involved in promoting the civic duties of the community.	93 (19.3)	162 (33.6)	73 (15.1)	154 (32.0)	2.40	0.852
I am involved in collaboration with community for useful services.	73 (15.1)	202 (41.9)	96 (19.9)	111 (23.0)	2.49	0.832
As a member of staff I am involved in training the youth in community activities.	50 (10.4)	106 (22.0)	150 (31.1)	176 (36.5)	2.06	0.999

Average Mean = 2.34

Grand Mean=2.63

Note: Percentages in parentheses: Not High= 0-2.4; Moderate =2.5-3.0; High=3.1- 3.4; Very High=3.5 - 5.0

Based on research question one, lecturer productivity in public polytechnics in South West, Nigeria as rated by lecturers, this was revealed under three indicators, and these are teaching, community service and project supervision. The average mean of teaching as an indicator of level of lecturer productivity in public polytechnics was given as 2.68, which implies that the respondents submitted it was moderate. On project supervision: The average mean of community service as an indicator of level of lecturer productivity in public polytechnics was given as 2.34, which implies that the respondents submitted that community service was not high in public polytechnics in Southwestern Nigeria.

The result showed that lecturer attitude to students and their assistance in publishing the supervisees' project was low.

Level of Lecturer Productivity in Public Polytechnics as Reflected in Research and Publication

RESEARCH ACTIVITIES	No of Publications				
	0	1 – 3	4 – 6	7 – 9	Above 10
Articles published within a year.	10 (2.1)	386 (80.1)	86 (17.8)	– (0.0)	– (0.0)
Group research work carried out with other lecturers within the department.	30 (6.2)	309 (64.1)	110 (22.9)	33 (6.8)	– (0.0)
Research done with other members of academic staff within the faculty.	146 (30.3)	303 (62.9)	33 (6.8)	– (0.0)	– (0.0)



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Research conducted and published with other members of academic staff within the polytechnic.	126 (26.1)	257 (53.4)	99 (20.5)	– (0.0)	– (0.0)
Research carried out with lecturers from other institutions.	54 (11.2)	275 (57.1)	43 (8.9)	110 (22.8)	– (0.0)
Papers published in local journals.	50 (10.4)	279 (57.9)	120 (24.9)	33 (6.8)	– (0.0)
Articles published in international journals.	126 (26.1)	160 (33.2)	142 (29.6)	44 (9.1)	10 (2.1)
Textbooks authored.	289 (60.0)	193 (40.0)	– (0.0)	– (0.0)	– (0.0)
Local books authored.	296 (61.4)	186 (38.6)	– (0.0)	– (0.0)	– (0.0)
Foreign books authored.	482 (100.0)	– (0.0)	– (0.0)	– (0.0)	– (0.0)
Conference papers Published	128 (26.6)	100 (20.7)	118 (24.5)	90 (18.7)	46 (9.5)
Books reviewed.	406 (84.2)	76 (15.8)	– (0.0)	– (0.0)	– (0.0)
Chapters in books Published	363 (75.3)	119 (24.7)	– (0.0)	– (0.0)	– (0.0)

moreover, the level of lecturer productivity in public polytechnics as reflected in research and publication of the lecturers. Ten (10) representing 2.1% of 482 lecturers did not published any article within a year, three hundred and eighty-six (386) representing 80.1% published 1-3 articles within a year, while eighty-six (86) representing 17.8% of the lecturers published 4-6 articles within a year. Thirty (30) representing 6.2% of 482 lecturers did not publish in group research within the department, three hundred and nine (309) representing 64.1% published 1-3 articles within a year, one hundred and ten (110) representing 22.9% of the lecturers published 4-6, while thirty-three (33) representing 6.8% of the lecturers published 7-9 published in group research work carried out with other lecturers within the department. One hundred and forty-six (146) representing 30.3% of 482 lecturers did not publish any article with colleagues in the faculty, three hundred and three (303) representing 62.9% published 1-3 articles within a year, while ninety-nine (99) representing 20.5% of the lecturers published 4-6 Research done with other members of academic staff within the faculty. One hundred and twenty-six (126) representing 26.1% of 482 lecturers did not publish with other members of academic staff within the faculty, two hundred and fifty-seven (257) representing 53.4% published 1-3 articles within a year, while ninety-nine (99) representing 20.5% of the lecturers published 4-6 in papers with other members of academic staff within the polytechnic. Fifty-four (54) representing 11.2% of 482 lecturers did not carry out research lecturers from other institutions, two hundred and seventy-five (275) representing 57.1% published 1-3 articles within a year, forty-three (43) representing 22.9% of the lecturers published 4-6, while one hundred and ten (110) representing 22.8% of the lecturers published 7-9 conducted research with lecturers from other institutions.



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Fifty (50) representing 10.4% of 482 lecturers did not publish papers in local journal, two hundred and seventy-nine (279) representing 57.9% published 1-3 articles, one hundred and twenty (120) representing 24.9% of the lecturers published 4-6, while thirty-three (33) representing 6.8% of the lecturers published 7-9 papers in local journals. One hundred and twenty-six (126) representing 26.1% of 482 lecturers did not publish papers in international journal, one hundred and sixty (160) representing 33.2% published 1-3 articles, one hundred and forty-two (142) representing 29.6% of the lecturers published 4-6, while forty-four (44) representing 6.8% of the lecturers published 7-9 papers in international journals. Two hundred and eighty-nine (289) representing 60.0% of 482 lecturers did not publish in textbook authorised, one hundred and ninety-three (193) representing 40.0% published 1-3 in textbook authored Two hundred and ninety-six (296) representing 61.4% of 482 lecturers did not publish local books authored, one hundred and eighty-six (186) representing 38.6% published 1-3 in local books authored. Four hundred and eighty-two (482) representing (100.0%) of 482 lecturers did not author foreign books.

One hundred and twenty-eight (128) representing 26.6% of 482 lecturers did not publish conference papers, one hundred (100) representing 20.7% reviewed 1-3 books, one hundred and eighteen (118) representing 24.5% of the lecturers reviewed 4-6 books, ninety (90) representing 18.7% of the lecturers reviewed 7-9 books, while ten (10) representing 2.1% of the lecturers reviewed books. Three hundred and sixty-three (363) representing 75.3% of 482 lecturers did not have chapters in book, while one hundred and nineteen (119) representing 24.7% of lecturers have 1-3 chapters in books.

Extent of Fund Adequacy in Public Polytechnics in South West, Nigeria

Items	VHE	HE	LE	NE	Mean	S.D
Subvention						
The polytechnic relies on budgetary allocations from government to run its affair	2 (50.0)	2 (50.0)	– (0.0)	– (0.0)	3.50	0.577
Budgetary allocations to this polytechnic are adequate to cater for welfare of lecturers.	1 (25.0)	– (0.0)	2 (50.0)	1 (25.0)	2.25	0.528
Budgetary allocations are equally distributed among the lecturers in terms of salaries and fringe benefits.	1 (25.0)	1 (25.0)	1 (25.0)	– (0.0)	2.75	0.957



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Budgetary allocations are approved as requested to provide infrastructural facilities for lecturers and other members of staff in the polytechnic.	– (0.0)	3 (75.0)	1 (25.0)	– (0.0)	2.75	0.500
Budgetary allocations are implemented as approved by the government for the polytechnic.	– (0.0)	3 (75.0)	1 (25.0)	– (0.0)	2.75	0.500
AM =2.8						
Sources of IGR						
Recurrent grants from NBTE/State Government (Main, Research Library)	– (0.0)	1 (25.0)	– (0.0)	3 (75.0)	1.50	0.841
Research Grants	1 (25.0)	1 (25.0)	2 (50.0)	– (0.0)	2.75	0.957
Student fees	2 (50.0)	1 (25.0)	– (0.0)	1 (25.0)	3.00	0.414
Investment income	– (0.0)	– (0.0)	1 (25.0)	3 (75.0)	1.25	0.500
Gifts (Endowment and donation)	– (0.0)	– (0.0)	2 (50.0)	2 (50.0)	1.50	0.577
Other incomes	– (0.0)	1 (25.0)	1 (25.0)	2 (50.0)	1.75	0.957
AM=1.96						
Uses of IGR						
Recurrent grant from NBTE	– (0.0)	– (0.0)	1 (25.0)	3 (75.0)	1.25	0.500
Research Grants	2 (50.0)	– (0.0)	2 (50.0)	– (0.0)	3.00	0.841
Recurrent grant from Federal/State Government	3 (75.0)	– (0.0)	– (0.0)	1 (25.0)	3.25	0.612
Student fees	2 (50.0)	1 (25.0)	– (0.0)	1 (25.0)	3.00	0.414
Investment income	– (0.0)	– (0.0)	2 (50.0)	2 (50.0)	1.50	0.577
Gifts (Endowment and donations)	– (0.0)	– (0.0)	3 (75.0)	1 (25.0)	1.75	0.500
External Grants	1 (25.0)	– (0.0)	2 (50.0)	1 (25.0)	2.25	0.582
Other incomes	– (0.0)	1 (25.0)	2 (50.0)	1 (25.0)	2.00	0.816
Average Mean=2.25						



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**Extent of
 Payment of
 Fringe Benefit**

Large scale commercial farming and animal breeding.	– (0.0)	1 (25.0)	2 (50.0)	1 (25.0)	2.00	0.816
Agriculture and food processing Bakeries	– (0.0)	– (0.0)	2 (50.0)	2 (50.0)	1.50	0.577
Bookshops	– (0.0)	– (0.0)	2 (50.0)	2 (50.0)	1.50	0.577
Guest houses	– (0.0)	– (0.0)	2 (50.0)	2 (50.0)	1.50	0.577
Hotels	– (0.0)	– (0.0)	1 (25.0)	3 (75.0)	1.25	0.500

Average Mean = 1.54
Grand Mean=2.14

Note: Percentages in parentheses

Key: VHE= Very High Extent; He=High Extent; LE= Low Extent; NE= No Extent

Note: Mean response ranges from Note: No Extent= 0 -2.4; Low Extent =2.5-3.0; High Extent=3.1- 3.4; Very High Extent=3.5 - 5.0

RQ 2: To what extent is funding adequate in public polytechnics in Southwestern Nigeria? Based on research question two, extent of fund adequacy in public polytechnics in Southwestern Nigeria as rated by bursars, this was revealed under four indicators, and these are subvention, sources of Internally Generated Revenue (IGR), uses of Internally Generated Revenue (IGR), payment of fringe benefit. On the subvention, the average mean of subvention as an indicator of funding in public polytechnics was given as 2.80, which implies that the respondents submitted that the extent of fund adequacy in federal polytechnics was low extent. On the sources of IGR, the following were revealed: Recurrent grant from NBTE (\bar{x} =1.50); Research Grants (\bar{x} =2.75); Student fees (\bar{x} =3.00); Investment income (\bar{x} =1.25); Gifts (Endowment and donation) (\bar{x} =1.50). Other incomes (\bar{x} =1.75). The average mean of sources of IGR as an indicator of funding in public polytechnics was given as 1.96, which implies that the respondents submitted that there was no extent adequacy in the adequacy of fund in federal polytechnics in Southwestern Nigeria. On the uses of IGR, the following were revealed: Recurrent grants from NBTE/State Government (Main, Research Library) (\bar{x} =1.25); Research Grants (\bar{x} =3.00); Recurrent grant from Federal/State Government (\bar{x} =3.25); Student fees (\bar{x} =3.00); On the extent of payment of fringe benefits, the average mean of sources of IGR as an indicator of funding in public polytechnics was given as 1.54, which implies that the respondents submitted that there was no extent in the payment of fringe benefits to lecturers in public polytechnics in Southwestern



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Nigeria. On the extent of payment of fringe benefits, the average mean of sources of IGR as an indicator of funding in public polytechnics was given as 1.78, which implies that the respondents submitted that there was no extent.

Discussion of Research Questions Findings

Lecturer productivity in public polytechnics in Southwestern Nigeria

The finding of this study was in line with the report of the previous studies of Halilu and Wilson (2018) on productivity of academic staff in polytechnics in North West Geo- Political Zone in Nigeria that productivity of lecturers was low. Also, this finding corroborates the findings of Abba, Anumaka and Gaito (2016) on leadership practices and productivity of academic staff in polytechnics in Nigeria. The results of the findings showed that the two leadership practices explained 3.8% of the variation in lecturer productivity.

Extent of funding Adequate in Public Polytechnics in Southwestern Nigeria

The finding of this study corroborates the submission of Obi and Onyewuchi (2019) in their study, underfunding of federal polytechnics in Nigeria and perceived impact on administration. Based on their findings, the budgetary allocation to education in Nigeria was low (0.8%) when compared with other countries in Africa. Also the finding of this study supports the finding of Ojo (2011) as revealed in the study, influence of funding and funding utilization and students' academic performance in public universities in Nigeria. The study revealed that the mode of funding Nigeria's public universities like other tertiary institution (such as polytechnics and others) were majorly through government allocation (80%), while IGR and others accounted for 20%. The result of this study was also in line with the finding of Ugwumba (2019) who investigated into identification of sources and utilisation of IGR by Nigerian polytechnics. The result revealed that commercial ventures, alumni fees and rates constituted the major sources of IGR to the polytechnics; although, IGR as the alternative sources of IGR was low in this study. Also the finding of this study was against the findings of Oyetakin and Yahya (2017) who investigated analysis of Internally Generated Revenue (IGR) and infrastructural development in public tertiary institutions in Ondo State. The finding of this study supports the finding of Ofoegbu and Alonge (2016) which revealed that commercial venture were among the main sources of IGR while money generated from these businesses was used to cater for welfare of staff and maintenance of campus facilities. Also, the finding of this study was in supports of the finding of Obi and Obi (2014) who revealed that poor budgetary allocation had resulted into labour market distortions, redundancy of the workforce, industrial dispute and job discontinuity which arose of brain drain as well as poor quality of graduates and high rate of drop-outs. The finding of this study also supported the finding of Azi (2017) that there is gross inadequate funding of higher institutions and this affect provision of offices for the staff, lecture halls for students and employment of more lecturers.



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Conclusion

The fund allocated to public polytechnics in Southwestern Nigeria was inadequate based on the results of the findings, apart from the budgetary allocation to public polytechnic polytechnics that was low and Internally Generated Revenue (IGR) by these polytechnics was also not adequate. This inadequate funding had resulted to low productivity of lecturers in the public polytechnics in Southwestern Nigeria. Despite the fact that Tertiary Education Trust Fund (TETFund) has been the major agency that is catering for the needs of the public polytechnics in Nigeria, however, it was evidenced in this research that government and other stakeholders in education sector and other sectors of the Nigerian economy have not been giving proper attention required to polytechnic education in Nigeria at large. Looking at our Higer Education Institutions in Nigeria, one would notice that majority of buildings and other infrastructure apart from road network are provided by TETFund including staff development.

Recommendations

Based on the findings of the study, the following recommendations are made: Governments at federal and state levels should increase the budgetary allocations/subventions to public polytechnics in Southwestern Nigeria. Similarly, management of public polytechnics should endeavour to increase sources of the internally generated revenue (IGR) of public polytechnics. State governments should support the TETFund in providing basic infrastructural facilities to their own and financed polytechnics. Emphasis should not be on payment of salaries and other allowances alone. State government should priortise polytechnic education by given special attention to their finances in the annual budgets. Research grants should be given to lecturers in public polytechnics, in order for them to be more productive in the area of teaching and research.

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EVALUATION OF WEED MANAGEMENT PRACTICES OF UPLAND RICE IN SOUTHERN GUINEA SAVANNA AREA OF NIGERIA

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Abstract

Field experiment was conducted on a farmer's field in 2024 rainy seasons at Badeggi, Nigeria to study the comparative effects of different weed management on growth and yield performance of upland rice in the Southern guinea savanna. The treatments consisted of four early maturing upland rice varieties (NERICA 1, 2, 4, 7) and four weed management practices. The parameters measured were plant height (cm), number of tillers and grain yield (kg ha⁻¹). Treatment means were separated using the least significant difference (LSD) at $P \leq 0.05$. The result on plant height at 9 WAS indicated that NERICA 4 produced the tallest plants while the application of PE Butachlor + POE Orizoplus gave the tallest plant at 9 WAS. Result of number of tillers (m²) indicated that at harvest the variety NERICA 4 produced the highest number of tillers (m²) among the other rice varieties. The result on grain yield (kg ha⁻¹) among the varieties indicated that NERICA 7 had the highest grain yield of 1534.7 kg ha⁻¹ while on weed management the application of PE Butachlor + POE Orizo plus gave the highest grain yield of 1373.49 kg ha⁻¹ while weedy check gave the lowest yield of 1178.1 kg ha⁻¹. Based on this study, it is concluded, that the application of PE Butachlor + POE Orizoplus produced the highest grain yield. It is recommended that farmers in this agro-ecological zone of Nigeria should adopt the variety NERICA 1 and the application of PE Butachlor + POE Orizoplus for suppressed weed growth and development, enhanced growth, and yield of upland rice.

Keywords: NERICA, Badeggi, Orizoplus

Introduction

Rice (*Oryza sativa* L.) is a crop of global importance in West Africa accounting for 64.2 % and 61.9 % of the total rice production and consumption in Sub Sahara Africa, respectively (Norhidayati *et al.*, 2015). In Nigeria, it is a major staple food widely consumed in all the geopolitical zones and socioeconomic classes International Institute of Tropical Agriculture (IITA, 2020). In West Africa Nigeria is the highest producer of the crop with an average of 8 million metric tons. As of 2019, Nigeria ranked the 14th largest producer in the world with China being the top producing country (Thrive Agric, 2020). As of 2019 Africa had a total production volume of 14.6 million out of which Nigeria produced about 55 % and Egypt produced about 30 % (Thrive Agric, 2020). In Nigeria the demand for rice is equally growing faster with the consumption broadening across all socio-economic classes, including the poor, such that rice is no longer seen as a luxury food (Bamidele *et al.*, 2010). This soaring rise in rice demand and consumption in Nigeria dates back to mid-1970s. A combination of various factors has been reported to have been responsible for this increase. Among the proffered reasons is urbanization which appears to be the most important cause of the shift in consumers' preference for rice in Nigeria (Akpokoje *et al.*, 2001; Akpokoje *et al.*, 2002). Other factors include, increase in population growth, increase in income level and associated changes in family



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occupational structures (Osiname, 2002). Although, the demand for rice in preference to other cereals has increased in recent years, production is still on a relatively small scale (Akande, 2001; PCU 2001; Olaleye *et al.*, 2008). A study conducted by Ismaila *et al.*, 2013 unveil that weeds are at present the most important biotic constraints affecting increased rice production in the world. He further explain that the major impediment in the cultivation of rice is heavy weeds infestation particularly in upland ecology, by competing with the crop to such extent that it could get smothered. This is why the use of herbicide in rice production becomes a necessity. This study is to evaluate weed management practices on NERICA rice varieties.

Materials and Methods

Description of Experimental Site

The experiment was carried out in a farmer's field, near National Cereals Research Institute (NCRI), Badeggi (Lat. 9° 45N, Long. 6° 07E; 70.5 m above sea level), located in the Southern Guinea savanna of Nigeria. The field trial was conducted during the rainy seasons of 2024. GPS machine was used to determine the exact location of the experimental site

Soil Sampling and Analysis

Soil samples were collected diagonally from five spots using alderman auger before sowing and mixed to form one composite sample and analyzed for some physical and chemical properties particularly organic N, total N, soil pH, available phosphorus and textural classes using routine chemical analysis as described by Carter (1993). The hydrometer method was used to determine the particle size distribution (Abideen *et al.*, 2020). The pH of the soil samples was determined using electronic pH meter (PCE- 228) in water –soil solution(1:1), while the organic carbon content of the soil were determined using Walkley and Black method and then multiply by 1.724 to calculate soil organic matter content (Ajon and Anjembe, 2018) . Total nitrogen and phosphorus were determined by micro-kjeldhal digestion –distillation methods (Abideen *et al.*, 2020) and electro photometer method (Ajon and Anjembe 2018). The exchangeable cation was extracted using 1M ammonium acetate solution. Ca and Mg were analyzed from the extract by EDTA titration method, while K and Na were done by flame photometer (AAS, MEDTECH) (Abideen *et al.*, 2020).

Treatments and Experimental Design

The treatments were laid out in a spilt plot design of four early maturing upland rice varieties: NERICA 1, 2, 4, 7 and four weed management practices: weedy check, pre emergence (PE) application of butachlor at 2.0 kg a.i ha⁻¹ followed by hoe weeding (HW) weeks after sowing (WAS), 2 HW at 3 and 6 WAS, post emergence (POE) propanil ha⁻¹ plus 2,4-D at ha⁻¹ (Orizo Plus, Proficol Calle, Baranquilla, Colombia) at the rate of 3.5 kg a.i. ha⁻¹ at 6 WAS and arranged as a split plot in a randomized complete block design and replicated three times . The main plot treatments were the combination weed management practices and sub-plot treatments was the upland rice varieties. Gross plot size was 3 m x 4 m (12 m²) consisting of 15 rows of 4 m long each, while net plot size was 1.5 m x 4 m (6 m²) consisting of 5 rows of 4 m long. An alley of 1.0 m was left between the treatments and replications.

Data Analysis

Data collected from the study was subjected to analysis of variance (ANOVA) using Statistical Analysis System (SAS) package version 9.0 (2002). Treatment means were separated using the least significant difference (LSD) at P≤ 0.05.

Results and Discussions



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Plant Height

Results on plant height is shown in table 1. Plant height at 3 WAS indicated that NERICA 1 produced the tallest plants of 28.9 cm while NERICA 2 produced the shortest plants of 25.8 cm. application of PE Butachlor + POE orizoplus at 3 WAS produced the tallest plants of 27.6 cm while weedy check at 3 WAS produced the shortest plants. At 6 WAS NERICA 7 produced tallest plants while NERICA 2 produced the shortest plants. On weed management application of PE Butachlor + 1 HW produced the tallest plants of 63.9 cm. Weed management practices at 6 WAS, weedy check and PE Butachlor + POE Orizoplus had similar results which were recorded as the treatment that produced the shortest plants 61.6 cm. At 9 WAS NERICA 4 recorded the tallest plants (106.1 cm) while NERICA 2 produced the shortest plants (96.1cm). on weed management, PE Butachlor + POE orizoplus produced the tallest plants (104.5 cm) while application of weedy check produced the shortest plants 93.1 cm. The variation in plant height among the rice varieties could be due to the varieties showing differences in genetic traits and differences in response to environmental conditions.

Table 1: Evaluation of Weed Management Practices on Plant Height of Upland Rice in the Southern Guinea Savanna in 2024 rainy season

Treatment	3 WAS	6 WAS	9 WAS
Varieties (V)			
NERICA 1	28.9	62.0	99.2
NERICA 2	25.6	61.5	96.1
NERICA 4	25.8	62.0	106.1
NERICA 7	26.4	64.2	97.9
LSD (0.05)	1.86	4.84	6.75
Weed management (M)			
Weedy check	26.0	61.6	93.1
2 HW at (3 + 6 WAS)	26.9	62.7	99.3
PE Butachlor + 1HW	26.2	63.9	102.4
PE Butachlor + POE Orizoplus	27.6	61.6	104.5
LSD (0.05)	1.86	4.84	6.75

Number of Tillers (m²)

The result on the evaluation of weed management practices on number of tillers of upland rice in the Southern Guinea Savanna is shown in table 2. At 3 WAS results indicated that NERICA 1, NERICA 4 and NERICA 7 all had similar values for the number of tillers (18.0) thereby producing the highest number of tillers while NERICA 2 produced the least number of tillers of 7.0. results on weed management shows that 2 HW at (3 + 6 WAS), PE Butachlor + 1 HW, PE Butalchor + POE orizoplus had similar values and produced the highest number of tillers (8.0) while weedy check produced the least number of tillers. At 6 WAS all the varieties shared similar results on the number of tillers of 9.0 while the application of PE Butachlor with 1 HW gave the highest number of tillers while weedy check gave the least number of tillers of 8.0. Results on 9 WAS indicated that NERICA 4 produced the most number of tillers 21.0 while NERICA 2 produced the least number of tillers. Results on weed management indicated that weedy check produced the least number of tillers while all other weed management treatment shared the same value which produced the highest number of tillers 17.0 Higher tiller production is a major characteristic of NERICA 4. The result is in conformity with

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the findings of Ghanem *et al.* (1994) who also observed significant differences in number of fertile tiller per unit area among different varieties.

Table 2: Evaluation of Weed Management Practices on Number of tillers of Upland Rice in the Southern Guinea Savanna in 2024 rainy season

Treatment	3 WAS	6 WAS	9 WAS
Varieties (V)			
NERICA 1	8.0	9.0	18.0
NERICA 2	7.0	9.0	11.0
NERICA 4	8.0	9.0	21.0
NERICA 7	8.0	9.0	18.0
LSD (0.05)	0.96	1.20	1.58
Weed management (M)			
Weedy check	7.0	8.0	16.0
2 HW at (3 + 6 WAS)	8.0	9.0	17.0
PE Butachlor + 1HW	8.0	10.0	17.0
PE Butachlor + POE	8.0	9.0	17.0
Orizoplus			
LSD (0.05)	0.96	1.20	1.58

HW = Hoe weeding

Grain Yield

Result on grain yield is shown on table 3. Variety NERICA 1 produced the highest grain yield of 1534.7 kg ha⁻¹ while NERICA 4 has the lowest grain yield of 969.7 kg ha⁻¹. Result on weed management has shown that the application of PE Butachlor + POE Orizoplus gave the highest grain yield of 1367.56 kg ha⁻¹ while weedy check gave the lowest yield of 1178.12 kg ha⁻¹. The variation in grain yield among the varieties is a function of interaction among yield components that were affected differently by the growing conditions and crop management practices. Similar results were reported by Tahir *et al* (1995) who also observed significant differences in the grain yield among different varieties.

Table 3: Evaluation of Weed Management Practices on Grain yield (kg ha⁻¹) of Upland Rice in the Southern Guinea Savanna in 2024 rainy season

Treatment	Grain yield (kg ha ⁻¹)
Varieties (V)	
NERICA 1	1534.7
NERICA 2	1273.1
NERICA 4	969.7
NERICA 7	1439.8
LSD (0.05)	174.83
Weed management (M)	
Weedy check	1178.12
2 HW at (3 + 6 WAS)	1298.18
PE Butachlor + 1HW	1367.56
PE Butachlor + POE Orizoplus	1373.49
LSD (0.05)	174.83

HW = Hoe weeding



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Conclusion and Recommendation

From this study it can be concluded that the variety NERICA 1 gave the highest grain yield per hectare and the application of pre-emergence (PE) application of Butachlor at 2.0 kg a.i + POE orizoplus gave the highest grain yield. The above conclusion is therefore recommended for farmers and further field experiment can be conducted in another agro-ecological zones of Nigeria.

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Artificial Intelligence for inclusive Education in ... Samuel, N., Et. al. (2025)

Artificial Intelligence for Inclusive Education in Nigeria: Systemic Challenges and Bridging the 21st Century Digital Divide

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Abstract

Nigeria's education sector is constrained by entrenched systemic challenges that impede progress toward equity, efficiency, and digital inclusion. These challenges range from inadequate infrastructure, weak digital governance, and teacher shortages to deeply rooted inequities - disproportionately affect marginalized and underserved populations. While Artificial Intelligence (AI) is increasingly leveraged globally to deliver inclusive, adaptive, and personalized education, its adoption in Nigeria remains fragmented and underdeveloped. This study critically explores AI's transformative potential within the Nigerian context, framing inclusivity not merely as access, but as the integration of cultural relevance, learner personalization, and equity-driven pedagogy. Emphasis is placed on rural and underserved areas where the digital divide is most pronounced. The paper examines strategic points for AI deployment during periods of educational reform or recovery, the roles of key stakeholders (students, teachers, administrators, and policymakers) and the ethical imperatives of context-sensitive integration. Core barriers identified include low digital literacy, infrastructural deficits, inconsistent policy frameworks, and gaps in data governance. In response, the study proposes a context-aware roadmap anchored in global best practices and local innovation, highlighting principles of equitable access, systemic transformation, and sustainable governance. It concludes that AI, when strategically implemented, represents not a distant aspiration but an immediate, viable instrument for closing Nigeria's educational divide and driving inclusive transformation in the 21st century.

Keyword: Inclusive Education, Technology, Digital Pedagogy & Localized AI Content

Introduction

Nigeria's educational landscape continues to grapple with entrenched systemic barriers that undermine efforts toward achieving equity, operational efficiency, and inclusive digital learning. Despite significant educational policy reforms, Nigeria still records the highest number of out-of-school children globally, estimated at over 20 million as of 2023 (UNESCO, 2023; Guardian Nigeria, 2024). Even for children who are enrolled and regularly attend school, learning outcomes remain alarmingly low, as reflected in persistent gaps in instructional quality, curriculum relevance, and resource availability. Studies show that more than 70% of Nigerian children cannot read and



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understand a simple sentence by age ten, which is a stark reflection of persistent learning poverty (World Bank, 2022; Guardian Nigeria, 2024). These inequities are compounded by structural inefficiencies across the system, ranging from insufficient funding, digital resource gaps decaying infrastructure and poor teacher training to governance deficits (Phillips Consulting, 2022; Okonkwo & Agbatogun, 2023). Many rural schools still lack basic electricity or internet access, making it nearly impossible to integrate modern learning technologies such as Artificial Intelligence (AI). The national teacher-student ratio remains critically high in many regions reaching as much as 1:70 while educational quality suffers due to a lack of culturally relevant instructional materials and limited continuous teacher professional development (Olayemi & Ogunyemi, 2021). In the face of these challenges, AI has emerged globally as a potentially transformative force in education. The technology promises language translation, personalized learning pathways, real-time feedback, early learner diagnostics and adaptive content delivery (Luckin et al., 2016; Holmes et al., 2019). In developed countries contexts, AI-powered tools have already been used to reduce administrative burdens, improve student engagement and outcomes and support learners with disabilities. Studies show that AI tutoring systems can accelerate learning by 2 - 3 times compared to traditional methods (World Bank, 2023; Zawacki-Richter et al., 2019). However, AI integration in Nigeria is just at the developmental stage and uneven; thereby facilitating some private EdTech companies like Edves and uLesson leveraging AI to deliver interactive content to millions of learners (Guardian Nigeria, 2024). Subsequently, most public education institutions are far behind in infrastructure provision, technical training and digital culture. This drawback reflects broader systemic dysfunctions: unclear ethical governance, low teacher readiness, limited national strategies for AI in education and inadequate indigenous software localization (Adewale & Oduwole, 2024; Olubiya, 2022).

The discourse on AI and education in Nigeria reveals several critical research gaps. Studies conducted revealed that there is a marked inadequate of empirical research on the real-world effectiveness of AI tools in the Nigerian context. The existing pilot studies such as the World Bank sponsored revealed the prevalence of AI-enhanced learning in low-income communities; few numbers of peer-reviewed evaluations explore outcomes at scale, particularly for marginalized learners (Adigun & Folorunso, 2023). Teacher preparedness towards integration and adoption of AI in facilitating pedagogic experiences seemed critically low. Findings from a study conducted by Okonkwo and Agbatogun (2023) shows that the pre-service teachers report low technological self-efficacy and limited exposure to AI-based instruction. The findings further revealed effort expectancy and insufficient institutional support are the major constructs acting as the key barriers to AI adoption in Nigeria. Subsequently, Ojo and Salawu (2022) attests that majority of AI learning tools are developed for foreign educational systems and fail to consider curriculum standards, local linguistic diversity, and pedagogical styles. This lack of contextual adaptation hinders effective uptake in Nigeria, especially in multilingual and under-resourced classrooms (Ojo & Salawu, 2022). The absence of regulatory frameworks and robust policy is another noteworthy void towards integration and adoption of AI in Nigeria. Nigeria currently lacks clear national roadmap for AI deployment in education and issues such as data privacy, algorithmic bias, and equitable access are major gray areas that are underexplored in policy discourse (Adefolu & Ezeani, 2023). Moreover, the digital divide continues to widen educational inequality, especially among rural and conflict-affected regions. Also, gender disparities are particularly pronounced as females in northern region of Nigeria face disproportionately low access to both formal schooling and digital resources, a fact corroborated by empirical reviews on female education and digital equity in Sub-Saharan Africa (UNESCO, 2022; Wikipedia, 2024). Students with disabilities are largely excluded from AI-driven educational

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interventions, thereby highlighting crucial need for inclusive design and universal access standards (Okeowo & Omoniyi, 2022). Based on these contextualized premise, these gaps call for a reimagined approach to AI integration that is not merely technologically driven but been informed by Nigeria’s socio-cultural, economic, and policy realities. There is a pressing need for grounded, context-sensitive research that examines what inclusivity truly means within the Nigerian educational context; identifies where the digital divide is most pronounced; determines when AI deployment can be both strategic and sustainable; clarifies who the key actors are in implementing inclusive AI systems; and explores how such systems can be ethically and effectively embedded within public education (Holmes et al., 2022; World Bank, 2023). This paper addresses these interlocking concerns by offering a systems-level analysis of how AI can be ethically and strategically deployed to overcome long-standing educational inequities in Nigeria. Through a multidimensional framework, it proposes an inclusive AI roadmap will designed not only to bridge the digital divide but also confront the underlying system fragilities that have, for decades, constrained educational advancement across the country. Figure 1 shows the proposed conceptual framework for inclusive AI integration in Nigerian education system.

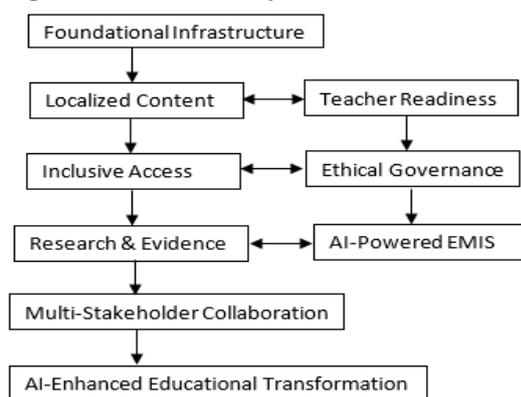


Fig. 1: Proposed Conceptual Framework for Inclusive AI Integration in Nigerian Education

Figure 1 depicts a proposed conceptual framework for inclusive AI integration in Nigerian education, which outlines a systemic and context-sensitive pathway for embedding artificial intelligence into the national education system. It recognizes the interconnectedness of infrastructure, governance, content, and collaboration in ensuring equitable and sustainable AI adoption. At the foundation of the framework is Foundational Infrastructure, which supports the localization of educational content and the development of teacher readiness. These foundational elements enable Inclusive Access and demand Ethical Governance, which together feed into the establishment of AI-Powered EMIS (Education Management Information Systems). Simultaneously, the framework highlights the centrality of Research and Evidence and the necessity of Multi-Stakeholder Collaboration including educators, policymakers, technologists, and communities. These components collectively contribute to AI-Enhanced Educational Transformation, the ultimate goal of the framework. This model emphasizes that AI integration must be inclusive, ethically guided, research-informed, and built on a foundation of robust infrastructure and local relevance.

Key Components and Their Synergistic Relationships

Foundational Infrastructure: This component comprises key subcomponents such as device access, internet connectivity, electricity and platform availability. Together, they form the bedrock upon which AI tools and systems can operate effectively in education. Without this foundational



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layer, the deployment and functionality of AI particularly in rural and marginalized areas remain impractical or severely limited. The significance of foundational infrastructure is underscored by national efforts like Nigeria's National Broadband Plan and the Rural Electrification Agency (REA) initiatives, which aim to expand digital and energy access to underserved communities (NCC, 2022).

Localized and Culturally Relevant AI Content: This component includes critical subcomponents such as curriculum alignment, language diversity (including indigenous languages like Yoruba, Hausa, and Igbo), and cultural relevance. The inclusion of localized contents will ensure that AI tools are contextually responsive, thereby engaging learners meaningfully across Nigeria's diverse socio-cultural landscapes. By enhancing cognitive accessibility and maintaining curriculum fidelity, localized AI-powered educational tools will improve learning outcomes. This synergy is evident in partnerships between EdTech startups like uLesson and Gradely and public education stakeholders, which have successfully tailored digital content to meet the needs of Nigerian learners (Ojo & Salawu, 2022).

Teacher Digital Capacity and Pedagogical Readiness: This dimension comprises pre-service and in-service AI training, digital pedagogy development, and building teacher confidence in technology integration. As frontline enablers of AI adoption, teachers play a pivotal role in determining how effectively AI tools are leveraged for instruction, learner engagement, and assessment. Teachers' digital competence directly affects classroom innovation and the scalability of AI solutions in education. This component is being operationalized through institutions such as the Teachers Registration Council of Nigeria (TRCN), National Teachers' Institute (NTI), Colleges of Education and Universities of Education, which are central to teacher professional development (Olayemi & Ogunyemi, 2021; Adigun & Folorunso, 2023).

Inclusive and Equitable Access: this component will address gender equity, disability inclusion, support for conflict-affected zones and rural outreach; thereby ensuring that no learner is left behind in AI-driven educational reforms. Inclusive and equitable access will promote social justice by leveraging assistive AI technologies such as text-to-speech tools, implementing gender-sensitive designs and deploying zero-rated educational platforms to reduce digital marginalization. By bridging access gaps, this pillar will enhance both equity and learning outcomes for vulnerable populations. It will strategically align with UNESCO's digital inclusion principles and national equity policies (Okeowo & Omoniyi, 2022; UNESCO, 2022).

Ethical Governance and Data Protection: this component will encompass algorithmic fairness, child data privacy, informed consent protocols, and anti-surveillance safeguards forming the ethical backbone of AI deployment in education. It will ensure that the rights, dignity, and agency of learners are protected in a data-driven ecosystem. By fostering trust, transparency, and accountability, it will mitigate risks of misuse and bias inherent in AI systems. Its implementation will be drawn from national frameworks such as the Nigeria Data Protection Regulation (NDPR) and emerging sector-specific AI-in-education policies (Holmes et al., 2022; UNESCO, 2021).

Evidence-Based Research and Evaluation: this component will integrate empirical studies, AI impact assessments, and the use of open data repositories to inform adaptive and context-aware decision-making. It will create robust feedback loops that will guide policy refinement, support localized AI tool development, and facilitate knowledge sharing across all educational tiers. Evidence-based research and evaluation will be anchored by institutions such as universities, the Nigerian Educational Research and Development Council (NERDC), teacher education colleges and Universities of Education, this evidence-driven ecosystem will ensure that AI integration remains responsive, relevant, and scalable (Adigun & Folorunso, 2023).



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Multi-Stakeholder Collaboration: this dimension will encompass active partnerships among the Ministry of Education (MoE), NITDA, NCC, EdTech companies, NGOs, and development partners. Through coordinated engagement, stakeholders will collectively promote sustainable AI integration, minimize resource duplication, and foster harmonized implementation across educational levels. A task-force-based national coordination model, as proposed by Adewale & Oduwole (2024) will exemplify how collaborative frameworks can streamline policy execution and ensure context-relevant innovation in Nigeria's education system.

AI-Powered Educational Management Systems: this component focuses on embedding AI-driven capabilities such as predictive analytics, dropout tracking, and real-time data utilization into existing Educational Management Information Systems (EMIS). These tools enable evidence-informed decision-making, facilitate targeted interventions, and support adaptive planning, especially in fragile, marginalized, and underserved regions. The integration of AI into EMIS, as emphasized by Zawacki-Richter et al. (2019) and the World Bank (2023), underscores its potential to transform educational governance and resource allocation.

The proposed conceptual framework is underpinned by three foundational assumptions that collectively shape the pathway for effective integration of Artificial Intelligence (AI) in the Nigerian education system. These assumptions recognize the multifaceted and dynamic nature of educational transformation in a resource-constrained yet culturally diverse context like Nigeria. First, the framework assumes that contextual relevance and equity are indispensable to AI's success. The application of AI technologies must be tailored to reflect local socio-cultural, linguistic, infrastructural, and educational realities. Without this localization, AI risks reinforcing existing inequalities rather than bridging them. Equity must therefore be a guiding principle to ensure inclusive access for all learners regardless of gender, disability, location, or socioeconomic status. Second, the framework is built on the belief that systemic transformation is necessary for sustainable impact. AI should not be treated as a plug-in solution; rather, it should be integrated within a holistic ecosystem that includes robust infrastructure, teacher capacity development, curriculum enhancement, inclusive digital content, and ethical governance. Transformation must be comprehensive, cutting across all layers of the education system. No single element—whether technological or human can drive change in isolation.

Lastly, the framework acknowledges the importance of a synergistic relationship between policy, practice, and research. These three domains must operate in continuous dialogue. Policymakers must be informed by empirical evidence and grounded classroom realities; practitioners must be supported by enabling policies; and researchers must study real-world implementation to inform adaptive strategies. This dynamic feedback loop ensures that AI integration remains contextually relevant, pedagogically sound, ethically responsible, and responsive to emerging needs and challenges. Together, these three assumptions form the philosophical and operational bedrock of the framework, guiding its structure and informing its components toward achieving inclusive, equitable, and sustainable AI-enhanced educational transformation in Nigeria.

Suggestions for a Contextualized Inclusive AI Integration in Nigerian Educational System

A contextualized roadmap for inclusive AI integration in Nigerian education is proposed as one that will address systemic inefficiencies while remaining sensitive to local sociocultural and infrastructural realities. Drawing on current research, international benchmarks, and national data, the "Way Forward" provides practical, evidence-based strategies for inclusive deployment of AI in ensuring that no learner is left behind in the digital transformation of education in Nigeria. The



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followings are suggestions to aid in contextualizing inclusive AI integration into Nigerian education system:

Reinvest in Foundational Education Infrastructure: to tackle poor learning outcomes and pervasive learning poverty, Nigeria needs to prioritize foundational investments in electricity, classrooms, connectivity and instructional materials, as these form the bedrock for effective AI deployment. Evidence from UNESCO (2023) and the World Bank (2022) shows that nations combining literacy improvements with infrastructure investment achieve greater EdTech impact. In Nigeria, strategic public-private partnerships such as with Airtel Education Projects and MTN Foundation can play a crucial role in funding ICT labs, particularly in underserved regions (Phillips Consulting, 2022).

Adopt a National AI-in-Education Strategy Anchored in Inclusivity: Nigeria currently lacks a unified roadmap for AI adoption in education. Therefore, there is an urgent need for a National AI Policy for Education that addresses equitable access, teacher capacity building, localized content, and ethical governance. Adefolu and Ezeani (2023) emphasize the importance of frameworks that ensure child data protection, algorithmic fairness, and inclusion. Lessons from India's "Responsible AI for Youth" program is a good example that offers a model for integrating AI into curricula and scaling training in secondary schools (NITI Aayog, 2021).

Design Indigenous AI Tools Tailored to Local Curriculum and Languages: Most current AI tools are misaligned with Nigeria's curriculum and linguistic diversity, limiting their effectiveness. Collaborations between local EdTech startups such as uLesson, Gradely, and Tuteria and public institutions can support the creation of localized content in major Nigerian languages, aligned with national learning goals (Ojo & Salawu, 2022). Promoting AI-powered multilingual and culturally relevant learning applications can enhance student engagement, particularly in rural and diverse classrooms.

Bridge the Digital Divide through Rural Connectivity and EdTech Subsidies: Many rural schools in Nigeria remain disconnected from the digital ecosystem due to lack of internet electricity, and deepening educational exclusion. Leveraging national initiatives like the Rural Electrification Agency (REA) and National Broadband Plan can help in no small in establishing powered learning hubs in underserved areas (NCC, 2022). Additionally, providing zero-rated access to educational platforms and distributing AI-enabled offline learning devices particularly in conflict zones and low-income communities can significantly bridge the digital divide (Okonkwo & Agbatogun, 2023).

Strengthen Teacher Capacity through Continuous AI-Focused Professional Development: Teacher readiness remains a major barrier to effective AI integration in Nigeria's education system. Introducing mandatory in-service training on digital pedagogy and AI tools through institutions like the National Teachers' Institute (NTI) and the Teaching Regulation Council of Nigeria (TRCN) is essential (Olayemi & Ogunyemi, 2021). In addition, embedding AI-focused modules into pre-service teacher education curricula will foster long-term digital fluency and preparedness (Adigun & Folorunso, 2023).

Develop Inclusive AI Systems for Females, Learners with Disabilities, and Disadvantaged Groups: Systemic exclusion of females in Northern Nigeria and learners with disabilities from AI-enhanced education persists. To bridge this gap, policies must mandate gender-sensitive EdTech practices, establish girls-only ICT centers, and deploy AI-powered assistive technologies like text-to-speech and adaptive interfaces (Okeowo & Omoniyi, 2022; UNESCO, 2022). Inclusive program design should actively engage NGOs, traditional leaders, and disability rights groups to ensure relevance and accountability.



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Institutionalize Data Governance and Ethical Standards for AI in Education: As AI-driven education increasingly relies on learner data, Nigeria requires a strong, education-specific data protection framework. Building on the Nigeria Data Protection Regulation (NDPR), policies must ensure transparency, algorithmic accountability, and safeguards against misuse or surveillance (Holmes et al., 2022). Ethical AI deployment must also protect children’s rights, with strict guidelines on consent, data profiling, and privacy (UNESCO, 2021).

Promote Empirical Research and Local Evidence on AI Effectiveness: There is a significant lack of large-scale empirical research on AI’s real-world impact in Nigeria’s public schools. To bridge this gap, universities, teacher training institutions, and research centers should receive targeted funding to conduct action research and evaluate AI interventions across diverse educational settings (Adigun & Folorunso, 2023). Additionally, establishing a national open-access repository for AI-in-education data and case studies would facilitate knowledge sharing, promote replication, and provide contextual evidence to inform policy and practice.

Build Multi-Stakeholder Ecosystems for AI Innovation: The transformation of AI in education cannot rest solely on the Ministry of Education. A multi-sectoral task force—bringing together the Ministry, NITDA, NCC, UNICEF, EdTech companies, and civil society—must collaboratively design and implement action plans (Adewale & Oduwole, 2024). Moreover, support from international donors and global tech partners such as Google for Education, Microsoft, and the UNICEF Innovation Fund is essential to pilot AI initiatives in low-resource contexts.

Use AI for Early Warning and Education System Optimization: AI’s predictive analytics can play a pivotal role in identifying potential dropouts, learning gaps, and inefficiencies in resource allocation. By integrating AI into Nigeria’s Education Management Information Systems (EMIS), real-time data tracking and targeted interventions become feasible particularly benefiting fragile regions and marginalized learners (Zawacki-Richter et al., 2019; World Bank, 2023).

Conclusion

This study proposes a context-aware and an equity-driven framework for the integration of Artificial Intelligence (AI) in the Nigerian education system. It emphasizes three core assumptions: the need for contextual relevance and equitable access; the importance of systemic, holistic transformation across infrastructure, pedagogy, and governance; and the critical synergy between policy, practice, and research. The framework highlights that sustainable AI adoption requires localized implementation, inclusive design, and continuous feedback among stakeholders. AI holds transformative potential for education in Nigeria, but its success depends on thoughtful integration rooted in local realities. By aligning technological innovation with inclusive policies, systemic reforms, and collaborative research-practice-policy cycles, Nigeria can harness AI to improve learning outcomes, reduce inequality, and modernize its education system for the future.

In summary, AI holds the potential to transform Nigeria’s education sector, but its success depends on how well foundational gaps are addressed, content is localized, teachers are empowered, and governance is ethically aligned. Rescinding Nigeria’s entrenched educational challenges requires a paradigmatic shift, where Artificial Intelligence is not just a technological novelty but a strategic, inclusive, and ethical tool for system-wide transformation. Therefore, addressing enabling teacher readiness, infrastructure deficits, promoting inclusive design, and embedding strong ethical and data governance frameworks will in no small measure unlocks AI’s full potential of technological engagement in Nigeria. Subsequently, progress will be birth via sustained investment, political will and evidence-based policy implementation that respects Nigeria’s unique socio-cultural fabric and educational disparities. With coordinated multi-stakeholder engagement, context-aware



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infrastructure, inclusive policies, and sustained research, Nigeria can move beyond fragmented interventions toward a resilient, AI-enhanced educational future.

Recommendations

The following recommendations are suggested:

1. Government, non-governmental organizations and educational stakeholders should encourage prioritizing the provision of foundational infrastructural facilities (internet connectivity, rural electrification, and access to emerging technological devices) as prerequisites for sustainable AI integration.
2. Educational stakeholders should encourage establishment of unified roadmap that emphasizes teacher capacity development, ethical governance, use of localized content, and inclusivity irrespective of individual special need.
3. Educational stakeholders (curriculum planners, developers and implementers) should encourage the development of indigenous AI-powered educational applications that are aligned with Nigeria's curriculum, diverse languages, and multi-cultural contexts.
4. Educational stakeholders, Government and non-governmental organizations should institutionalize continuous AI-focused professional development and that would support embedding digital pedagogy into pre-service teacher training for professional development.
5. Government and non-governmental organizations should encourage the deployment and engagement of AI systems that will address disability inclusion, gender equity and support indigent students in rural and conflict-affected areas.
6. Government, non-governmental organizations and educational stakeholders should encourage building an ecosystem that would unite EdTech firms, government, global partners, NGOs, and local communities in co-designing of AI innovations.
7. Educational stakeholders, Government, and non-governmental organizations should encourage the mobilization of political will and public-private partnerships in ensuring long-term financing and scalable implementation of inclusive AI solutions.

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Effects of Geometrical Set and Geogebra Application on Achievement in Geometry among Upper Basic Students in Owerri Education Zone, Imo State, Nigeria

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Abstract

This study investigated the effect of geometrical set and GeoGebra application on students' academic achievement in geometry, with attention to gender differences, in the Owerri education zone, Imo State. The study adopted a quasi-experimental design with pre-test, post-test, and control groups. A total of 107 Junior Secondary School students, purposively drawn from three schools, participated in the study. Students were assigned to three groups: one taught with GeoGebra, another with geometrical sets, and a control group taught with lecture methods. Data were collected using a validated geometry achievement test, while mean, standard deviation, and Analysis of Covariance (ANCOVA) were used for analysis. Findings revealed significant differences in achievement across the instructional methods. Students exposed to GeoGebra and geometrical sets performed significantly better than those taught with lecture method. GeoGebra produced more consistent achievement outcomes, while gender differences were not significant, indicating that digital tools may help bridge gender gaps in mathematics learning. The study concludes that integrating GeoGebra with geometrical sets provides a balanced and effective instructional material for teaching geometry.

Keywords: Geometry, GeoGebra, Geometrical sets, Academic achievement

Introduction

Mathematics, often regarded as the “language of science,” is the study of numbers, patterns, shapes, and logical relationships that enable humans to solve problems and interpret the world (Uzuegbu *et al.*, 2024). It equips learners with reasoning, problem-solving, and analytical skills that are essential for academic success and national development. Within mathematics, geometry holds a special place as it explores the properties and relationships of points, lines, angles, surfaces, and solids. Beyond schoolwork, geometry underpins careers in engineering, architecture, computer graphics, and science applications (Okigbo & Okeke, 2020). Yet, despite its significance, Nigerian secondary school students consistently underperform in geometry, as documented in repeated WAEC Chief Examiners' Reports (2021; 2022; 2023), raising critical concerns about teaching practices and learning outcomes especially in geometry. Geometry's abstract nature demands spatial reasoning skills many students struggle to develop. Concepts such as points, lines, planes, and transformations are intangible and, when taught mainly through lectures, remain disconnected from learners' experiences. Okigbo and Okeke (2020) observe that the lecture method emphasizes memorization over conceptual understanding, limiting students' ability to visualize geometric relationships. Yet geometry underpins mathematics, science, technology, and architecture, meaning poor mastery disadvantages students



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in examinations and future pursuits. Addressing geometry learning challenges is therefore central to improving achievement and preparing students for national development. Instructional tools provide a pathway to overcoming these learning challenges in geometry. Geometrical sets (compasses, protractors, rulers, and set squares) promote accuracy, active engagement, and hands-on construction. They allow students to model geometric ideas and practise repeatedly, which builds confidence and deeper understanding. Research shows that learners who engage with these tools retain concepts better than those taught by lecture alone (Eze & Nworgu, 2021; Onwumere & Ugwuegbulam, 2020). Yet many teachers undervalue their potential, preferring lecture methods that limit interaction and practice (Okeke & Aja, 2022). The neglect of these low-cost, effective tools is therefore troubling.

Technological advances have introduced GeoGebra, a dynamic software that encourages active engagement through interactive diagrams, real-time feedback, and visualizations. It allows students to model abstract concepts, practice problem-solving, and explore geometry in discovery-based ways. Research confirms that GeoGebra promotes deeper understanding, higher-order thinking, and independent learning (Achor & Umoru, 2019; Usman & Akinyemi, 2021). However, adoption in Nigerian schools is still limited due to poor teacher training, scarce resources, and weak awareness (Akani & Eke, 2023). Meanwhile, lectures dominate because they are cheaper, yet they reduce students to passive listeners (Iji & Abah, 2020). This imbalance requires urgent change. The issue of underutilized methods highlights the need for comparative studies. While GeoGebra, geometrical sets, and lecture methods each have strengths, limited evidence exists on their relative effectiveness in improving geometry achievement (Odey & Onah, 2020; Achor & Okoh, 2022). Moreover, the role of gender remains inconclusive. Some studies suggest males excel due to stronger spatial reasoning (Nwoye & Abah, 2021), while others show no significant gender differences when effective tools are used (Eze & Okeke, 2023). These contradictions suggest that both method and gender may shape achievement. Against this backdrop, the present study compares the effects of GeoGebra, geometrical sets, and lecture methods on students' geometry achievement, while also examining gender differences. The findings are expected to guide teachers, policymakers, and curriculum planners toward evidence-based strategies that improve learning outcomes. Furthermore, this study is anchored on Constructivist Theory, which emphasizes knowledge construction through active engagement. In geometry, this occurs when students use physical instruments or manipulate virtual objects in GeoGebra. Social Cognitive Theory (Bandura) also explains that interaction, modelling, and practice influence learning. These frameworks support examining the relative benefits of GeoGebra and geometrical sets across genders.

Empirical evidence highlights these tools' effectiveness. Onwumere and Ugwuegbulam (2020), using quasi-experimental design with 100 JSS3 students, found that geometrical sets significantly improved performance compared to lectures. Similarly, Eze and Nworgu (2021) showed that both genders benefited, though females gained more in accuracy and retention. Usman and Akinyemi (2021), studying 120 students exposed to GeoGebra, reported no significant gender differences, indicating that interactive tools can bridge spatial reasoning gaps. Together, these studies confirm that both GeoGebra and geometrical sets improve outcomes, though their comparative gender impact remains underexplored. This gap underscores the relevance of the present study.

Statement of the Problem

Despite the central role of geometry in mathematics and its application in science, engineering, and technology, Nigerian secondary school students continue to perform poorly in the subject. Repeated



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West African Examinations Council (WAEC) Chief Examiners' Reports (2021, 2022, 2023) highlight persistent weaknesses in plane, circle, and construction geometry, indicating that the problem is systemic and unresolved. The abstract nature of geometry, coupled with the dominance of lecture-based instruction, makes it difficult for students to visualize and internalize concepts. As a result, many learners resort to rote memorization, leading to shallow understanding and low achievement. Instructional tools such as geometrical sets and modern digital applications like GeoGebra have the potential to make geometry more interactive, concrete, and engaging. Yet, their use in Nigerian classrooms remains limited due to teacher preference for lectures, inadequate training, and lack of resources. Furthermore, existing studies provide inconclusive findings on the relative effectiveness of these methods, particularly when gender differences are considered. Some research suggests male students perform better in spatial tasks, while others report no significant gender effect when supportive tools are used. This inconsistency creates uncertainty for teachers and policymakers. In the light of this, a systematic study comparing GeoGebra, geometrical sets, and lecture methods—while examining gender interactions—is urgently needed.

Objectives of the study

1. Determine the mean achievement scores of students when taught geometry using GeoGebra, Geometrical Sets and those exposed to lecture method without these facilities.
2. Interaction effect of gender and instructional materials on students' achievement scores in geometry.

Research Questions

1. What are the mean achievement scores of students taught geometry using GeoGebra, geometrical sets, and those taught without these facilities exposed to lecture method?
2. What is the interaction effect of gender and instructional materials on students' mean achievement scores in geometry?

Hypotheses

- H₀₁:** There is no significant difference in the mean achievement scores of students taught geometry using GeoGebra, geometrical sets, and those taught without these facilities
- H₀₂:** There is no significant interaction effect of gender and instructional tools on students' mean achievement scores in geometry.

Methodology

This study adopted a quasi-experimental research design of the pre-test, post-test, non-equivalent control group type. This design was considered appropriate because it allowed the researcher to determine the effect of GeoGebra, geometrical sets, and the lecture method on students' academic achievement in geometry without random assignment of participants. The population of the study comprised all Junior Secondary School (JSS 2) mathematics students in the Owerri Education Zone of Imo State, Nigeria. From this population, three intact classes were purposively selected from three different schools to ensure comparable exposure to the curriculum. A total of 107 students participated, with 35 assigned to the GeoGebra group, 35 to the geometrical set group, and 37 to the control (lecture) group. The instrument for data collection was a researcher-developed Geometry Achievement Test (GAT) consisting of 25 multiple-choice and structured items covering plane and solid geometry. The instrument was validated by three experts in mathematics education and measurement/evaluation. Its reliability was established using the Kuder-Richardson formula (KR-20), yielding a coefficient of 0.82, indicating high internal consistency. Data collection followed three phases: pre-test, treatment, and post-test. Each group received instruction for four weeks according to their designated method. The GeoGebra group was taught using dynamic geometry software; the



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geometrical set group was taught with compasses, rulers, and protractors; while the control group received conventional lecture instruction. Data were analyzed using mean and standard deviation to answer the research questions, while Analysis of Covariance (ANCOVA) was employed to test the hypotheses at 0.05 level of significance.

Presentation of Results:

Research Question 1:

What are the mean achievement scores of students taught geometry using GeoGebra, geometrical sets, and those taught without these facilities exposed to lecture method?

Table 1: Mean achievement scores and standard deviations of students taught geometry using GeoGebra application, geometrical sets and those taught without them.

Materials	N	Pre-test \bar{X}	SD	Post-test \bar{X}	SD	Mean Achievement Gain
GeoGebra Application	35	25.77	4.82	59.34	7.26	33.57
Geometrical sets	35	26.49	5.40	64.38	10.79	37.89
Control	37	23.89	4.44	52.97	8.72	29.08

At the pre-test stage, students across the three groups recorded similar low mean scores: GeoGebra (M = 25.77, SD = 4.82), geometrical sets (M = 26.49, SD = 5.40), and control (M = 23.89, SD = 4.44), indicating comparable baseline previous knowledge. After instruction, all groups improved, but with notable differences. The geometrical sets group achieved the highest post-test mean of 64.38 (SD = 10.79), reflecting a gain of 37.89. The GeoGebra group followed with a post-test mean of 59.34 (SD = 7.26) and a gain of 33.57, while the control group, though improved, had the lowest post-test mean of 52.97 (SD = 8.72) with a gain of 29.08. Variability in scores also differed: the geometrical sets group showed the widest spread, suggesting uneven mastery, while the GeoGebra group's lower SD reflected more consistent outcomes. Overall, instructional materials enhanced achievement more effectively than lecture, with geometrical sets proving most impactful.

Hypothesis 1: There is no significant difference in the mean achievement scores of students taught geometry using GeoGebra, geometrical sets, and those taught without these facilities

Table 2: Analysis of covariance (ANCOVA) on the mean achievement scores of students taught geometry using GeoGebra application, geometrical sets and those taught without them.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	3633.649 ^a	6	605.608	8.314	.000
Intercept	12323.486	1	12323.486	169.178	.000
Pretest	2.480	1	2.480	.034	.854
Materials	2185.187	2	1092.593	14.999	.000
Gender	109.604	1	109.604		.223
Materials*Gender	1145.129	2	572.565		.001
Error	7284.351	100	72.844		
Total	383385.000	107			
Corrected Total	10918.000	106			

a. R Squared = .333 (Adjusted R Squared = .293)



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From Table 2, it can be seen that after adjusting for pretest scores, there was a statistically significant main effect of instructional materials on students' achievement in geometry, $F(2, 100) = 14.999$, $p < .05$. This indicates that students taught with GeoGebra, geometrical sets, and lecture method did not achieve equally, thereby rejecting the null hypothesis of no significant difference. Specifically, the type of instructional material accounted for meaningful variation in post-test achievement scores, with $R^2 = .333$ showing that about 33% of the variance in achievement was explained by the model. The non-significant effect of pretest ($p = .854$) suggests that initial differences among groups did not influence the outcome, strengthening the validity of the post-test differences. Additionally, the significant interaction between materials and gender ($p = .001$) indicates that the effectiveness of instructional materials varied by gender. Thus, the hypothesis is rejected: instructional materials significantly influenced students' mean achievement scores in geometry and their order of influence is established in Table 3.

Table 3: LSD Post hoc Analysis of Students Post-test scores classified by Instructional Materials

(I) Method	(J) Method	Mean Difference (I-J)	Std. Error	Sig.
GeoGebra Application	Geometrical Set	-5.036	1.163	.540
	Control	6.371*	1.179	.113
Geometrical Set	GeoGebra Application	5.036	2.141	.021
	Control	11.407*	2.141	.000
Control	GeoGebra Application	-6.371*	2.170	.004
	Geometrical Set	-11.407*	2.141	.000

* = significant at .05 level of Significance

The LSD post hoc analysis in Table 3 provides further insight into the differences among instructional methods. The comparison between GeoGebra and Geometrical Sets shows a mean difference of -5.036, which is not statistically significant ($p = .540$). This suggests that although the geometrical sets group performed slightly better, the difference was not large enough to be meaningful. However, when GeoGebra is compared with the Control group, the mean difference of 6.371 is statistically significant ($p = .004$), indicating that students taught with GeoGebra outperformed those taught through lecture. Similarly, comparing Geometrical Sets with the Control group yields the largest mean difference of 11.407, which is highly significant ($p = .000$). This confirms that students taught with Geometrical Sets performed far better than those in the lecture group. In summary, both GeoGebra and Geometrical Sets significantly improved achievement compared to lecture, with Geometrical Sets producing the strongest effect.

Research Question 2: What is the interaction effect of gender and instructional materials on students' mean achievement scores in geometry?

Table 4: Mean achievement and Standard deviation scores of male and female students taught geometry using GeoGebra and geometrical set.

Instructional Materials	Gender	N	Pretest (\bar{X})	SD	Posttest (\bar{X})	SD	Mean Achievement Gain
Geometrical Set	Male	17	25.10	4.51	66.21	9.34	41.11
	Female	20	26.44	3.29	62.55	7.01	36.11



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GeoGebra	Male	16	25.80	3.91	57.90	6.97	32.10
Application	Female	19	27.18	4.89	60.78	6.09	33.60

The results in Table 4 shows that the interaction between gender and instructional materials on students' mean achievement scores in geometry has mixed patterns. For the geometrical set, males achieved a higher mean gain (41.11) than females (36.11), indicating that this method was slightly more effective for boys. In contrast, with the GeoGebra application, females recorded a greater mean gain (33.60) compared to males (32.10), suggesting that the digital approach supported girls' achievement more strongly. The standard deviations also highlight differences in consistency. Among those taught with the geometrical set, males (SD = 9.34) showed more variability in post-test performance than females (SD = 7.01), while in the GeoGebra group, the spread of scores was similar for males (SD = 6.97) and females (SD = 6.09). The results point to an interaction effect: geometrical sets favoured boys' achievement, whereas GeoGebra fostered slightly better gains among girls, which shows the importance of gender-sensitive instructional strategies in geometry learning.

Hypothesis 2: There is no significant interaction effect of gender and instructional tools on students' mean achievement scores in geometry.

Table 5: Analysis of Covariance (ANCOVA) on Interaction Effect of Gender and Instructional Materials on Students' Mean Achievement Scores in Geometry

Source	Type III Sum of Squares	df	Mean Square	F	Sig. (p)	Decision
Corrected Model	1105.642	4	276.411	7.462	.000	S
Intercept	20065.214	1	20065.214	541.883	.000	S
Pretest	362.187	1	362.187	9.785	.003	S
Gender	689.024	1	689.024	18.608	.000	S
Materials	12.837	1	12.837	0.347	.558	NS
Gender × Materials	23.652	1	23.652	0.639	.427	NS
Error	2504.218	67	37.390			
Total	436,405.000	71				
Corrected Total	3610.000	71				

a. R Squared = .306 (Adjusted R Squared = .265)

The ANCOVA results indicate that gender had a statistically significant main effect on achievement ($F = 18.608, p < .05$), while instructional materials alone did not ($F = 0.347, p = .558$). Importantly, the interaction between gender and instructional materials was not significant ($F = 0.639, p = .427$), meaning the combined effect of gender and instructional method did not influence achievement differently across groups. However, since the interaction effect was not significant, the null hypothesis was not rejected. This implies that while gender plays an independent role in achievement, the choice of instructional material does not interact with gender to affect outcomes in geometry

Discussion of Findings

The findings of this study resonate strongly with the theoretical frameworks guiding it. The Constructivist Theory underscores that students learn best through active engagement with instructional tools (Uzuegbu *et al.*, 2024). The present results confirm this: both GeoGebra and geometrical sets significantly improved achievement compared to the lecture method, with geometrical sets producing the highest mean gain. This supports Onwumere and Ugwuegbulam (2020), who found geometrical sets more effective than conventional methods. Educationally, this implies that teachers should integrate hands-on materials and digital tools into geometry instruction rather than relying solely on lectures, as such approaches foster deeper conceptual understanding.



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The results also revealed gender differences, with males benefiting more from geometrical sets and females showing stronger gains with GeoGebra. This aligns with Eze and Nworgu (2021), who observed that gender influences learning outcomes in accuracy and retention. The implication is that educators should adopt a blended strategy, offering both physical and digital tools to cater to diverse learner needs and reduce gender-based disparities. However, the ANCOVA results showed that the interaction effect of gender and instructional materials was not significant ($p = .427$). This finding echoes Usman and Akinyemi (2021), who reported that GeoGebra minimizes gender differences in spatial reasoning. This suggests that when thoughtfully implemented, modern instructional technologies can bridge gender gaps, making classrooms more equitable. Teachers should therefore be trained to apply such tools inclusively, ensuring both male and female learners are equally supported. From the above, the study demonstrates that instructional materials matter more than gender interactions in shaping achievement. The broader implication for educational policy is the urgent need to equip schools with both digital tools like GeoGebra and traditional sets. This will enable teachers to design learner-centered, gender-sensitive geometry lessons that enhance achievement for all students.

Conclusion

This study set out to examine the comparative effects of GeoGebra, geometrical sets, and the conventional lecture method on students' achievement in geometry, with attention to possible gender interactions. The findings revealed that both GeoGebra and geometrical sets significantly enhanced achievement compared to lecture, with geometrical sets proving the most effective overall. While males benefitted slightly more from geometrical sets and females from GeoGebra, the interaction effect between gender and instructional materials was not statistically significant, showing that both tools can support learning across genders. These results aligned with Constructivist and Social Cognitive theories, confirming that active engagement, modelling, and practice are vital for meaningful geometry learning. Empirical evidence from earlier studies also resonates with these findings, underscoring the superiority of instructional tools over rote lecture methods. The study concludes that improving students' achievement in geometry requires moving beyond lecture-based instruction towards integrating both traditional and digital tools. Such practices not only strengthen spatial reasoning but also promote inclusive learning, thereby equipping Nigerian students with the mathematical competencies needed for academic progression and national development.

Recommendations

Based on the outcome, the following recommendations are made:

1. Ministries of Education and school administrators should ensure that GeoGebra is incorporated into the mathematics curriculum at the secondary school level. Teacher training workshops should be organized to build capacity for its effective use.
2. Teachers should not underrate geometrical sets as outdated. Instead, they should actively incorporate them into daily geometry lessons, especially for constructions and measurements, since they promote accuracy and hands-on learning.
3. Teachers are encouraged to adopt a blend of GeoGebra and geometrical sets alongside lectures. This hybrid approach will help bridge the gap between abstract visualization, practical reasoning, and theoretical knowledge.
4. Given that GeoGebra eliminates gender gaps in achievement, schools should prioritize its use to provide equitable learning opportunities for both male and female students.



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Assessment of Manpower Development on Early Childhood Care Development in Ijebu-Ode Local Government Area of Ogun State, Nigeria

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Abstract

The study examined the role of manpower development on early childhood care development in Ogun State, Nigeria. Three research questions guided the study. A descriptive research design was used. The population comprised all the early childhood education teachers and caregivers in Ijebu-ode local government area. A total of 33 early childhood education teachers and care givers were selected as sample size using purposive sampling technique. A researcher developed instrument tagged: Role of Manpower Development on Early Childhood Care Development Questionnaire (RMDECCDQ) with 0.96 reliability coefficient was used for data collection. Descriptive and inferential statistics were used for analyzing the research questions. The findings revealed that induction, on-the-job training, off-the-job training, workshops/courses, educational seminars/conferences, qualification programmes, teachers were among the needed manpower development for improving early childhood care development. Increase the quality and quantity of teacher output per unit instruction in school; helps to updates teachers with the new development in the pedagogy in the area of new knowledge and skills; averts future death of manpower need in early childhood education; helps equips an individual teacher with new skills were among the role of manpower development towards improving early childhood care development. There was relationship between manpower development and early childhood care development. Early childhood education teachers or caregivers should be given on-the-job training on a regular basis to keep them abreast of the current educational programme and employ trained manpower in early child care and development education system.

Keywords: Care Development, Early Childhood, Manpower Development

Introduction

Early childhood is a pivotal period of child development that begins before birth through age eight. This is a period of rapid brain and body development. In the first few years of life, more than 1 million new neural connections are formed every second. The quality of a child's early experiences makes a critical difference as their brains develop, providing either strong or weak foundations for learning, health and behaviour throughout life. Early childhood offers a critical window of opportunity to shape the trajectory of a child's holistic development and build a foundation for their future. For children to achieve their full potential, as is their human right, they need health care and nutrition, protection from harm and a sense of security, opportunities for early learning, and responsive caregiving – like talking, singing and playing – with parents and caregivers who love them (UNICEF, 2024). Early childhood is a stage of growing up which extends beyond physical development to involve significant



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changes in a child 's behaviour, thought processes, emotions and attitude (Nwanekezi & Onyekuru, 2014). This largely determines the kind of adult that a child will become.

Early child care and development education is defined by the National Policy on Education (FRN, 2014) as education given in educational settings to children from ages 0 through 4 years in preparing their entry into pre-primary or Basic School. It also includes creche, nursery and kindergarten popularly called *otaakara* in some parts of Nigeria. Grunewald and Rolnick (2003) cited Igbinomwanhia, Ibadin and Osagie (2021) traced early child care and development education to the efforts of prominent European education experts like: John Amos Comenius (1590-1690), J. J. Rousseau (1782 – 1788), Johann Heinrich Pestalozzi (1748-1827) and Friedrich Froebel (1782-1751). These experts championed the right of children to early education. Many educationists and scholars, including Fafunwa (2004) and Oniyama (2011), supported and advocated the views held by the earlier educators that there was the need for good early child care and development education to help pupils develop their full potential. Igbinomwanhia et al (2021); Samu (2020); Abasili, Chioke and Udeoba (2023) agreed that early childhood educational system depends heavily on manpower development for the execution of its programme. Manpower is the labour force or work force of a country. In its broad concept, it includes all who are potentially employable, ranging from unskilled to the most highly skilled workers. Development involves change for better. Manpower development involves quantitative and qualitative training of person to carry out job in the society. It is an important factor in the economy of every nation and no serious nation can afford to ignore it. Nigeria, it has been a major concern of the government since independence.

Nwachukwu (2024) stated that manpower development can also be seen as human capital development which refers to the knowledge, abilities, health, and skills that people invest in and accumulate throughout their lives, enabling them to realize their potential as productive members of a country. In contrast, manpower development refers to the process of acquiring and increasing the number of persons who have the skills, education, and experience that are critical for the economic growth and development of a country's economy (Okojie, 2005). Also, Ejere (2011) posited that manpower development refers to the human factor in the production process; and consists of the combined knowledge, skills or competencies and abilities of the workforce. Of all the factors of production and educational development, most especially, only human beings are capable of learning, adapting or changing, innovative and creative. The sum of an individual's knowledge, abilities, and assets is referred to as their manpower development (Nwachukwu, 2024). Investing in manpower development has been recognized as a fundamental driver of educational progress, economic growth, and social progress. Without substantial investment in manpower development, no country can achieve sustainable economic and educational development (Ebisine, 2015). Moreover, manpower development goes beyond mere economic considerations because it enriches people's understanding of themselves and the world around them, improving their quality of life and providing broad social benefits for individuals and society (Febriyanti & Ihsani, 2019). Manpower development is essential for driving innovation, increasing productivity, and ultimately contributing to economic growth. It is a key factor in determining an individual's earning potential and career advancement opportunities. Investing in manpower development through education and training programs can lead to higher levels of productivity and competitiveness in the workforce (Febriyanti & Ihsani, 2019). To actualize the educational objectives in early childhood care depends heavily on the manpower development or teacher or caregiver. Manpower development are the human beings (teacher or caregiver) needed to accomplish the goals of the system. They are the key to rapid socioeconomic development and efficient instruction delivery (Onah, 2008). Without adequate,



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skilled and well-motivated personnel operating within a system, a sound educational system will not be possible. Omah and Pepple (2019) stated that teachers were the critical resource for effectively implementing and realising educational policies and objectives at the practical level of the classroom. Teachers are therefore, one the most indispensable entities in the school. The shortage (in terms of quantity and quality) of teachers reduces the extent to which the curriculum can be effectively delivered (Igbinomwanhia, et al 2021). Furthermore, since Nigeria has pledged her commitment to provide quality and comprehensive early child care and development education and care for all preschoolers, there is the need for adequate manpower development in the sector.

Statement of the Problem

Education delivery at the early stage required experience and qualified teachers or caregivers to handle to achieve educational objectives. However, the current situations of instruction delivery in public early childhood centres in Ogun state are a source of worry and concern to the stakeholders in the sector. A situation where teachers seem not to have been subjected to training and re-training exercises for many years is not a good development for early childhood education care development. The more the teachers are being trained, the more they develop knowledge and skills for the achievement of childhood education development objectives. This study was an attempt to examine the role of manpower development on early childhood care development in Nigeria.

Objectives of the Study

The main objective of the study was to examine the role of manpower development on early childhood care development in Nigeria. Specifically, the study sought to:

1. identified the needed manpower development for improving early childhood care development.
2. ascertained the role of manpower development towards improving early childhood care development.
3. examine the relationship between manpower development and early childhood care development.

Research Questions

The following research questions were raised and answered in this study:

1. What are the needed manpower development for improving early childhood care development?
2. What are the role of manpower development towards improving early childhood care development?
3. Is there any relationship between manpower development and early childhood care development?

Theoretical Framework

The theoretical framework for this study was Pestalozzi theory of education and the theory was propounded by Trohler Daniel in 2013. The theory postulated that ability of every individual human being to learn and in the right of every individual to education. He explained that education should develop the power of the head, heart and hands to create individuals who were capable of knowing what was right or wrong and would act according to that knowledge. His contributions to education involved his educational philosophy and instructional method which encouraged harmonious intellectual, moral and physical development, methodology of empirical sensory learning, especially through object lessons and use of activities, excursions and nature. The implications of this theory to the present study were that the manpower development in the early childhood care development plays a major role in developing the power of the head, heart and hands by implementing the policy guiding the education system. The Pestalozzi theory of education further buttressed the policies and outcomes of their implementation. Early childhood education teachers need to be subjected to



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routine training exercises to update their knowledge, skills, and new methods of imparting knowledge to children to achieve the early childhood education aim and objectives.

Methodology

A descriptive research design was used for this study. The population of this study comprised all the public early childhood education teachers. caregivers in Ijebu-ode local government area of Ogun State, Nigeria. A total of 33 public early childhood education teachers and caregivers in Ijebu-Ode local government area of Ogun State were selected as the sample size. Purposive sampling technique was used for selecting the teachers and caregivers. A researcher self-developed instrument tagged: Role of Manpower Development on Early Childhood Care Development Questionnaire (RMDECCDQ). RMDECCDQ was a self-structured instrument geared towards eliciting information from early childhood education teachers and caregivers regarding the role of manpower development on early childhood care development. The instrument (RMDECCDQ) was divided into two sections namely section A and B. Section A focused on demographic characteristics of the respondents, while B identified the needed manpower development and its role for improving early childhood care development. The instrument requested responses on a four (4) – point scale format which was a modification of 5-point Likert scale. The responses rating scales are as follows: Strongly Agree (SA) 4-points; Agree (A) 3-points; Disagree (D) 2-points and Strongly Disagree (SD) 1-point, respectively. To ensure the content validity of the instrument (RMDECCDQ), a copy of the instrument was made available to the expert in the field of early childhood education and development. All the corrections raised, were amended before the final draft was used to gather relevant data for study. In this case, copies of the instrument (RMDECCDQ) were administered on 6 early childhood education teachers twice in Ijebu-North local government area of the state that are parallel to the sampled population. The collected data were analyzed using Pearson Product Moment Correlation (PPMC) and 0.96 was reported as reliability coefficient. The researcher with the helped of three trained research assistants participated in the questionnaire administration of the instrument which took two weeks before the completion. After completion of the exercise, a total of 31 copies of the questionnaires were retrieved. Retrieval rate was 93.94%. Descriptive statistics of mean, standard deviation and bar-chart were used for providing answers to the research questions 1 and 2. Research question 3 was answered using inferential statistics of PPMC.

Presentation of Results

Research Question 1: What are the needed manpower development for improving early childhood care development?

Table 1: Descriptive statistics on the needed manpower development for improving early childhood care development

Items	Mean	SD	Remarks
Induction	2.96	0.999	Agreed
On-the-Job Training	3.01	0.714	Agreed
Off-the-Job Training	3.16	0.699	Agreed
Workshops/courses (e.g. on subject matter or methods and/or other education-related topics	2.87	0.899	Agreed
Educational Seminars/conferences (at which teachers and/or researchers present their research results and discuss education problems)	2.81	0.910	Agreed
Qualification programmes (e.g. degree, PGDE programmes etc.)	2.99	0.938	Agreed
Teachers observation visits to other schools	3.02	0.806	Agreed
Participation in a network of teachers formed specifically for the purpose of professional development	3.18	0.803	Agreed

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Individual or cooperative research on a topic of professional interest	3.15	0.799	Agreed
Mentoring and/or peer observation and coaching, as part of a formal school arrangement	3.08	0.783	Agreed
Cluster Mean	3.02		

Source: Field Survey, 2024

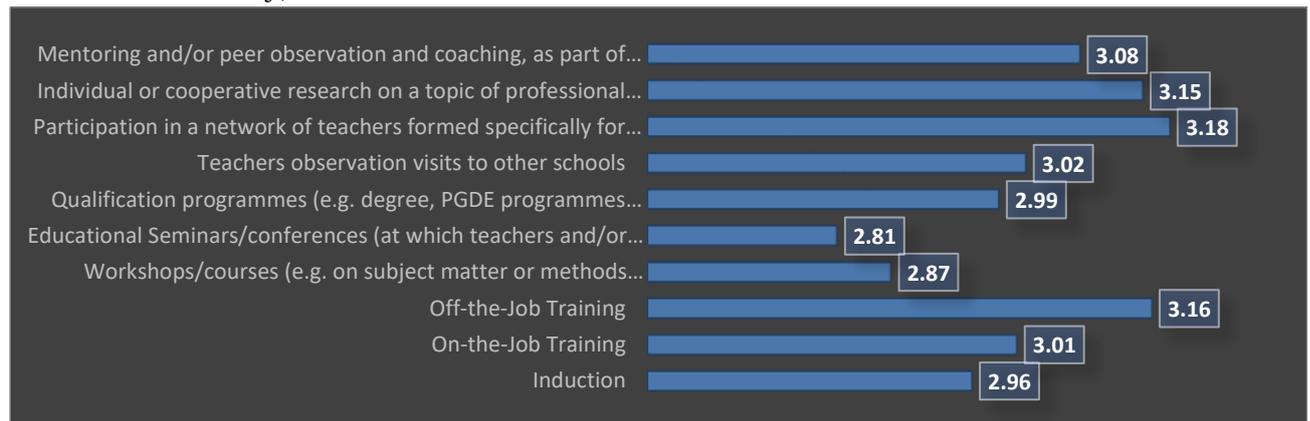


Figure 1: Bar-chart showing the needed manpower development for improving early childhood care development

Table 1 indicated that cluster mean was 3.02 which greater than the bench mark mean value 2.50 (3.02 > 2.50). The implications of this was that induction, on-the-job training, off-the-job training, workshops/courses (e.g. on subject matter or methods and/or other education-related topics, educational seminars/conferences (at which teachers and/or researchers present their research results and discuss education problems), qualification programmes (degree, PGDE programmes etc.), teachers observation visits to other schools, participation in a network of teachers formed specifically for the purpose of professional development, individual or cooperative research on a topic of professional interest and mentoring and/or peer observation and coaching, as part of a formal school arrangement were among the needed manpower development for improving early childhood care development.

Research Question 2: What are the role of manpower development towards improving early childhood care development?

Table 2: Descriptive statistics on the role of manpower development towards improving early childhood care development

Items	Mean	SD	Remarks
Increase the quality and quantity of teacher output per unit instruction in school.	3.18	0.691	Agreed
Helps to updates teachers with the new development in the pedagogy in the area of new knowledge and skills.	3.24	0.687	Agreed
Averts future death of manpower need in early childhood education.	3.00	0.666	Agreed
Helps equips an individual teacher with new skills and technical know-how in handling new teaching strategies and methodologies.	2.93	0.817	Agreed
Help of staff development programme handle situation more technically so as to enhance continuous existence of the school	2.96	0.843	Agreed
Helps weaker teachers become more effective.	2.98	0.896	Agreed
Helps exchange information and expertise among teachers and others, e.g. academics and industrialists.	3.16	0.684	Agreed

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Enable schools to develop and apply new strategies concerning the curriculum and other aspects of teaching.	3.03	0.626	Agreed
Enhances teachers' competence in carrying out their job effectively through knowledge and skills acquisition.	3.26	0.611	Agreed
Reform teachers' behaviour through learning experiences.	3.34	0.671	Agreed
Cluster Mean	3.11		

Source: Field Survey, 2024



Figure 2: Bar-chart showing the role of manpower development towards improving early childhood care development

Table 2 revealed that cluster mean was 3.11 which greater than the bench mark mean value 2.50 (3.11 > 2.50). This implied that increase the quality and quantity of teacher output per unit instruction in school; helps to updates teachers with the new development in the pedagogy in the area of new knowledge and skills; averts future death of manpower need in early childhood education; helps equips an individual teacher with new skills and technical know-how in handling new teaching strategies and methodologies; help of staff development programme handle situation more technically so as to enhance continuous existence of the school; helps weaker teachers become more effective; helps exchange information and expertise among teachers and others, e.g. academics and industrialists; enable schools to develop and apply new strategies concerning the curriculum and other aspects of teaching; enhances teachers' competence in carrying out their job effectively through knowledge and skills acquisition and reform teachers' behaviour through learning experiences were among the role of manpower development towards improving early childhood care development.

Research Question 3: Is there any relationship between manpower development and early childhood care development?

Table 3: Relationship between manpower development and early childhood care development

Variables	Mean	Std. Dev	df	rvalue	pvalue
early childhood care development	21.2840	3.10074			
manpower development	58.2440	6.60816	3	.007	.001

Source: Field Survey, 2024

Table 3 revealed Mean, Standard Deviation and zero order correlation between the variables. It was observed that there was relationship between the independent variable and the dependent variable in the order of (r = 0.007, p<.05). On this premise, the researcher concluded that there was relationship between manpower development and early childhood care development.



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Discussion of Findings

The findings of the study indicated that induction, on-the-job training, off-the-job training, workshops/courses, educational seminars/conferences, qualification programmes, teachers were among the needed manpower development for improving early childhood care development. These findings corroborate with Igbinomwanhia et al (2021) who examined human resource adequacy in early childhood educational development in Nigeria and their findings showed that attending seminar, workshop, human development programmes needed by the teachers of early childhood education. The findings further revealed that increase the quality and quantity of teacher output per unit instruction in school; helps to updates teachers with the new development in the pedagogy in the area of new knowledge and skills; averts future death of manpower need in early childhood education; helps equips an individual teacher with new skills and technical know-how in handling new teaching strategies and methodologies; help of staff development programme handle situation more technically so as to enhance continuous existence of the school; helps weaker teachers become more effective; helps exchange information and expertise among teachers and others, e.g. academics and industrialists; enable schools to develop and apply new strategies concerning the curriculum and other aspects of teaching; enhances teachers' competence in carrying out their job effectively through knowledge and skills acquisition and reform teachers' behaviour through learning experiences were among the role of manpower development towards improving early childhood care development. These findings were in consonant with the study of Ogunode, Adah, Audu and Mama (2020) who examined staff development programme for primary education teachers in Nigeria and they found that manpower development was a good development in right direction for early childhood education teacher or caregiver towards up bring their intellectual knowledge in order to handle situation for education development and they also revealed that it will helps teachers and care givers to avert death of needed manpower in early childhood education. Finally, the study showed that there was a relationship between manpower development and early childhood care development. These findings support Samu (2020) who examined education and manpower in Nigeria and He found that the manpower development programme for teachers of early childhood education directly associated with the development of childhood education.

Conclusion

This study focused on the limelight of manpower development in developing early childhood care and education in Nigeria. Induction, off-the-job training, on-the-job training, workshops, educational seminars, and upgrading knowledge of early childhood educators were focused in the limelight of this study. Moreover, it provides evidence that manpower development enhances the level of knowledge, competency, and quality of teaching skills of teachers and thus improves the quality of teaching as well as the social development of young children. Also, childhood development and child care go in tandem with manpower, and constant professional development is therefore necessary. Occasionally, there should be training and employed trainee teachers and quality early childhood education. The instructors are concerned with the long-term success and sustainability of early childhood education among the learners as well as among the instructors.

Recommendations

Based on the findings of the study, it was then recommended that government should embark on a need training assessment of early childhood education teachers and caregivers, develop an action plan, develop a financial plan for implementation, set up an effective monitoring and evaluation system, ensure policies continuity and fight all institutional corruption in the ministries. It was also recommended that workshops should be organized that will comprise all stakeholders in early



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childhood, including the head teachers, assistants, and caregivers, on necessary knowledge and new trends in the field of early childhood education. The workshop environment should be conducive, thus it should be well ventilated, have a good light system, and adequate chairs and tables should be provided for participants (teachers). Early childhood educators or caregivers should be given on-the-job training on a regular basis to keep them abreast of the current educational programme. More so, there is an urgent need to employ trained manpower in the early child care and development education system, and also motivate them.

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Strengthening Teacher Quality in Nomadic Schools as A Tool For Combating Rural Insecurity In Nigeria: A Sociological Viewpoint

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Abstract

This paper explores the crucial role of strengthening teacher quality in nomadic schools in northern Nigeria as a strategy for combating rural insecurity, framed within Émile Durkheim's Anomie Theory. Rural insecurity, largely driven by socio-economic deprivation and limited access to formal education among nomadic populations, exacerbates social instability and alienation. The paper argues that improving teacher quality is essential for addressing the educational marginalization of nomadic children, which contributes to normlessness and social disintegration. Using Durkheim's theory, it explains how the absence of stable educational structures fosters a breakdown in societal norms, increasing vulnerability to deviant behaviors, including violence and criminal activity. The paper highlights the importance of well-trained, motivated teachers in restoring social cohesion and fostering integration by equipping nomadic children with the skills and values necessary for economic and social participation. It presents a framework for improving teacher quality, emphasizing specialized training, professional development, financial incentives, and community involvement. Given the persistent challenges in the nomadic education system such as inadequate infrastructure, teacher shortages, and frequent teacher transfers, the paper offers targeted recommendations, including enhancing teacher training programs, refining multigrade teaching strategies, increasing the recruitment of female teachers, and ensuring job stability in nomadic schools. By investing in teacher quality and addressing systemic educational deficiencies, this paper asserts that nomadic schools can serve as a tool for fostering social stability and reducing rural insecurity. Strengthening the education system in these communities will not only improve learning outcomes but also contribute to broader societal cohesion, ultimately promoting a more stable and secure northern Nigeria.

Keywords: Nomadic Education, Teacher Quality, Rural Insecurity, Anomie Theory,

Introduction

Rural insecurity in Northern Nigeria, particularly the violent conflicts between pastoralists and sedentary farming communities, has been a persistent issue. Competition for resources such as land and water has escalated tensions, leading to violent clashes that result in deaths, displacement, kidnapping, and property destruction. Between 2011 and 2021, over 12,000 deaths occurred, along with significant displacement, livestock theft, and substantial ransom payments. Banditry, driven by the financial rewards of kidnapping, remains a thriving criminal enterprise involving numerous armed groups. Economic deprivation, criminality, and foreign interference are key factors contributing to this crisis, but the lack of formal education in nomadic and rural communities is often overlooked. Émile Durkheim's Theory of Anomie provides a valuable framework for understanding this issue. Anomie, a state of normlessness and social instability, can be applied to



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nomadic communities in rural Nigeria. The transient nature of nomadic life disrupts access to consistent education, leading to social disintegration. The fragmented educational infrastructure in these communities exacerbates this issue, resulting in a lack of stability in education, which in turn contributes to the erosion of social norms and values. This breakdown of societal cohesion creates an environment conducive to deviant behavior, including violence and insecurity (Akinmoladun et al., 2022; Adewale, 2021). Durkheim argued that societal breakdown leads to deviance, as individuals, particularly youth, lack clear guidance and structure (Durkheim, 2013; Haralambos & Holborn, 2018). Education plays a central role in restoring social order. According to Durkheim's concept of collective conscience, shared values and norms bind society. In nomadic communities, improving the quality of education can restore social cohesion by integrating both academic knowledge and societal norms. Quality teachers, trained in cultural sensitivity and conflict resolution, can reinforce a collective identity among nomadic children, providing them with a sense of belonging and stability. This process of moral integration, where students are taught academic content alongside values of peace and cooperation, can help integrate them into the larger societal framework, making them more resilient to external threats such as extremism (Durkheim, 2013; Tella & Tella, 2020; Baker & Keegan, 2021).

Teachers are critical social anchors who provide moral direction, particularly in nomadic schools where educational structures are weak or inconsistent. High-quality teachers can reduce feelings of alienation and foster social cohesion, helping mitigate the risk of violent conflict and integrate nomadic students into the broader societal framework (Olaniyan et al., 2018; Akinmoladun et al., 2022). The poor quality of teachers in nomadic schools—due to inadequate training, cultural insensitivity, high turnover, and policy shortcomings—results in subpar learning experiences and limited opportunities for nomadic children. This lack of educational opportunity perpetuates cycles of poverty and instability, further contributing to insecurity (NCNE, 2023). Durkheim's theory suggests that when people feel disconnected due to unequal opportunities, it leads to higher rates of deviance and insecurity. In the context of nomadic communities, addressing educational inequalities by improving teacher quality can bridge this gap, fostering social cohesion and reducing feelings of anomie. By investing in teacher quality, nomadic children are provided with equal opportunities for social integration and success, helping to build a more stable society (Akinmoladun et al., 2022; Baker & Keegan, 2021). In conclusion, improving teacher quality in nomadic schools can address the issue of anomie by providing stability and fostering shared values. Teachers not only impart academic knowledge but also teach the values of peace, cooperation, and social integration, which can reduce involvement in criminal activities and contribute to the reduction of rural insecurity. By investing in education and strengthening teacher quality, Northern Nigeria can reduce social disintegration and violence, contributing to a more cohesive and peaceful society (Tella & Tella, 2020; Olaniyan et al., 2018).

Conceptual Framework

Teacher Quality

In the context of the theoretical framework, teacher quality plays a crucial role in addressing the root causes of insecurity, as framed within Durkheim's theory of anomie. Durkheim's concept of anomie, which refers to the breakdown of societal norms and values, can be applied to nomadic communities in Northern Nigeria where poor educational quality and lack of social cohesion contribute to normlessness. Teacher quality, as identified through key dimensions, helps counter this breakdown by offering a structured, cohesive learning environment that provides the guidance and stability needed to combat anomie.



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Subject Matter Expertise: According to Durkheim's theory, when individuals are not properly socialized into the norms and values of society, they are more likely to engage in deviant behaviors. Teachers with strong content knowledge help provide a stable structure in the learning environment. By addressing misconceptions and deepening understanding, they contribute to restoring social norms, fostering a sense of order and stability in students' lives. Research suggests that strong subject knowledge positively impacts student outcomes (Hattie, 2009), which, in turn, can lead to greater societal cohesion and a reduction in deviant behavior linked to insecurity.

Pedagogical Skills: Effective teaching strategies, such as differentiated instruction and formative assessments, align with Durkheim's argument that education is key in restoring societal values and norms. Teachers who are adept at meeting diverse student needs can reduce feelings of alienation, a core component of anomie. These strategies engage students and reinforce social integration through methods that cater to different learning styles and speeds (Tomlinson, 2001), which promotes societal solidarity by preventing students from falling into deviant behaviors or social isolation.

Classroom Management: Effective classroom management is a direct application of Durkheim's notion of social order. By maintaining an orderly environment, teachers provide students with a stable and predictable atmosphere, essential for promoting discipline and social conformity. As classroom disruptions are minimized, students are better able to focus on learning, which, according to Durkheim's theory, prevents the breakdown of social norms and encourages cooperative behavior. Studies indicate that good classroom management is linked to better student outcomes and fewer behavioral problems (Emmer & Sabornie, 2015), aligning with Durkheim's assertion that effective social systems help reduce deviant behaviors.

Professionalism and Continuous Learning: Durkheim emphasizes the role of social institutions in ensuring stability. Continuous professional development, as highlighted in the conceptual framework, is a way to keep teachers connected to evolving educational norms and practices. Lifelong learning for teachers equips them to adapt to changes in society, reinforcing social values that foster cohesion. Teachers who embrace professional growth contribute to long-term societal stability by ensuring that education remains responsive to social changes and community needs (OECD, 2020).

Nomadic Education: The challenges faced by nomadic education in Northern Nigeria are rooted in the exclusion of these communities from the broader educational system. As highlighted in the theoretical framework, this exclusion leads to feelings of anomie and normlessness. Durkheim's theory helps explain how the lack of stable education exacerbates this issue. The federal government's establishment of the National Commission for Nomadic Education (NCNE) addresses these challenges, aiming to integrate nomadic children into the educational system. This integration, facilitated by improved teacher quality, is essential for restoring social cohesion, as it brings marginalized communities into the broader social fold. However, as the framework indicates, this integration is hindered by barriers such as poor infrastructure, low-quality teachers, and cultural resistance (NCNE, 2017). Improving these aspects can address the feelings of alienation described in Durkheim's theory and ultimately reduce insecurity.

Rural Insecurity: Rural insecurity, primarily caused by armed groups such as bandits, is closely linked to the anomie experienced in nomadic and rural communities. Durkheim's theory suggests that the breakdown of societal norms leads to deviant behavior, such as violent crime. The lack of effective education in these communities can foster an environment where lawlessness and violence thrive. The activities of armed groups, including cattle rustling, kidnapping for ransom, and raids on villages (United Nations Institute for Disarmament Research, 2024), can be seen as manifestations of anomie, where the breakdown of social norms and values contributes to criminal behavior.



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Armed Groups and Raids: The presence of armed groups in rural areas, which prey on vulnerable communities, highlights the absence of a social framework that could prevent such criminal behavior. Durkheim's theory would argue that the lack of social integration and strong community ties contributes to the rise of these groups. By improving teacher quality and educational outcomes, these communities can experience better integration into society, reducing the appeal of joining criminal gangs.

Kidnapping for Ransom: Kidnapping, as a major crime in rural Northern Nigeria, is exacerbated by the lack of social cohesion and institutional support. According to Durkheim's theory, the breakdown of social structures, including education, increases the likelihood of deviant behavior. Enhancing education, and thus restoring a sense of order and belonging, can reduce the risk of young people being drawn into criminal enterprises.

Theoretical Framework

Durkheim's concept of *anomie*, a state of normlessness and social instability, can be applied to nomadic communities in rural Nigeria. In these areas, the transient nature of nomadic life disrupts consistent access to education, leading to a breakdown of social cohesion. This fragmented educational infrastructure exacerbates the issue, resulting in instability and the erosion of social norms and values. Such social disorganization increases the potential for deviant behavior and insecurity (Akinmoladun et al., 2022; Adewale, 2021). Education is essential in restoring social order. Durkheim's notion of *collective conscience* emphasizes the importance of shared values and norms that bind society. In nomadic communities, improving education quality can help restore social cohesion by integrating academic knowledge and societal norms. Quality teachers can reinforce a collective identity, giving nomadic children a sense of belonging and stability. This moral integration, which includes teaching values like peace and cooperation, can help integrate students into the broader society and make them more resilient to external threats like extremism (Durkheim, 2013; Tella & Tella, 2020; Baker & Keegan, 2021). Durkheim argued that anomie occurs when individuals lack guidance and structure. Teachers play a critical role as social anchors, especially in nomadic schools with weak or inconsistent educational structures. High-quality teachers can reduce alienation and foster social cohesion, helping mitigate violent conflict and integrate nomadic students into the broader societal framework (Olaniyan et al., 2018; Akinmoladun et al., 2022). Educational disparities between rural and urban areas in Nigeria exacerbate feelings of alienation and insecurity. Durkheim's theory suggests that inequality in educational opportunities leads to higher rates of deviance and conflict. Addressing these disparities in nomadic communities can bridge the gap, promoting social cohesion and reducing anomie (Akinmoladun et al., 2022; Baker & Keegan, 2021). Improving teacher quality can provide nomadic children with equal opportunities for social integration and success. Social cohesion is key to stability, and Durkheim emphasized that its lack leads to insecurity. Improving education in nomadic communities can foster this cohesion. Teachers impart not only academic knowledge but also values promoting peace and cooperation, which can reduce involvement in criminal activities and contribute to reducing rural insecurity. Culturally competent teachers can serve as role models and help build resilience against threats like violent extremism (Baker & Keegan, 2021; Olaniyan et al., 2018). Durkheim's theory of anomie highlights the challenges faced by nomadic schools in Nigeria. Strengthening teacher quality can restore social cohesion, reduce alienation, and prevent the breakdown of norms that contribute to insecurity. Teachers, through stable, high-quality education, play a vital role in mitigating the causes of anomie and fostering shared values and community solidarity, ultimately helping to reduce insecurity in nomadic and rural communities (Tella & Tella, 2020).



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Overview of the Nomadic Education Programme in Nigeria

The Nomadic Education Programme in Nigeria was introduced to address the unique educational needs of nomadic populations, including pastoral nomads, migrant fishermen, and other mobile communities. This initiative began in 1989 with the establishment of the National Commission for Nomadic Education (NCNE), which was tasked with implementing the programme nationwide. The NCNE works in close collaboration with state and local governments, as well as local communities, to ensure that nomadic children have access to education. The programme is a crucial component of Nigeria's effort to provide equal educational opportunities to all citizens, particularly those who live in marginalized, mobile, or isolated communities (NCNE, 2013). The primary focus of the programme is to provide primary education for children in nomadic communities, ensuring that they can integrate into the broader educational system while also respecting their distinct lifestyles. Given the mobile nature of these populations, the education system has been adapted to meet their needs, incorporating flexibility in classroom structures and educational delivery methods. The Blueprint for Nomadic Education, as outlined by the National Commission for Nomadic Education (NCNE, 2013), highlights the following objectives:

Expose nomadic children to modern education – Providing a foundation for nomadic children to access primary education and integrate into formal education systems.

Instill a sense of belonging – Educating nomadic children to recognize themselves as members of the broader Nigerian society, fostering national unity and understanding.

Facilitate community development – Ensuring that nomadic children can actively participate in the development of their local environments and the country as a whole.

Improve living conditions – Educating nomadic children to modernize their herding and animal management techniques, thereby improving their livelihoods and reducing hardship.

Promote moral and religious values – Teaching moral and religious practices to promote the overall well-being of the child.

Support physical and intellectual development – Providing opportunities for nomadic children to develop the skills necessary to thrive in the modern world, including both academic and practical knowledge.

To accommodate the distinctive lifestyle of nomads, various approaches have been integrated into the Nomadic Education Programme in Nigeria:

Regular Schools – Designed for settled nomadic groups, with the inclusion of "helping teachers" who assist children struggling with unfamiliar curriculum or school systems.

On-Site Schools – Established for semi-sedentary nomads, typically located along common movement routes, enabling children to attend school while their families continue with their traditional activities.

Mobile Schools – Portable, flexible classrooms designed for families on the move. These schools incorporate models such as the Koranic Mallam Model, which is culturally relevant and adapted to the mobility of the students.

Adult Education – Offering basic literacy and numeracy programs for nomadic men and women to ensure that the entire community has access to educational opportunities.

Radio and Distance Education – A supplemental learning method that utilizes culturally relevant radio programs to reach nomadic children who may be geographically isolated or difficult to reach through traditional schooling methods.

The classroom structures within the Nomadic Education Programme are flexible and designed to accommodate the nomadic lifestyle. These structures include:



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- i. Permanent structures in settled communities.
- ii. Semi-permanent classrooms that can be adapted as needed.
- iii. Temporary classrooms that are easily moved to accommodate the mobile nature of nomadic communities.
- iv. Under tree-shade classrooms for areas where even temporary structures are difficult to establish.

Teacher Quality in Nomadic Schools in Nigeria

Teacher quality is a critical factor influencing the overall quality of education in Nigeria's nomadic schools. Despite the National Commission for Nomadic Education (NCNE) implementing various programs to improve teacher training, there are still significant challenges in providing qualified and competent educators for nomadic communities. Many teachers who receive specialized training for nomadic schools are often transferred to conventional schools, leaving a shortage of qualified staff in these rural areas. Additionally, the reluctance of teachers to accept postings in rural and remote regions exacerbates the staffing crisis, which has been a major barrier to improving the quality of education for nomadic children (NCNE, 2018). One of the states most affected by this issue is Bauchi, where schools suffer from dilapidated infrastructure and insufficient qualified teachers. For example, in Mararaban Liman Katagum, a 14-year-old student struggles with algebraic equations, despite being taught by a social studies teacher who was reassigned to teach mathematics without the necessary background (UNICEF, 2023). This lack of subject-specific expertise highlights the broader issue of inadequate teacher preparation and mismatched assignments in nomadic schools.

In response to the teacher shortage, the NCNE has implemented a multigrade teaching method that allows a single teacher to manage multiple grade levels. While this approach is a necessary adaptation, it faces significant hurdles, including limited funding, insecurity, and a continued lack of teachers willing to serve in rural areas (NCNE, 2017). These challenges have led to low pupil enrollment, high dropout rates, and an increasing number of out-of-school children in nomadic communities. A 2023 report by the NCNE identified several persistent problems that impact teacher quality, including a shortage of qualified teachers, especially female teachers who could serve as role models for the nomadic girl-child. The report also noted that many trained teachers are indiscriminately transferred to conventional schools without replacement, further undermining efforts to improve education in nomadic communities (NCNE, 2016).

Sociological Viewpoint on Teacher Quality as a Tool for Combating Rural Insecurity in Nigeria

Emile Durkheim's Anomie Theory provides a compelling framework for understanding the challenges of teacher quality in nomadic schools in northern Nigeria and how improving education in these communities can serve as a tool for combating rural insecurity. Anomie, in Durkheim's terms, refers to a state of normlessness, where the absence or breakdown of social norms and values leads to a disconnect between individual aspirations and societal expectations. In times of social change or instability, this lack of shared norms can result in alienation, frustration, and ultimately, social disintegration. When individuals feel disconnected from established societal norms, they may engage in deviant behavior, which, in the case of rural insecurity, can contribute to rising violence and criminal activity. In the context of nomadic schools in northern Nigeria, Durkheim's concept of anomie helps explain the consequences of poor teacher quality and its broader social implications. Nomadic communities are typically marginalized in terms of access to education, economic resources, and infrastructure. This educational deprivation results in a shortage of qualified and adequately trained teachers, perpetuating a cycle of educational anomie. Without proper standards,



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norms, or qualifications, the educational system in these regions fails to provide children with a strong foundation for societal integration, exacerbating feelings of alienation and disconnection. This dysfunction within the educational system has far-reaching social consequences. Nomadic communities face the unique challenge of constant migration, which undermines the stability of educational programs. Teachers in these areas are often undertrained and lack the necessary resources to effectively educate students. This situation fosters a sense of normlessness—children in these communities are not equipped with the skills or knowledge required to participate in the formal economy or integrate into broader society. Consequently, they may grow up feeling disconnected from mainstream society, increasing their vulnerability to recruitment by groups involved in criminal activities, such as armed banditry and kidnapping.

Enhancing teacher quality in nomadic schools can serve as a crucial countermeasure to the social dysfunction described by Durkheim. Addressing teacher shortages, providing professional development opportunities, and ensuring that teachers in nomadic areas are properly qualified can help re-establish educational norms and standards essential for social integration. High-quality education can act as a stabilizing force, giving children a sense of purpose and direction, thereby reducing the likelihood of social dislocation and insecurity. Education not only equips students with essential skills for economic participation but also fosters a shared understanding of societal values, contributing to greater social cohesion and peace within these communities. Durkheim's theory underscores the role of education as a mechanism for social integration. It helps establish common values and norms that promote social solidarity. In nomadic communities, providing quality education can mitigate feelings of alienation by equipping children with the tools necessary to build sustainable livelihoods. This educational empowerment can also strengthen community bonds, as children who are educated with a focus on shared values and community development are more likely to contribute positively to their society. Recent studies highlight the role of education in combating rural insecurity in Nigeria. According to a 2023 report, over 60% of children in nomadic areas lack access to quality education, and many of those who do attend school face high dropout rates due to inadequate teaching and resources (NCNE, 2023). As a result, educational institutions, particularly those in rural and nomadic areas, remain key sites for addressing the root causes of rural insecurity. As noted by the United Nations Development Programme (UNDP, 2024), improving educational outcomes in rural areas can mitigate the socio-economic factors that drive violence and insurgency. From a Durkheimian perspective, improving teacher quality in nomadic schools in northern Nigeria is more than just an educational reform; it is a vital tool for combating rural insecurity. By restoring order and stability in educational systems, society can integrate marginalized groups into the broader social and economic fabric, thereby reducing the alienation that often fuels insecurity.

Conclusion

Strengthening teacher quality in nomadic schools in northern Nigeria is essential not only for improving education but also for addressing rural insecurity. Poor teacher qualifications, inadequate resources, and social dislocation contribute to educational deprivation, reinforcing the normlessness and instability that fuel insecurity. From a Durkheimian perspective, investing in teacher training, professional development, and educational infrastructure can restore social cohesion, reduce alienation, and equip children with the skills necessary for economic and societal integration. By improving education in nomadic communities, society can mitigate the root causes of rural insecurity and promote long-term stability.



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Suggestions

Based on the conclusion drawn on the basis of discussion, the following suggestions were put forward:

1. There is a need for the government, through the NCNE, to increase Teacher Training Programmes. This can be achieved by establishing specialized training programs for teachers in nomadic schools to ensure they possess the necessary skills and knowledge to teach effectively in these unique environments.
2. Considering the unique challenges faced while teaching in nomadic schools, there is a need to provide incentives for teachers. This can be done by offering financial and professional incentives, such as higher salaries and housing allowances, to attract qualified teachers to rural and nomadic schools.
3. To complement government efforts, there is a need for pastoralists to be willing to give up some control. To achieve this, the issue of the cattle tax (*Jangali*) needs to be revisited. However, this can only be possible when pastoralists make themselves known, register, and allow their movements to be monitored before any reasonable planning for the livestock sector can take place.
4. To achieve the above suggestions, there is a need for the NCNE to continue promoting community involvement. This can be done by encouraging local communities to actively participate in the education process, fostering a sense of ownership and responsibility for the success of nomadic schools.
5. Since effective teaching and learning interactions require classroom infrastructure, which is lacking in nomadic schools, more emphasis should be placed on multigrade teaching models to improve teacher quality. Therefore, the NCNE should refine multigrade teaching strategies that allow teachers to effectively handle mixed-age classrooms often found in nomadic schools.
6. There is also a need to increase the recruitment and support of female teachers to serve as role models, especially for girls in nomadic communities, helping to address gender disparities in education.
7. The frequent transfer of trained teachers to conventional schools needs to be stopped while ensuring consistent deployment and job stability in nomadic schools.

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Impact of Hausa-Chemistry-Practical-Module on ... Salihu, F., Et. al. (2025)

Impact of Hausa-Chemistry-Practical-Module on Achievement in Science-Process-Skills among Secondary School Chemistry Students in Minna, Niger State, Nigeria

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Abstract

The study developed and validated a Hausa Chemistry practical module for integrating science process skills among secondary school students in Minna, Niger state. This study employed the design and development research approach to establish an empirical basis for creating the Hausa Practical Module, a self-instructional module. In particular, the researcher utilised the ADDIE (Analysis, Design, Development, Implementation, Evaluation) Model in developing the Hausa Practical Module in Volumetric Analysis. The total population was twelve thousand four hundred and thirty-three (12433). The students in each of the intact classes will constitute the sample size (414, as obtained from the Rao soft Sample Size Calculator) to be used for the study. Two research questions were raised. Six experts validated the research instrument used for the study. Three instruments were used for this study. A Test-Retest Method was used to administer the CPATEL and CPATHL, i.e. the students were given the CPATEL and CPATHL multiple-choice items with four options A-D after one week, and the same test was re-administered to the same group of students. The results of the first test and the second were subjected to Pearson's Product-Moment Correlation Coefficient (r), and their correlation coefficient indexes of 0.89 for the CPATEL and 0.81 for the CPATHL, meaning the two instruments are reliable for the study.

Keywords: Hausa Practical Module and Science process skills.

Introduction

Chemistry instruction accentuates understanding and establishing the relationship between the students' knowledge and intuition about the concrete structure and theoretical nature of Chemistry, and because of its abstract nature, Chemistry is also usually a subject that is best endured rather than enjoyed by most young learners who are not well grounded in learning and studying Chemistry concepts. As an educationist, it is thus significant to explore how instructional design can be used in a traditional learning environment to enhance the teaching and learning of Chemistry concepts. Instructional design, which involves the systematic development of instructional materials and activities, ensures that learners achieve specific learning goals or educational outcomes reflected in the education curriculum and also provides relevant instructions suitable for a wide range of learning environments in schools at all times (Torrefranca, 2017).



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One of the important educational innovations in instructional design that can complement traditional face-to-face instruction is programmed instruction in module form. This approach, often called the Modular Approach, consists of self-directed learning activity packets that are self-instructional, self-paced, student-directed, and place the responsibility of learning on the students. The basic principles of modular instruction involve the division of the curriculum into limited units or modules of learning, which are assessed at the end of that unit, with the student building up a degree through such learning being credited (Torrefranca, 2017). Through this method, the teacher sheds the role of presenter, demonstrator, driller, and questioner, and now takes on the role of facilitator, initiator, monitor, coach, and coordinator. More importantly, it provides students with opportunities to direct their learning while constructing meaningful experiences about the concepts being taught, which can be done in any mother tongue, not just English. In learning, the use of Mother Tongue Language(s) can play an important role, because without language communication in any given society may be difficult to comprehend, and these languages come in different forms and types for instance English, Latin, Spanish, Arabic, Yoruba, Igbo, Gbaygi, Nupe, and Hausa which are all examples of Mother Tongue all over the world (Anna and Ericson, 2018).

In the same vein, Mother tongue is the first language one learns as a baby, the language one grows up knowing, which is also known as the native language of that particular child. A child first comprehends what is around them through the language the child hears his/her mothers communicate with and use daily. Also, the mother tongue is central in framing the thinking and emotions of individuals learning in school with the use of that particular language and it is an influential tool in advancing the learning of an individual or persons, the mother tongue also largely refers to not only the language one learns from one's mother but also the speaker's dominant and home language within a given community that is, the native language of that community for example in Nigeria Yoruba, Igbo, Gbaygi, Nupe and Hausa are few but native languages in the country that are used in daily activities and in almost all the communities, schools, markets within the country (Ali, et. al., 2014). Hausa is a major Mother Tongue Language with more first-language speakers than any other sub-Saharan African language with – an estimated population of 50 million speakers or more – most of whom live in Northern Nigeria and the Southern Republic of Niger. Mother-tongue speakers of Hausa include many ethnic groups in Nigeria, including the Fulani, amongst others. The Hausa language can also be used as a medium of instruction in a class to teach science courses like Chemistry.

Chemistry is a sub-discipline of science that deals with the study of matter and the substances that constitute it. It also deals with the properties of these substances and the reactions undergone by them to form new substances. Chemistry primarily focuses on atoms, ions, and molecules, which, in turn, make up elements and compounds. These chemical species tend to interact with each other through chemical bonds. It is important to note that the interactions between matter and energy are also studied in the field of chemistry. The five primary branches of chemistry are Physical chemistry, Organic Chemistry, Inorganic chemistry, Analytical chemistry, and Biochemistry. Apart from these primary branches, there exist several specialised fields of chemistry that deal with cross-disciplinary matters. Some such examples include Medicinal chemistry, Neurochemistry, Material Chemistry, Nuclear Chemistry, Environmental chemistry, Polymer chemistry, and Thermochemistry. All these branches of chemistry are taught to students in senior secondary schools in the form of theory and practical (Gebrekidan, et. al, 2014).



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Practical work carried out by students themselves is an essential part of Chemistry, although critical views on its effectiveness also exist. Many chemistry education researchers believe that students' practical work improves their learning of science. It is on this basis of the above that Gebrekidan, et. al., (2014), for example, opined that “laboratory experiences have been purported to promote central science education goals, including the enhancement of students’ abilities; scientific practical skills and problem-solving abilities; scientific ‘habits of mind’; understanding of how science and scientists’ work; as well as interest and motivation”. Chemistry without practical work was seen as a body of factual information and general laws, which conveyed nothing of lasting power to the mind. In this study, the term 'practical', as it is commonly used in the science education literature, refers to any type of science teaching and learning activity in which students are expected to be working either individually or in groups, interact with materials to observe and understand the natural world specifically in Chemistry (Gebrekidan et. al, 2014).

Accordingly, central to the teaching-learning process in the secondary chemistry curriculum is practical work geared towards mastery of scientific skills: process skills, manipulative skills, and critical thinking skills. More specifically, after completion of their upper secondary chemistry syllabi students are expected to use scientific methods in solving problems; and demonstrate an understanding of experimental skills, knowledge of laboratory procedure, and scientific inquiry skills including observing, inferring, predicting, comparing and contrasting, communicating, analysing, classifying, applying, theorizing, measuring; asking questions, developing hypotheses, performing and designing experiments, interpreting data, drawing conclusions, making generalizations and problem-solving for better academic achievement of students (Anna and Ericson, 2018).

Achievement is defined as the measure of accomplishment in a specific field of study within a specific period. Some researchers maintained that the achievement of the students is the demonstration of the students’ abilities to attain certain levels of instructional objectives outcome of classroom instruction and experience (Okwara and Upu, 2017). Once learning truly takes place it will be reflected in students’ academic achievement of that particular student as stated in the study of Yahaya, et. al., (2020) who see achievement as a quantified means that measures the student’s academic standing about those of other students' age bracket and of the same learning environment. Academic achievement from different perspectives of researchers is a key component in education of any school or institution and this is the reason why over the years, it has been a major focus of researchers and experts in education. With the use of Hausa as a medium of instruction in schools, the academic achievement of Chemistry Senior Students in Secondary Schools may yield knowledge of science in the advancement of a nation (Faruku and Corrienna, 2019).

The nature of science is dichotomous, because, it is both a body of knowledge and a process of acquiring new knowledge. In other words, science is categorized into ‘Process’ and ‘Product’ (Safaah, et. al., 2017). The ‘process’ of science is categorized into two, namely; scientific attitude and science process skills; while the ‘product’ of science are facts, concepts, principles, theories, and laws. Scientific attitude is the ability to react consistently, rationally, and objectively in certain ways to a novel or problematic situation (Olasehinde and Olatoye, 2014). Scientific attitude can also be the mindset to do things in a way that relies on proven and empirical principles rather than unverified principles. A scientific attitude is not adequate to produce a more reliable outcome without the use of science process skills (SPS). Science Process Skills are hands-on and minds-on skills that are deployed in solving scientific problems. Science process skills provide a framework for how scientists think, work, and study problems as well as seek solutions scientifically (Idiege, et. al., 2017).



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According to Safaah, et. al., (2017), science process skills are a set of skills used in conducting scientific activities and using scientific information to solve problems. Science process skills originated from a program named 'Science A Process Approach' (SAPA) introduced by the 'American Association for Advancement of Science' (AAAS) in the year 1967. The AAAS classified SPS into the basic and integrated skills, which were fifteen (15); the basic science process skills are eight (8), while the integrated science process skills are seven (7).

The basic science process skills are fundamental skills that are necessary for scientific discovery. Examples of basic science process skills are: observing, measuring, classifying, communicating, predicting, inferring, using numbers, and questioning. Integrated science process skills are higher skills that are the pillars, which are built on the existence of basic science process skills. Examples of integrated science process skills are: formulating hypotheses, experimenting, manipulating and controlling variables, interpreting data, defining operationally, formulating models, and presenting information. The basic science process skills that will be assessed in this study are: observing, measuring, classifying, communicating, inferring, and recording/using numbers (Keziah and Adamu, 2022). These science process skills will be assessed because it is captured in the senior secondary school two (SS2) Chemistry syllabus. Basic science process skills are deployed through practical experiences in science subjects, which chemistry at various ability levels. Witkin et. al. (2015) have identified three ability levels in teaching-learning situations, viz: High, medium, and low. High-ability level learners are those who prefer isolation and social distance, theoretical and abstract ideas (akin to field independent learners). According to him, high-ability individuals are better than medium or low-ability groups and might be better in other tasks that have to do with the use of hands. In this case, the high-ability group has a greater ability to structure information and solve problems. However, medium-ability level learners perform relatively better on learning activities involving social materials and are more likely to require externally defined goals and reinforcements (Witkin et. al., 2015). These ability levels of students can be found in both genders. Gender is a state of being a male or a female. The role of gender in achievement, especially in Chemistry from one study to another. Various studies, for example, Jugović (2017) and Okwara and Upu (2017), in the area of gender influence on achievement were unpredictable. Some studies favoured male students over females in Chemistry achievement, while other studies are in favour female students. With the empirical evidence about academic achievement, the study seeks to develop and validate of Hausa Practical Module for Integrating Science Process Skills Among Secondary School Students in Minna, Niger State.

Despite the increasing diversity of students in multilingual classrooms across most schools in Nigeria, the language of instruction remains a contentious issue due to the National Policy on Education (NPE) 2013. Section 1, which covers the Philosophy and Goals of Education in Nigeria under serial number 8, states that "To fully realise the goals of education in Nigeria and benefit from its contribution to the national economy, the Government shall take necessary measures to ensure that: every child shall be taught in the mother tongue or language of the immediate community for the first four years of basic education. Additionally, it is expected that every child shall learn one Nigerian language. This policy highlights the importance of the mother tongue or language in teaching and understanding core subjects like the economy, but it is limited to the first four years of basic education. However, if the use of the mother tongue or language could be incorporated into the teaching and learning of chemistry practicals, it could significantly contribute to Nigeria's economic development, given that practical chemistry enhances economic benefits. This entails developing a skilled workforce through practical chemistry, which is essential for industries, research institutions,



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and laboratories. While practical work is vital in chemistry education, it also presents challenges, such as difficulties in reading and understanding materials published in a foreign language. Furthermore, practical work demands more time and the presence of qualified and experienced teachers, as well as technical assistants. More importantly, the language used in teaching practicals can hinder some students' ability to interpret key concepts and terminology. Based on these considerations, the study aims to develop and validate a Hausa Chemistry Practical Module to integrate science process skills among secondary school students in Minna, Niger State.

Aim and objectives of the study

The main aim of this research study is to develop and validate a Hausa Chemistry practical module for integrating science process skills among secondary school students in Minna, Niger state. Specifically, the objectives of the study are to:

1. Design a Hausa Chemistry Practical Module for integrating science process skills among secondary school students in Minna, Niger state.
2. Establish the content validity of the designed Hausa Chemistry Practical Module for integrating science process skills among secondary school students in Minna, Niger state.
3. Find out the effect of the Hausa Chemistry Practical Module on Secondary School Students' Achievement in Volumetric Analysis.
4. Find out the effect of the Hausa Chemistry Practical Module on Secondary School Achievement in Volumetric Analysis based on Gender.

Research Questions

The following Research Questions were raised to guide the study:

1. What are the strategies in the development of the Hausa Chemistry Practical Module?
2. What is the established content validity of the designed Hausa Chemistry Practical Module for integrating science process skills among secondary school students in Minna, Niger state?
3. What is the effect of the Hausa Chemistry Practical Module on Secondary School Students' Achievement in Volumetric Analysis and those taught with the demonstration method?
4. What is the effect of the Hausa Chemistry Practical Module on the mean achievement scores of Male and Female students taught Volumetric Analysis?

Scope of the Study

The study was limited to Minna, Niger State, which is the state capital and has two major local government areas, Chanchaga and Bosso, respectively, located at 10°00'N and 6°00'E of the equator. The topic covered was titration in Chemistry Practical. The study was conducted in the four (4) Senior Secondary Schools, which are Chanchaga and Bosso Local Government Area of Minna. The study was delimited to SS II students of the selected Senior Secondary Schools because the topic is offered in the SS II curriculum. The variable scope is Volumetric Analysis, and the study lasted for six (6) weeks.

Research Methodology

This study utilised the design and development research approach to establish an empirical basis for the creation of the Hausa Chemistry Practical Module, which is a self-instructional module. In particular, the researcher utilised the ADDIE (Analysis, Design, Development, Implementation, Evaluation) Model in developing the Hausa Chemistry Practical Module in Volumetric Analysis, as shown in (Appendix A). while the study also utilised a quasi-experimental design (pre-test post-test non-equivalent, non-randomised, control group). The reason for adopting a quasi-experimental design is that the researcher will use intact classes in the implementation and Evaluation of the



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Hausa Chemistry Practical Module. The quasi-experimental design layout utilised is shown in Table 3.1

Table 3.1 Research Design Illustration

Groups	Pretest	Treatment	Posttest
Experimental Group	O ₁	X	O ₂
Control Group	O ₁	-	O ₂

Where:

O₁, O₁ - Pretest Scores of experimental and control groups.

O₂, O₂ - Posttest Scores of experimental and control groups.

X₁ – Treatment for the experimental group only

Population of the Study

The population of this study comprised all the Senior Secondary II Students from all the government-owned Senior Secondary Schools in Minna, the capital of Niger State. The total population was Twelve Thousand Four hundred and thirty-three (12433) (See Appendix K) students who were in SSII, although the targeted population for the study were all Senior Secondary II Students who registered for Chemistry in the 2023/2024 academic session.

Sample and Sampling Techniques

For this study, a simple random sampling technique was applied to select the four 4 schools and similarly, the same sampling technique was applied in picking Senior Secondary School Students II (SSII) intact classes used for the research exercise. The students in each of the intact classes constituted the sample size (414) used for the study. The four 4 intact classes selected for the study, two classes out of the four, were assigned as experimental and control groups randomly. The distribution of the sampling size of (414) for this study

Research Instrument

Three instruments were used for this study and were categorized as follows;

1. Treatment Instrument (Hausa Chemistry Practical Module (HCPM))
2. Test Instrument (Chemistry Practical Achievement Test (CPAT))
3. Science Process Skills Rating Instrument (SPSRI)
4. Evaluators' Rating Form (ERF)

Validation of Research Instruments

Validation of Hausa Practical Module (HPM)

To gather evidence that supported the adequacy of objectives, content, format and language, presentation, and usefulness of the Hausa Chemistry Practical Module to its intended users, expert judgments were sought by the researcher. In doing this, the first draft of the Hausa Chemistry Practical Module was printed and presented by the researcher to her supervisor and two experts on the development in the Chemistry Department, COE Minna. Then, the researcher revised the module based on the comments and suggestions of the experts who were requested to read and evaluate the modules. Afterwards, the revised HCPM was validated by 7 experts. This panel of experts consisted of one chemistry professor, three Hausa teachers, one head teacher, one college of education chemistry instructor, and one test specialist. They examined the module based on five indicators, which include: (1) objectives; (2) content; (3) format and language; (4) presentation; and (5) usefulness of the instructional module. Observations, Corrections and Suggestions of the experts were used to produce the final copy of this instrument, which was used for this study.



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Validation of Chemistry Practical Achievement Test (CPATEL) and Science Process Skills Rating (SPSREL)

The Chemistry Practical Achievement Test in English Language (CPATEL) and Science Process Skills Rating in English Language (SPSREL) were validated by three (3) experts: one in the Chemistry Department, College of Education, Minna, one Chemistry teacher from Maryam Babangida Girls Science College, Minna, and one Chemistry Teacher from Himma International School, Minna. These experts examined the face and content of the instruments. Generally, the validators' comments and suggestions were used for necessary modifications. The test items were corrected and modified according to the suggestions and comments of the experts.

Validation of Chemistry Practical Achievement Test in Hausa Language (CPATHL) and Science Process Skills in Hausa Language (SPSHL)

The Chemistry Practical Achievement Test in Hausa Language (CPATHL) and (SPSHL) were validated by three experts, one in the Hausa Department, College of Education, Minna, one in Maryam Babangida Girls Science College, and one expert in Himma International School, Minna. These experts examined the face and content of the instruments. Generally, the validators' comments and suggestions were used for necessary modifications. The test items were corrected and modified according to the suggestions and comments of the experts.

Reliability of the Research Instruments

A pilot test was conducted to determine the reliability of the test instrument, which was conducted in a different Senior Secondary School that did not constitute the sample of the study. Forty (40) (20 Male and 20 Female) students were used to obtain the reliability of the Chemistry Practical Achievement Test in English Language (CPATEL) and Chemistry Practical Achievement Test in Hausa Language (CPATHL). A Test-Retest Method was used to administer the CPATEL and CPATHL, i.e. the students were given the CPATEL and CPATHL multiple-choice items with four options A-D after one week, and the same test was re-administered to the same group of students. The results of the first test and the second were subjected to Pearson's Product-Moment Correlation Coefficient (r), and their correlation coefficient indexes of 0.89 for the CPATEL and 0.81 for the CPATHL, meaning the two instruments are reliable for the study. The SPSR obtained was subjected to the Cronbach Alpha, and it yielded a correlation coefficient index of 0.82.

Method of Data Collection

The researcher visited the four (4) sampled schools two weeks before the experiment to seek official permission from the school Management. After the permission had been granted, the researcher was introduced to both teachers and students of the selected schools. A total of 414 (241 Male and 173 Female) students were selected from the four 4 sampled schools. The technique adopted was the simple random sampling technique, which was used to select the class in each of the schools (experimental and control) for the study. Afterwards, the researcher, together with the research assistants, made arrangements on how to use the (HCPM) on the experimental groups and use a normal practical class procedure on the control group. During the first and second (1st and 2nd) weeks of the study pre-test was administered to all the groups with the help of the research assistants before the treatment to determine the knowledge equivalence of both the experimental and control groups. Thereafter, actual teaching for all the groups took place from the third to the fifth (3rd to 5th) week. Lessons on the content areas were therefore presented for three (3) weeks using a double period of eighty minutes per week. From the 6th week, there was a revision and administration of the Chemistry Practical Achievement Test (CPAT) to the two groups (experimental and control) as a post-test. The entire period for data collection lasted for six (6) weeks.



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Method of Data Analysis

A descriptive statistic specifically percentages, means and standard deviations in analyzing the evaluation ratings of experts were used to answer the stated research questions stated for this study because the data obtained were discrete in nature and also z-test and Analysis of variance (ANOVA) was used to test all the hypotheses at 0.05 significant level and the statistical tool was chosen because the data obtained from pretest and posttest scores was of discrete numerical type. A computer software Statistical Package for Social Science (SPSS) version 23.0 was used for the analysis of data obtained for the study.

Results And Discussion

This Chapter presents the relevant data for answering the research questions and for testing the hypotheses. The descriptive statistics of mean and standard deviation were used to answer the research questions, while the hypotheses were tested using the z-test statistics.

Designed Self-Learning Module

Hausa Chemistry Practical Module (HCPM) areas of Volumetric Analysis were developed and validated. Specifically, the module consisted of 6 lessons on Volumetric Analysis and is listed as follows: Volumetric Analysis; Units of Measurement; Acid-Base Titration; Acid-Base Determination of the Concentration (Standardisation) of a Solution; Acid-Base Determination of Percentage Purity of a Substance; Acid-Base Titration of a Solution of a Weak Base and A Strong Acid

The developed instructional module included the following parts: objectives, pretest, learning activities with illustrative examples, practice tasks, and posttest. The researcher ensured that the developed module has built-in statements of objectives informing students about what they should be able to learn after instruction. Furthermore, the module has the information sequenced in logical steps, and then testing (e.g. practice tasks, posttest) is undertaken to make sure that students can follow the steps.

Validation of the Developed Instructional Module

Table 1a Evaluators' Rating

Aspect of the Instructional Module	Items	Mean (\bar{x})	SD	Decision
Objectives of the Module	The objectives are clearly stated in the module's behavioural form	3.29	1.113	Good
	The objectives are well-planned, formulated, and organised.	4.15	0.691	Very Good
	The objectives stated are specific, measurable, and attainable.	3.86	1.070	Very Good
	The objectives are relevant to the topics of each lesson of the module	3.58	1.398	Very Good
	The objectives take into account the needs of the students	3.58	1.512	Very Good
	Overall	3.69	1.157	Very Good
Content of the Module	The content of each lesson is directly relevant to the defined objectives	3.00	1.155	Good
	The content of each lesson is simple and easy to understand	3.72	0.952	Very Good
	The topics of each lesson are fully discussed.	3.29	1.113	Good



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	The topics are supported by illustrative examples, and the practice tasks are suited to the level of the students	3.15	1.215	Good
	Each topic is given equal emphasis in the lesson.	3.58	1.273	Very Good
	Overall	3.35	1.142	Good
Format and Language of the Module	The format/layout is well-organised, which makes the lessons more interesting.	3.43	1.273	Good
	The language used is easy to understand.	3.58	1.134	Very Good
	The language used is clear, concise, and motivating.	3.43	0.535	Good
	The symbols used are well-defined.	3.58	1.134	Very Good
	The instructions in the instructional module are concise and easy to follow	3.86	0.691	Very Good
	Overall	3.58	0.953	Very Good
Presentation of the Module	The topics are presented in a logical and sequential order.	2.72	0.952	Good
	The lessons of the module are presented in a unique and original form.	3.29	1.254	Good
	The learning activities are presented clearly.	3.86	1.070	Very Good
	The presentation of each lesson is attractive and interesting to the students	3.29	1.254	Good
	Adequate examples are given to each topic.	3.00	1.155	Good
	Overall	3.23	1.137	Good
Usefulness of the Module	The instructional module will motivate the students to study volumetric analysis	3.58	1.273	Very Good
	The instructional modules will help the students master the topics at their own pace.	3.72	1.381	Very Good
	The instructional module will allow the students to use their time more efficiently	3.58	0.976	Very Good
	The instructional module will develop the analytical thinking and reasoning skills of students in solving problems	3.58	1.134	Very Good
	The instructional module will serve as supplementary material that can cater to the needs of the students	3.43	1.512	Good
	Overall	3.58	1.255	Very Good

Table 1b: Summary of the Evaluators' Rating based on the Aspect of the Instructional Module

Aspect of the Instructional Module	Mean (\bar{x})	SD	Decision
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Objectives of the module	3.69	1.157	Very Good
Content of the Module	3.35	1.142	Good
Format and Language of the Module	3.58	0.953	Very Good
Presentation of the Module	3.23	1.137	Good
Usefulness of the Module	3.58	1.255	Very Good
Overall	3.47	1.123	Good

In detail, all evaluators strongly agreed that the instructional module has objectives which are clearly stated in behavioural form, specific, measurable, and attainable. Also, they strongly agreed that the objectives are well-planned, formulated, organised, and relevant to the topics of each lesson of the module, and they take into account the needs of the students. Likewise, the evaluators' responses showed that they strongly agreed that the content of each lesson is directly relevant to the defined objectives, and it is easy to understand. Furthermore, all evaluators strongly agreed that the topics of each lesson are fully discussed and supported by illustrative examples and practice tasks, which are suited to the level of the students. Also, as shown in Table 1a, the variation in the form of the standard deviation of the responses is very small. With regard to the format/layout of the module, the evaluators agreed that the format/layout is well-organised. Likewise, the language used for the module is clear, concise, motivating, and easy to understand. Regarding the presentation of the instructional modules, the evaluators strongly agreed that the topics are presented in a logical and sequential order. They further agreed that the lessons of the modules are presented in a unique and original form. Lastly, looking at the evaluators' responses on the usefulness of the module, the evaluators strongly agreed that the developed instructional module will motivate the students to study Volumetric Analysis. Furthermore, they strongly agreed that the module will help the students master the topics at their own pace. Also, they strongly believed that this module would allow the students to use their time more efficiently and would cater to their needs.

Answering Research Questions

What is the effect of the Hausa Chemistry Practical Module on Secondary School Students' Achievement in Volumetric Analysis, and those taught with the demonstration method? The descriptive statistics of mean and standard deviation were used to answer this research question, and a summary of the results is presented in Table 2

Table 2 shows the descriptive statistics of the mean and standard deviation of students' scores of experimental and control groups at the pre-test and post-test.

Groups	N	Pre-test		Post-test		Mean Difference
		\bar{x}	SD	\bar{x}	SD	
Experimental	192	5.03	1.989	13.70	3.281	8.67
Control	222	5.09	2.005	10.33	2.938	5.24

The data presented in Table 2 shows that the experimental group had a mean score of 5.03 and a standard deviation of 1.989 in the Pre-test and a mean score of 13.70 and a standard deviation of 3.281 in the Post-test, resulting in a Pre-test and Post-test difference in the experimental group to be 8.67. The control group had a mean score of 5.09 and a standard deviation of 2.005 in the pre-test and a post-test mean score of 10.33 and a standard deviation of 2.938, with a pre-test post-test



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difference of 5.24 in the control group. With this result, the students in the experimental group performed better in the achievement test than the students in the control group.

What is the effect of the Hausa Chemistry Practical Module on the mean achievement scores of Male and Female students taught Volumetric Analysis? The descriptive statistics of mean and standard deviation were used to answer this research question, and a summary of the results is presented in Table 3

Table 3: Means and Standard Deviation of Achievement Mean Score Male and Female Groups of Students Taught Volumetric Analysis Using HCPM

Groups	N	Pre-test		Post-test		Mean Difference
		\bar{x}	SD	\bar{x}	SD	
Male	119	4.98	1.979	13.71	3.355	8.98
Female	73	5.11	2.018	13.68	3.179	8.57

Results in Table 3 show that the male group had a mean score of 4.98 and a standard deviation of 1.979 in the pre-test and a mean score of 13.71 and a standard deviation of 3.355 in the post-test, resulting in a pre-test and post-test score difference in the male group to be 8.98. On the other hand, the female group had a mean score of 5.11 and a standard deviation of 2.018 in the pre-test and a mean score of 13.68 and a standard deviation of 3.179 in the post-test making a pre-test and post-test difference of 8.57 The results show that there is a difference between the mean achievement scores of male and female students when taught Volumetric Analysis Using HCPM in favour of the male students.

Conclusion

The study investigated the effects of the development and validation of a Hausa chemistry practical module for integrating science process skills among secondary school students in Minna, Niger state. Seven objectives and corresponding research questions, as well as four research hypotheses, were formulated and have guided the study. The study used Chemistry Practical Achievement Test in English Language (CPATEL, Chemistry Practical Achievement Test in Hausa Language (CPATHL, and Science Process Skills Rating (SPSR) as test instruments. On the other hand, it used Hausa and English versions Volumetric Analysis Modules as the treatment modules. The participants were assigned to the Hausa group and the English group, and a control group was also established. Students were taught and tested, and the data collected were analysed using descriptive statistics and inferential statistics (mean, standard deviation, Z-test). The result established better achievement and higher science process skills among the Hausa version taught group. It was therefore concluded that: Hausa volumetric module is an effective medium of instruction in chemistry as it enhances students' achievement in chemistry. Moreover, Hausa volumetric module is a gender friendly module that can be used in secondary school chemistry practical class learning.

Recommendations

Align with the Recommendation of Federal University of Technology, Minna and Department of Science Education to conduct research in marketable areas and in award-winning research, the researcher recommends the following for future studies:

1. The developed instructional modules can be used to complement the teaching of Volumetric Analysis in the class
2. The federal government of Nigeria should encourage the use of the mother tongue in the teaching and learning of chemistry and other science subjects in secondary schools, as practised by some countries.



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