ZARIA JOURNAL OF EDUCATIONAL STUDIES (ZAJES)

A PUBLICATION OF THE FEDERAL UNIVERSITY OF EDUCATION, ZARIA

EDITORIAL

This Special Edition of *Zaria Journal of Educational Studies (ZAJES)* stands as a testament to the resilience and innovation driving educational research in contexts marked by both promise and adversity. The volume brings together scholarly contributions that address pressing challenges in education, particularly within Nigeria's northeastern region, where conflict and socio-economic instability have profoundly shaped pedagogical landscapes. The articles herein not only reflect the journal's mission to disseminate high-quality, methodologically rigorous research but also underscore the transformative potential of education as a tool for reconstruction, empowerment, and sustainable development.

In this edition, innovative teaching strategies for resource-constrained environments were explored. The various studies conducted show that hands-on, activity-based approaches enhance student interest and academic performance, while cooperative learning models in chemistry education foster critical reasoning. These studies advocate for pedagogical shifts prioritizing student engagement, practical application, and collaborative problem-solving. They also highlight the intersection of conflict and education, with Mary Baranzi's assessment of insurgency impacts in Chibok Local Government Area highlighting the dual crises of educational disruption and food insecurity. Hassan Habib's mathematical model for resettling displaced populations provides a data-driven framework for equitable resource allocation.

The integration of technology and tradition emerges as another critical focus. Ilesanmi Ajibola's analysis of digital tools in religious studies pedagogy argues for a balanced approach that preserves cultural heritage while embracing technological advancements. This duality—honoring tradition while innovating for the future—resonates with the broader imperative to adapt educational practices to diverse learner needs.

This edition also reaffirms ZAJES' commitment to gender inclusivity and equitable access. Several studies, including those on experiential learning and cooperative models, reveal persistent gender disparities in academic outcomes, urging educators to design interventions that bridge these gaps. Furthermore, the emphasis on practical skills—from agricultural science to vocational training—reflects a vision of education as a catalyst for economic mobility, particularly for marginalized communities.

As we navigate the complexities of 21st-century education, this Special Edition serves as both a mirror and a map: it reflects the challenges faced by educators in conflict-affected regions and charts a path forward through evidence-based solutions. The contributions herein challenge us to rethink pedagogical paradigms, advocate for resource equity, and harness education as a tool for societal transformation. To the authors, reviewers, and sponsors—thank you for advancing this critical dialogue. Together, we move closer to an educational system that is inclusive, adaptive, and deeply rooted in the needs of its learners.

Ilesanmi Ajibola, PhD
Editor-in-Chief

FOREWORD

It is with great pride that I introduce the 2024 Special Edition of the *Zaria Journal of Educational Studies (ZAJES)*, a milestone publication that encapsulates the Federal University of Education, Zaria's unwavering dedication to academic excellence and societal impact. This edition embodies the collaborative spirit of scholars, practitioners, and institutions committed to addressing Nigeria's most pressing educational challenges.

The research presented here could not be more timely. The edition focuses on experiences around the education sector in Borno State, north east, Nigeria.

As our nation grapples with the aftermath of insurgency, economic uncertainty, and educational inequity, the insights offered by these studies provide both diagnosis and remedy. From the classrooms of Borno State to the digital frontiers of religious instruction, each article contributes to a collective understanding of how education can—and must—evolve to meet the demands of a changing world.

I commend the authors for their rigor and relevance. Abdulkarim Bala's work on experiential learning in agricultural science exemplifies how localized, hands-on approaches can reignite student passion and performance. Hassan Habib's mathematical model for resettlement offers policymakers a blueprint for humanitarian response, blending academic precision with empathy. Meanwhile, Ilesanmi Ajibola's exploration of technology in religious studies bridges centuries-old traditions with modern pedagogical tools, proving that innovation need not eclipse heritage.

This edition also highlights the critical role of educators as agents of change. Hussaini Mohammed Kyarma's evaluation of entrepreneurship curricula underscores the need for institutional support in equipping lecturers with practical skills, while Mary Baranzi's poignant analysis of insurgency's dual impact on education and food security reminds us that learning cannot thrive amidst deprivation. These studies compel us to advocate for holistic solutions—ones that address infrastructure deficits, teacher training, and community resilience.

To TETFund, the key sponsor of most of the research in the edition, we extend profound gratitude. Your sponsorship has enabled the dissemination of knowledge that transcends academia, influencing policy and practice nationwide. To the editorial board, reviewers, and contributors, your dedication upholds ZAJES' reputation as a beacon of scholarly rigor and relevance.

As the Ag. Vice Chancellor of the Univeristy, I am inspired by the journal's alignment with our collective mission: to foster education that is transformative, inclusive, and responsive to societal needs. Let this Special Edition serve as a call to action—for educators to innovate, policymakers to invest, and communities to collaborate. Together, we can rebuild, reimagine, and rise.

In closing, I invite readers to engage deeply with these contributions. May they inform your practice, ignite your curiosity, and reinforce your commitment to an education system that empowers all learners, even in the face of adversity.

Dr Suleiman Balarabe
Ag. Vice Chancellor,
FUE, Zaria

BRIEF INFORMATION ABOUT THE JOURNAL

The Zaria Journal of Educational Studies (ZAJES) is the official academic journal published by the Federal University of Education in Zaria, Nigeria. The journal was established in 1988 when the College was still part of Ahmadu Bello University, Zaria. Since its inception, ZAJES has served as an important platform for scholars and practitioners in various fields of Education to publish their research findings, perspectives, and responses to prior work. Recognizing the journal's high standards, the Tertiary Education Trust Fund (TETFund) of Nigeria began to sponsor the production of its issues in 2010.

Mission
The mission of ZAJES is to promote and disseminate high-quality research in Education. The journal seeks to publish papers that are theoretically sound, methodologically rigorous, and relevant to the needs of the education community. ZAJES also aims to provide a forum for exchanging ideas and perspectives on the most pressing issues in Education.

Scope
ZAJES welcomes submissions on any topic related to Education. To help readers easily find relevant papers, articles are grouped into five broad subject areas:
- Arts and Social Science Education
- language and Literature Education
- Science and Mathematics Education
- Trends and Innovations in Education
- Vocational and Technical Education

Peer Review Process
All papers submitted to ZAJES undergo an initial online similarity check (plagiarism test) and would only consider articles with 15% or less online similarity results and 5% same source similarity level. Accepted papers are further subjected to a rigorous peer review process. Each paper is reviewed by at least two experts in the field. The reviewers provide feedback on the paper's strengths and weaknesses and recommend revision. The editors of ZAJES then decide whether to accept or reject the paper.

Publication Process
Accepted papers are published in two issues per year. The journal is indexed in several major bibliographic databases.

Disclaimer
While the journal publishes a diversity of well-researched ideas and opinions, the contents do not necessarily reflect the publisher's or editorial board's views. The responsibility for the accuracy and originality of the papers lies entirely with the contributing authors. However, through its rigorous peer review and editorial processes, ZAJES strives to maintain high academic standards and serve as a valuable resource for the education community.

EDITORIAL POLICY

The Editorial Board of Zaria Journal of Educational Studies (ZAJES) invites papers from interested stakeholders in education for publication in the journal. The paper may focus on analytical research, research reports, replicated research, research notes, descriptive research, book reviews, etc, from any of the following areas in Education:

- Adult and Non-formal Education
- Citizenship Education
- Computer Information and Communication Technology (ICT)Education
- Continuing/Distance Education
- Creative Arts Education
- Curriculum Planning and Development
- Educational Management/Administration, Planning and Supervision
- Health and Physical Education
- Language and Literature Education
- Measurement and Evaluation
- Library and Information Management
- Nomadic and Disadvantaged Peoples' Education
- Philosophy and Sociology of Education
- Family Life Education
- Pre-Primary, Primary, Secondary and Higher Education
- Psychology and Counselling
- Religious and Moral Education
- Science, Technology and Mathematics Education
- Social Science Education
- Special and Rehabilitative Education
- Vocational and Technical Education

Guidelines for Paper Preparation

Manuscripts:

- must be written in English or any other acceptable language and should be scholarly, original and contribute to knowledge.

- must not have been published or under consideration for publication in any other journal. Once a paper is accepted for publication in ZAJES, the author(s) cede copyright to the journal's publisher.

- should clearly state on its front cover page the title of the paper, the author's name(s), their status/rank, and institutional affiliation. The next page should also begin with the paper's title (but no author's name), followed by an abstract of not more than 150 words.

- should be computer typed on one side of the paper, using a font size of 12 double-spaced for the main work and single line spacing for the abstract should not exceed 12 pages of A4 paper, including abstract, references appendices: and Tables, figures, and diagrams, where applicable, should be simple, camera-ready and kept to the barest minimum to facilitate printing.

References
The current American Psychological Association (APA) citation style (7ᵗʰ edition) is the accepted style for the journal. It should be cited as follows:

In-Text Citation
An in-text citation should be deployed when the author quotes a source or paraphrases another work in their own words. These could be in the article's narrative or as a parenthetical citation. See the examples below.
Narrative Citation
The narrative citation should be used when an author's work or quote is cited alongside their name. For example, The impact of colonial missionary activities on Igbo socio-cultural activities is well captured by Achebe (2009), who observed that "The white man is very clever. He came quietly and peaceably with his religion. We were amused at his foolishness and allowed him to stay. Now, he has won over our brothers, and our clan can no longer act like one. He has put a knife on the things that held us together, and we have fallen apart" (p.81).

Parenthetical Citation
This form of citation is used when someone else's work or idea is paraphrased as a summary or synthesis in one's own words.

For example, Achebe (2009) narrates the development of the negative effect of colonial influence on African culture in *Things Fall Apart* (p.81). Or,
The radical factor for the disconnect between the *de iure* and *de facto* African family system is the unbridled assimilation of western culture by Africans (Achebe, 2009).

Book
Achebe, C (2009). *Things Fall Apart*. Penguin Books.

Chapter in an Edited Book
Swindler, L (2013). The History of Inter-Religious Dialogue. In C. Cornille (Ed.), *The Wiley-Blackwell Companion to Inter-Religious Dialogue*. Wiley-Blackwell: A John Wiley & Sons, Ltd., Publication.

Journal
Maccido, M. I (1997). Recreational Activities in Federal University of Education, Zaria Academic Staff. *Zaria Journal of Educational Studies*. 2 (1), 166-172.

Conference Proceedings
Ikenga, G. U (2015). Education in 100 Years of Nigeria's Existence: The Needs and Benefits of Public Private Partnerships in Education. *Proceedings of The IRES 3rd International Conference*, 74–78.

Projects/Thesis/Dissertations
Ajibola, I (2018). *A Theological Analysis of Confessional-Centric Curriculum of Christian Religious Education: Towards an Inclusive Religious Pluralistic Centred Curriculum for Nigeria Colleges of Education*. Doctoral dissertation, Duquesne University, Pittsburgh, PA, USA.

Type of Citation	Narrative Format	Parenthetical Format
Single author	Achebe (2009)	(Achebe, 2009)
Two authors	Soyinka and Anyebe (2009)	(Soyinka & Achebe, 2009)
Three or more authors	Achebe et al. (2009)	(Achebe et al., 1999)

Submission of Manuscript/Correspondence

Submission of the manuscript is online-based. All articles must be submitted at zarjes.com

Editorial inquiries/correspondence should be addressed to:
The Editor-in-Chief,
Zaria Journal of Educational Studies,
Federal University of Education,
P. M. B. 1041
Zaria, Nigeria.
zajes@fcezaria.edu.ng

CONTENTS

EFFECTS OF EXPERIENTIAL LEARNING STRATEGY ON SENIOR SECONDARY SCHOOL STUDENTS' INTEREST AND ACHIEVEMENT IN PRACTICAL AGRICULTURAL SCIENCE IN SOME SELECTED SCHOOL IN BORNO STATE, NIGERIA

Abdulkarim Bala

Department of Educational Curriculum Studies
College of Education Waka-Biu Borno State
abdulkarimbala75@gmail.com
08030169576

This study investigates the effects of experiential learning strategies on senior secondary school students' interest and academic performance in practical agricultural science in Biu, Borno State, Nigeria. Anchored on Kolb's experiential learning theory, the study employs a quasi-experimental research design with a non-equivalent group pre-test/post-test approach. A population of 871 Senior Secondary School II (SS II) students offering agricultural science in five government secondary schools formed the basis of the study, from which a sample of 300 students (150 male and 150 female) was selected using simple random sampling. The experimental group was exposed to experiential learning strategies, including fieldwork, while the control group was taught using the conventional lecture method. Data were collected using the Agricultural Science Practical Test (ASPT) and the Students' Agricultural Science Interest Inventory (SASII). The findings revealed that the experiential learning strategy significantly improved students' interest, with a mean gain of 3.28 in the experimental group compared to 1.29 in the control group. Academic performance also improved notably, with the experimental group achieving a mean gain of 23.34 compared to 6.75 in the control group. Additionally, male students in the experimental group outperformed their female counterparts, with a mean difference of 4.2 in academic performance. The study concludes that experiential learning strategies enhance students' interest and academic performance in practical agricultural science, offering a more effective alternative to traditional lecture methods. It recommends the integration of experiential learning into agricultural science curricula and the provision of resources to support hands-on activities, ensuring gender inclusivity and equitable access for all students.

Introduction

Agricultural science is a subject taught in both junior and secondary schools in Nigeria to equip the students with sound scientific knowledge to empirically understand the science of soil formation and management, crop and animal production in relation to food production and prepare them for further education in vital science-based courses like biotechnology, agricultural pathology, agriculture engineering, veterinary, food technology among others. According to Newton (2020) Agricultural Science is the science that encompasses everything from food and fiber production to soil and crop cultivation and animal processing.

The importance of Agricultural science knowledge and skills in promoting self-reliance through the production of staple foods for the populace and the provision of employment

opportunities together with raw materials for the agro-allied industries cannot be over-emphasized. This is because the knowledge of Agricultural science can help individuals understand the physical and chemical characteristics and effects of agriculture on soil fertility, factors of production like climate, weeds, fungi, erosion, leaching and pests, plant physiology, genetics, nutrition, satellite-based micro-management of inputs and the maximization of sustained yield as well as how to market farm products. Agricultural science education plays a crucial role in promoting self-reliance and economic development through food production. The Nigerian agricultural science curriculum aims to equip students with skills for self-reliance after graduation, though inadequate facilities hinder practical teaching (Ishaya & Bello, 2022). Agricultural education can improve food security, youth employment, and raw material provision, but faces challenges such as insufficient funding and a lack of qualified personnel (Innocent-Ene et al., 2022). Small-scale farming, which accounts for about 95% of Nigeria's agricultural output, requires support through innovative applications of agricultural science, including soil science and improved production techniques (Nworu, 2018).

Despite the importance of Agricultural science to food security, self-reliance and national development at large, youth engagement in agricultural activities like crop cultivation, and livestock rearing as well as taking agriculture as an occupation has not been encouraging. This lack of interest in agriculture has resulted in low performance in practical agriculture in external examinations (WAEC Chief Examiners' Reports, 2016-2023). The reports revealed that candidates continue to perform poorly in the practical examinations over the years. Based on the findings, the reports advised that schools offering the subject should have the following infrastructural facilities: a school farm/site to conduct students' practicals, poultry house, piggery pen, goats and sheep pen, rabbits, ducks, guinea fowls, pigeon pen; aqua-culture/fish pons (natural & artificial); animal specimens example snail, beehive and others. Students should be made to go on excursions to agricultural institutions to make the subject interesting and they will have the opportunity to familiarize themselves with practical exercises.

Practical agriculture is the fundamental principle of exposing students to the real production chain of agriculture, which helps to eradicate pseudo-teaching and readdress the students' wrong mindset towards the subject.

Otekunrin et al., (2019) Observe that one of the major causes of students' poor performance in Agricultural science is the poor teaching techniques, which are without appropriate instructional materials. Corroborating the assertions, Bash, (2021) the conventional lecture strategy is usually the dominant approach used by teachers in Nigeria and students are not actively involved in developing knowledge; they generally remain passive listeners throughout the lesson. Hence the strategy is mainly a teacher-centered approach to learning, which is not an effective method for teaching Agricultural science. From the foregoing, it becomes imperative for more research to discover better teaching methods that could enhance students' interest and achievement in the subject. Based on this, more effort ought to be accorded to experiential learning strategy since it has proven to be efficacious in the teaching of skill-based and practical-oriented subjects like Agricultural science. Experiential Learning (EL) is learning by doing or learning through experience.

Experiential learning is a type of learning in which students participate in some activities, reflect upon the activities and use their analytical skills to derive some useful insight from the experience and then incorporate their new understanding into their lives. In experiential learning, a person's experience is the central point for learning, which allows students to test the validity of the ideas that were created during the learning process. Experiential learning is like taking students to the zoo to observe or interact with the animals, instead of reading about them from books.

The studies of Bibi et al., (2022) show that through the use of experiential learning activities, students' interest can be enhanced as well as achievement. However, little research has been done in the area of experiential learning to enhance student's interest and performance in practical agricultural science. Hence, this study looks at the effects of experiential learning strategy on senior secondary school students' interest and achievement in practical agricultural science in Biu, Borno state Nigeria.

The study is limited to the effects of experiential learning strategy on students' interest and academic performance in practical Agricultural science in senior secondary schools in Biu, Borno State. Similarly, the study is restricted to only SS II students who offer agricultural science in senior secondary schools in Biu Borno State.

Statement of the Problem

Agricultural science is a vital component of the senior secondary school curriculum, designed to equip students with practical skills and knowledge for sustainable agricultural practices. Despite its significance, students often demonstrate low interest and poor academic performance in the subject,

particularly in its practical aspects. Traditional teaching methods, such as the lecture method, which emphasizes theoretical knowledge over hands-on experiences, may contribute to this challenge. This situation raises concerns about the effectiveness of conventional instructional strategies in fostering students' engagement and academic success in practical agricultural science.

In response to these challenges, experiential learning, which emphasizes active participation and real-world application, has emerged as a potential strategy to enhance students' interest and academic performance. However, the extent to which experiential learning influences students' interest and academic outcomes, compared to the lecture method, remains unclear. Furthermore, it is uncertain whether the experiential learning strategy affects male and female students differently in terms of their academic performance.

This study seeks to address these gaps by examining the effects of the experiential learning strategy on students' interest and academic performance in practical agricultural science in senior secondary schools in Biu, Borno State. Specifically, the study aims to compare the outcomes of experiential learning with the lecture method, as well as investigate potential gender differences in students' academic performance following exposure to experiential learning.

Objectives of the study

The study aims to determine the effects of experiential learning strategy on students' interest and academic performance in practical agricultural science in Biu, Borno State, while the objectives are to:

i. Determine senior secondary school students' interest when taught practical

agricultural science using experiential learning strategy and when taught with lecture method;

ii. Determine the academic performance of students taught practical agricultural science using experiential learning strategy and that of their counterparts taught with the conventional lecture method;

iii. Find out the academic performances of male and female senior secondary school students in practical agricultural science after exposure to experiential learning strategy.

Research Questions

i. What is the pre-test and post-test interest mean score of senior secondary school students when taught practical agricultural science using experiential learning strategy and when taught with lecture method in the experimental and control groups?

ii. What are the pre-test and post-test academic performance mean scores of senior secondary school students taught practical agricultural science using experiential learning strategy and that of their counterparts taught with the conventional lecture method in the experimental and control groups?

iii. What are the academic performances of male and female senior secondary school students in practical agricultural science after exposure to experiential learning strategy?

Literature Review

Agricultural Science education in Nigeria plays a crucial role in promoting food security, economic development, and self-reliance. The subject is included in the secondary school curriculum to equip youth with essential knowledge and skills. However, several challenges hinder effective teaching and learning, including inadequate facilities, theoretical-focused instruction, and a lack of qualified teachers (Otekunrin et al., 2017). Despite these obstacles, the Nigerian agricultural science curriculum is considered appropriate for fostering self-reliance among students (Ishaya & Bello, 2022). Improving agricultural education can lead to enhanced food security, youth employment, and economic growth (Innocent-Ene et al., 2022). To address these issues, recommendations include increased funding for equipment and facilities, providing incentives for learners, and employing innovative teaching methods to sustain student interest and improve academic performance (Innocent-Ene et al., 2022; Otekunrin et al., 2017).

Research indicates that traditional lecture methods are less effective than alternative teaching strategies in agricultural science education. Multiple studies have found that demonstration, peer-tutoring, project-based learning, and role-play methods significantly improve student achievement and interest compared to lecture-based instruction (Nwachukwu et al., 2020). Demonstration method consistently ranked highest in enhancing student performance across studies (Nwachukwu et al., 2020). Role-play was found to be particularly effective in increasing student interest (Nwachukwu et al., 2020). These findings highlight the limitations of the lecture method in fostering student engagement and academic success in agricultural science. To address these shortcomings, researchers recommend providing teachers with training in alternative teaching strategies, particularly demonstration techniques (Nwachukwu et al., 2020). Implementing a variety of teaching methods can help overcome the limitations of lecture-based instruction and improve overall

student outcomes in agricultural science education.

Poor performance in agricultural science examinations has been attributed to several factors. Examination malpractice is identified as a significant determinant, reducing students' interest in agriculture (Oloidi, 2023). Chief examiners' reports highlight issues such as poor map work, inadequate preparation, and scanty explanations in geography, which may also apply to agricultural science (Eze, 2020). The lack of laboratory and farming facilities significantly impacts students' performance in agricultural science (Nsa et al., 2016). Additionally, practical performance in subjects like music has been reported as poor, suggesting a need for pragmatic measures from examination bodies, school administrators, and the government (Amuah et al., 2021). These issues collectively contribute to the declining performance in agricultural science examinations. Addressing these challenges requires a multifaceted approach, including improving teaching strategies, providing adequate resources, and enhancing practical skills development to better prepare students for external examinations.

Nigerian schools face significant infrastructural and resource challenges that hinder effective education delivery. Secondary schools lack adequate buildings, laboratories, and equipment for teaching science and practical subjects (Ojeje & Adodo, 2018; Uche Emma, 2013). There is a shortage of qualified teachers and laboratory technicians, particularly for science and technology subjects (Uche Emma, 2013). Electricity supply is unreliable, with only 30% of schools receiving power for up to 4 hours daily (Uche Emma, 2013). Tertiary institutions struggle with insufficient lecture rooms, furniture, library services, and laboratory installations (Usman,

2014). Additional challenges include inadequate funding, student indiscipline, examination malpractices, and an inappropriate curriculum (Matthew, 2013). To address these issues, recommendations include increased funding, improved school administration, teacher recruitment and training, curriculum review, and regular school inspections (Matthew, 2013). Providing functional buildings, laboratories, and equipment is crucial for enhancing the quality of education and achieving national development goals (Ojeje & Adodo, 2018; Uche Emma, 2013).

Experiential learning is an educational approach emphasizing active participation, reflection, and real-world application (Chae, 2024; Wooding, 2019). It involves "learning by doing" and constructing meaningful knowledge through reflection-in-action (Chae, 2024; Wooding, 2019). Key principles include the continuity of experience and interaction between experience and reflection (Chae, 2024). This approach engages students in phenomena they are studying, such as internships, service learning, and research projects. Experiential learning theory, based on the works of Dewey, Kolb, and Schön, posits that growth is education and education is a reconstruction of experience (Chae, 2024). It has been applied in various fields, including medical education, to prepare students for unpredictable futures and professional roles (Chae, 2024). The teacher's role is to create worthwhile educational experiences for students to reflect upon, fostering critical thinking and interpersonal skills development (Wooding, 2019).

This study is anchored on the theory of experiential learning propounded by David Kolb in 1984. Kolb conceptualized experiential learning as learning through experience, involving active interaction with the

environment. The theory consists of four stages of the learning cycle, popularly known as Kolb's cycle of experiential learning: concrete experience, reflective observation, abstract conceptualization, and active experimentation (Jones-Roberts & Bechtold, 2024).

The application of situated learning theory and experiential learning to agricultural education has shown promising results. Situated learning can enhance students' achievement, interest, and ability to apply knowledge to real-life situations in practical arts education. However, challenges exist in integrating practical skills in agricultural education, including teaching methodologies and resource allocation. Teacher-related factors such as competencies, qualifications, and preferred teaching methods significantly influence the integration of practical skills in agriculture teaching (Shabani et al., 2023). Regular professional development for teachers and curriculum alignment with national agricultural policies are recommended to enhance practical agricultural science education.

Methodology

This study will adopt a quasi-experimental research design, specifically employing the non-equivalent group pre-test/post-test design. Intact classes within the study area were randomly assigned to experimental and control groups, as described by Awotunde and Ugodulunwa (2004). The design was chosen because random assignment of students to groups was not feasible due to the use of the normal schooling period for administering the treatment. A pre-test will be administered to both experimental and control groups to determine any existing differences between the two groups before treatment. Only the experimental group will receive the treatment

(experiential learning), after which a post-test will be administered to both groups. Diagrammatically, the design is represented as follows:

O1 → X → O2 (Group 1: Experimental)
O3 → O4 (Group 2: Control).

In this design, the experimental group (Group 1) and the control group (Group 2) were both exposed to a pre-test, denoted as O1 and O3, respectively. Only the experimental group received the treatment (X), after which a post-test (O2 and O4) was administered to both groups. The absence of randomization of the samples to either group is indicated by the dotted line in the diagram.

The population of this study consists of all 871 Senior Secondary School II (SS II) students in five government secondary schools within the study area who are offering Agricultural Science. The population comprises 520 male and 351 female students. A sample of two secondary schools was randomly selected from the five government secondary schools using a simple random sampling technique. These two schools were then randomly assigned to experimental and control groups. The sampled schools had a combined population of 300 students, consisting of 150 males and 150 females. School A had 181 students, while School B had 119 students.

The sampling technique employed was the simple random sampling method using the lottery technique. This method ensured fairness in the selection process, allowing each of the five schools an equal chance of being included in the study. The two selected schools were randomly assigned to either the experimental or control group to facilitate the quasi-experimental design.

The instruments used for data collection in this study are the Agricultural Science Practical

Test (ASPT) and the Students' Agricultural Science Interest Inventory (SASII). These instruments were designed to measure students' practical skills in agricultural science and their interest in the subject, respectively. The ASPT focused on assessing hands-on skills, while the SASII evaluated the students' enthusiasm and engagement with agricultural science.

Results

Research Question One:

What is the pretest and posttest interest mean score of senior secondary school students when taught practical agricultural science using experiential learning strategy and when taught with lecture method in the experimental and control groups

Table 1

Mean Scores of Pretest and Posttest of Students Interest when Taught Practical Agricultural Science using Experiential Learning Strategy and when taught with Lecture Method in the Experimental and Control Groups

Groups		Pretest		Posttest		Mean	
	N	Mean	SD	Mean	SD	Gain/Loss	X diff.
Experimental	150	34.78	5.45	38.06	8.71	3.28	
							1.99
Control	150	34.62	7.79	35.91	9.33	1.29	

Table 1presents the mean scores of pretest and posttest interest of students taught Practical Agricultural Science using an experiential learning strategy (experimental group) compared to those taught with a lecture method (control group). The result showed that in the experimental group, students had a pretest mean score of 34.78 (SD = 5.45) and a posttest mean score of 38.06 (SD = 8.71), resulting in a mean gain of 3.28. The calculated difference in mean scores from pretest to posttest was 1.99. While in the control group, students achieved a pretest mean score of 34.62 (SD = 7.79) and a posttest mean score of 35.91 (SD = 9.33), indicating a smaller mean gain of 1.29. This suggests that the experiential learning strategy significantly improved students' interest compared to the traditional learning strategy used in the control group. Hence, the results indicate that while both groups showed improvement from pre-test to post-test, the experimental group, taught using experiential learning, exhibited a greater mean gain in scores compared to the control group taught with the lecture method.

Research Question Two: What is the pre-test and post-test academic performance mean scores of senior secondary school students taught practical agricultural science using experiential learning strategy and that of their counterparts taught with the conventional lecture method in the experimental and control groups?

Table 2

Mean Scores of Pre-tests and Post-test Academic Performance of Students Taught Practical Agricultural Science using Experiential Learning Strategy and that of their Counterparts Taught with the Conventional Lecture Method in the Experimental and Control Groups.

Test		Pretest		Posttest		Mean	$\underline{X}$
	N	Mean	SD	Mean	SD	Gain/Loss	diff.
Experimental	150	44.63	5.45	67.97	5.93	23.34	
							16.59
Control	150	42.79	7.29	49.54	5.93	6.75	

Table 3 reveals the mean scores of pre-tests and post-test academic performance for students taught Practical Agricultural Science using an experiential learning strategy (experimental group) and those taught with a conventional lecture method (control group). The result showed that students in the experimental group had a pre-test mean score of 44.63 (SD = 5.45) and a post-test mean score of 67.97 (SD = 5.93). This resulted in a gain of 23.34 points, indicating a significant improvement in academic performance following the experiential learning strategy. The calculated difference in mean scores from the pre-test to the post-test was 16.59. While in the control group, students recorded a pretest mean score of 42.79 (SD = 7.29) and a post-test mean score of 49.54 (SD = 5.93), reflecting a gain of only 6.75 points. This smaller increase suggests that the conventional lecture method was less effective in enhancing academic performance compared to the experiential learning strategy. Therefore, these findings indicate that the experiential learning strategy significantly improved students' academic performance in Practical Agricultural Science, as evidenced by the larger mean score gain compared to those taught with the conventional method.

Research Question Three: What are the academic performances of male and female senior secondary school students in practical agricultural science after exposure to experiential learning strategy?

Table 4
The Academic Performance Mean Scores of Male and Female Students in Practical Agricultural Science of the Experimental Group

Test			Posttest		
		N	Mean	SD	$\underline{X}$ diff.
Experimental	Male	150	67.71	7.70	
					4.2
	Female	150	59.22	11.90	

Table 4 reveals the academic performance mean scores of male and female students in the experimental group for Practical Agricultural Science. The result showed male students had a mean score of 67.71 (SD = 7.70), while female students had a mean score of 59.22 (SD = 11.90). The mean difference between male and female students was 4.2, indicating that male students outperformed their female counterparts in the academic assessment. These results suggest a notable difference in academic performance between genders within the experimental group, with males achieving higher scores on average compared to females.

Discussion of Findings

The study revealed that students taught using experiential learning strategies showed higher levels of interest compared to those taught through traditional lecture methods. This finding is consistent with (Nwachukwu et al., 2020), who emphasised that alternative teaching methods, such as role-play and project-based learning, significantly enhance student engagement. Experiential learning's focus on active participation and real-world application aligns with (Chae, 2024, Wooding, 2019), who underscored the role of interaction and reflection in fostering interest. These studies reinforce the importance of moving away from theoretical instruction to practical, hands-on learning experiences to sustain students' enthusiasm for Agricultural Science.

The findings showed that students taught using experiential learning strategies performed better academically than those taught with conventional lecture methods. This aligns with the observations of (Nwachukwu et al., 2020), who reported that the demonstration method consistently improves academic performance. Additionally, the experiential learning theory of Kolb (1984) supports this result by emphasizing the importance of active

experimentation and reflective observation in the learning process. Studies by (Innocent-Ene et al., 2022; Otekunrin et al., 2017) further validate that innovative teaching methods enhance students' understanding and retention, leading to improved academic outcomes.

The study found no significant disparity in academic performance between male and female students exposed to experiential learning strategies. This aligns with the recommendations of (Shabani et al., 2023), who advocate for gender-inclusive teaching practices to ensure equitable access to quality education. However, challenges such as resource allocation and teacher competencies, as highlighted by (Uche Emma, 2013; Matthew, 2013), may affect the effectiveness of these strategies. Addressing these barriers through professional development and curriculum alignment with practical applications can help sustain the gains in academic performance for both genders.

The findings also underscore the infrastructural and resource challenges faced by Nigerian schools, such as inadequate facilities and teacher shortages (Ojeje & Adodo, 2018). These limitations hinder the effective implementation of experiential learning strategies. Addressing these challenges requires increased funding, improved teacher training, and resource provision to support practical agricultural education, as recommended by (Matthew, 2013; Innocent-Ene et al., 2022).

Conclusion

1. **Student Interest in Practical Agricultural Science:** The study found that senior secondary school students exhibited a significantly higher level of interest in practical Agricultural Science when taught using the experiential learning strategy compared to the traditional lecture method.

This suggests that experiential learning methods, which involve hands-on activities and real-world applications, are more engaging for students and promote a deeper interest in the subject.

2. **Academic Performance of Students:** The academic performance of students taught practical Agricultural Science using the experiential learning strategy was significantly higher than that of students taught using the conventional lecture method. This highlights the effectiveness of experiential learning in improving students' understanding and performance in practical subjects, providing evidence that active learning strategies are more beneficial for students' academic achievement.

3. **Gender Differences in Academic Performance:** The study revealed no significant gender differences in the academic performance of male and female students exposed to experiential learning strategies. Both male and female students showed comparable improvements in performance, indicating that experiential learning strategies can be equally effective for students of all genders in practical Agricultural Science education.

Recommendations

The following recommendations are made:

1. **Enhancing Students' Interest in Practical Agricultural Science:** Teachers should adopt experiential learning strategies, such as fieldwork, farm visits, and hands-on activities, to increase students' interest in practical agricultural science. These strategies provide interactive and real-life learning experiences that make the subject more engaging and relatable for students, as opposed to the conventional lecture method.

2. **Improving Academic Performance through Experiential Learning:** Experiential learning strategies should be implemented as the primary teaching approach for practical agricultural science. By offering students practical exposure and active participation in agricultural practices, their academic performance can be significantly improved compared to those taught with traditional lecture methods.

3. **Addressing Gender Differences in Academic Performance:** Schools and teachers should ensure that experiential learning strategies are designed to support both male and female students equally. Efforts should be made to eliminate gender-based disparities in access to resources and opportunities during practical agricultural science activities, ensuring that both male and female students can achieve optimal academic performance.

Acknowledgement

References

Amuah, J., E. Acquah, M. Dzansi-McPalm (2021). Assessment of Music Teachers on the Poor Performance of West African Examinations Council (Wassce) Music Practical Test. African musicology online. https://doi.org/10.58721/amo.v7i1.28

Aruoriwo Ojeje, Anselm Adodo (2018). Education Infrastructure in Nigeria: An Analysis of Provision of School Building Facility in Secondary Schools in Delta State Nigeria

Bash, A. E. (2021). *Effects of graphic organizers and experiential learning with feedback on students' critical thinking, achievement and retention in basic science and technology.* Unpublished PhD thesis, Benue State University, Makurdi.

Bibi, R., Muhammad, N., & Sajid, R. (2022). Effect of experiential learning on students' academic achievement at the elementary level in the subject of general science. *Multicultural Education 8*(1), 139-151.

Chae, S., (2024). Understanding and Application of Experiential Learning Theory in Medical Education. *Korean Medical Education Review*. https://doi.org/10.17496/kmer.23.042

Chelsea Wooding (2019). Experiential Learning. *High Impact Teaching for Sport and Exercise Psychology Educators.* https://doi.org/10.1007/978-94-6209-497-0_37

Eze, Emmanuel (2020). Why Nigerian Secondary School Geography students perform poorly in external examinations: synthesis of WAEC Chief Examiners' Reports of a decade. https://doi.org/10.21203/rs.3.rs-28665/v1

Innocent-Ene, E. O., A. Suleiman, J. Sanni (2022). Implication of Agricultural Science Education on the Development of the Nigerian Economy. *Kashere Journal of Education.* https://doi.org/10.4314/kje.v2i2.19

Ishaya, A. Dahiru Lamaran Bello (2022). An Appraisal on the Readiness of Secondary Schools toward the Attainment of Self-Reliance through Agricultural Science Education in North East Nigeria. *International journal of education, learning and development.* https://doi.org/10.37745/ijeld.2013/vol10n7pp2838

Jones-Roberts, Charlotte; Crystle Bechtold (2024). Experiential Learning in Higher Education. *Journal of Technology-Integrated Lessons and Teaching.* https://doi.org/10.13001/jtilt.v3i2.8587

Newton, E. (2020). Everything you need to know about agricultural science. Retrieved from https://revolutionized.com/what-is-agriulturalsicence/.

Nwachukwu, C; F. Onah, E. O. Obijiofor, C. Nwankwo, Toochukwu C. Eze Celestina C. and Okan (2020). Effects of Multiple Teaching Methods on Academic Achievement and Interest of Primary School Pupils in Agricultural Science in Anambra State

Nwachukwu, Uche Emma (2013). The state of science and technology infrastructure in secondary schools in Nigeria

Oloidi, F. F., (2023).Examination Malpractice as Determinant for Poor Academic Performance of Students in Agricultural science in Ife Central Local Government, Osun State. *International journal of educational spectrum.* https://doi.org/10.47806/ijesacademic.1320278

Osondu, Chimezie Nworu (2018). Applying the Values and Practical Implementation of Agricultural Science in Nigeria Farming System. *Archives of Business Research*

Otekunrin, O., L. Oni, O. Otekunrin (2017). Challenges, Attitudes and Academic Performance of Agricultural Science Students in Public Secondary Schools of Ibadan North, Nigeria. https://doi.org/10.9734/jsrr/2017/31216

Rehema, Nanyama Shabani, J. Shiundu, S. Mutsotso (2023). Teacher-Related Factors and their Influence on the Integration of Practical Skills in Teaching and Learning of Agriculture in Secondary Schools in Busia County, Kenya. *East African Journal of Education Studies.* https://doi.org/10.37284/eajes.6.2.1321.

Usman, B. (2014). Infrastructural challenges to the study of physics in tertiary institutions. Corpus ID: 110648448.

EFFECTS OF THE PEER TUTORING APPROACH ON SENIOR SECONDARY SCHOOL MATHEMATICS STUDENTS'ACHIEVEMENT IN BIU LOCAL GOVERNMENT EDUCATIONAL ZONE, BORNO STATE, NIGERIA

Audu Yusuf

Department of Educational Foundation College of Education Waka-Biu, Borno State, Nigeria
auduyusufali20@gmail.com

Mathematics at the basic and secondary school level is mostly hated by students because of its abstract nature and how it is presented resulted lead to much failure in WASSCE. The thrust of the study is to determine the effects of the peer tutoring approach on senior secondary school mathematics students' achievement in Biu Local Government Borno State. The design is pre-test post-test quasi-experimental research. The sample of 126 (SSSII) mathematics students was drawn from four randomly sampled secondary schools in Biu Local Government, Borno State. The study was guided by two research questions where the treatment for the experimental group was done by peer tutoring while the control group was taught by a conventional method. The instrument used for data collection was the Achievement Mathematics Test (AMT) which was subjected to both content and face validity with a reliability coefficient of 0.77 by Kuder Richardson (KR 20) method. Mean and Standard Deviation were used to answer the research question. The findings of the study provided the empirical basis to recommend that secondary school teachers should always peer tutoring in mathematics teaching.

Introduction

Building mathematics interest in students is not as easy as it sounds, students need to know some basic facts on what mathematics is all about because the knowledge of mathematics is not only important and useful to the learner alone but for everyone who intends to play a part in the current change in our modern society, that is useful in astrological development of the human intellectual focus. Students perceive that mathematics is difficult so students lose confidence in the subject and this leads to poor performance in mathematics (Okoli & Egbunonu, 2012). Mathematics is one of the compulsory subjects offered at almost all levels of education.

The lecture method of teaching is one of the frequent methods used by teachers to impart knowledge in Nigeria and the world as a whole because lecture has the advantage of being less tasking, allowing for wider content coverage within a short time and can also be applied to a large number of students at a time. In the lecture method, the teacher is being more active in the learning process than the students. According to Albaar, Acim and Abdullah (2023), Students only listen to explanations from the teacher and tend not to be invited to understand the concepts of the material so students are slow in mastering and understanding the learning material which is why it does not always produce positive outcomes. However, mathematics learning in

schools today seems as if students only receive, listen, or record explanations given by the teacher and work on problems according to examples and direction from the teacher(Syahrial, Kurniawan, Asrial, Sabil, Maryani, and Rini, 2022). Efforts need to be made to increase students learning active involvement by applying an appropriate learning model so that the objectives of the learning and teaching can be achieved (Purnomo, 2021).

Peer tutoring approach on the other hand is a strategy which involves students assisting each other in learning content usually through structured interaction where one student within the group assumes the role of the tutor while others are tutees (learners). This method has gained attention for its potential academic and social benefits. Studies have demonstrated that peer tutoring can bolster performance, especially in mathematics and science. Beyond academics, peer tutoring fosters social interaction, communication skills and collaborative learning leading to a more inclusive classroom environment (Toppings and Duran, 2017). Effective peer tutoring requires proper training of tutors for productive interaction and accurate delivery of content. Therefore, positive learning outcomes are expected through adopting Peer Tutoring Strategy (PTS) which will integrate the nature of the subject with the theory, models, strength of knowledge and mode of tutoring (Imoko and Agwaga, 2006: Tyler, 2003).

There are many debates about gender differences in mathematics educational achievement. According to Astalini et al, 2023, males are intrinsically and genetically superior to females in cognitive ability which determines excellence, particularly in physical science. For instance, males are good at abstract thinking while females are good at correlating reasoning (Darmaji, Astalini, Kurniawan and Adila, 2022). In terms of social interaction males interact confidently because of being ridiculed by their peers towards working hard in school to achieve academic excellence while females are not like males because of social limitations like domestic chaos depression, societal norms and inferiority courses like mathematics is masculine in nature and this could be the reason while many females left the science for social science and art.

Problem Statement

It is a known fact that learners are continually receiving mathematics instructions but still, there are high failure rates of students in mathematics WASSCE. Hence the need to investigate the causes of the high failure rate in mathematics becomes necessary. Poor mathematics performance hinders many students from proceeding to further studies and such students eventually drop out. The predominant use of the didactic lecture method in school especially in science and mathematics teaching leads students to develop poor attitudes to the subject. This subsequently leads to poor performance in the subject. Mathematics is a core subject offered by all students at the basic and secondary school level (National Policy on Education, FRN, 2004). Despite the efforts of many researchers in proposing teaching methods to curtail the abysmal poor performance in mathematics (WASSCE) in Nigeria, students still fail the subject (Adamu and Yabo, 2024). The thrust of the study is therefore to determine the effect of peer tutoring approach on senior secondary school mathematics students' achievement in Biu Educational Zone Borno State.

Objective of the Study

The objective of the study is to determine the effect of peer tutoring strategy on senior secondary school mathematics students'

achievement in Biu in Local Government, Borno State. The specific objectives are to:

1. Determine student's achievement in senior secondary school when taught mathematics using peer tutoring strategy and conventional method
2. Determine the influence of gender on the achievement of senior secondary school students when taught mathematics using peer tutoring strategy and conventional methods.

Research Questions

1. What are the mean post-test scores of senior secondary school students' achievement in mathematics when taught using the peer tutoring approach and conventional method?
2. What is the gender difference in the mean achievement scores of senior secondary school students in mathematics when taught using the peer tutoring approach and conventional method?

Literature Review

The theoretical framework of the study is based on the social constructivist views of learning that emphasize the role of the students to generate learning where students coach peers through social interaction within their zone proximal development Vygotsky (1978). According to the theory, the range of tasks too difficult for the learner to do alone is possible with the help of adults and more skilled learners.

Peer tutoring involves dividing the entire class into groups of two - five students with different ability levels. Students then act as tutors, tutees or both tutors and tutees. Typically, peer tutoring involves highly structured procedures, direct rehearsal, competitive teams, and the posting of scores (Herper and Maheady 2007).

Abdulmalik and Ttortpev (2016) examine the impact of class-wide peer tutoring strategy on secondary school low learners performance in redox reaction in Funtua educational zone Katsina State, Nigeria. The study is a quasi-experimental research design involving a population of 977 SSII students. A sample of 108 slow learners from two secondary schools was used, guided by three hypotheses tested using a T-test at 0.05 level of significance. Treatment for the experimental group was by Class Wide Peer Tutoring (CWPT) and the control group was taught by conventional method. REdox Performance Test (REPT) duly validated by the expert with a reliability coefficient of 0.85 through the test re-test method. Results revealed that learners taught by peer tutors using CWPT performed significantly better than those taught by a conventional method. The study recommended that chemistry teachers should be trained through workshops, seminars and conferences on the use of class-wide peer tutoring strategy in teaching and learning chemistry. Abdulmalik and Ttortpev (2016) study is relevant to the present study because the study is on the same instructional strategy model of tutoring except on different subjects. The study is a quasi-experimental and also the research questions were analyzed using the Mean and Standard Deviation in the area of similarity. Akpan Sylvester, Okworo, Gibson and Emma (2017), study is relevant to the present study in the sense that the peer-assisted cooperative instructional strategy is a model of the peer tutoring approach. The area of relevance includes the use of quasi-experimental research design and Mean and Standard Deviation to answer the research questions while the area of difference includes the use of T-test to analyse the hypotheses which may not give a valid result because the T-test is not suitable for comparing control and experimental group while the present study used and standard deviation to answer the research questions.

There are many debates over gender differences in mathematics educational achievements. According to Astalini et al., (2023) Males are intrinsically and genetically superior to females in cognitive abilities which determine excellence, particularly for physical sciences. For instance, males are good at abstract thinking while ladies are good at correlating reasoning (Darmaji, Astalni, Kurniawan and Adila, 2022). In terms of social interaction males interact confidently because of being ridiculed by their peers towards working hard in school to achieve academic excellence while females are not like males because of social limitations like domestic chaos depression, societal norms and inferiority courses. Courses like Mathematics is masculine in nature and this could be the reason why many females left the sciences for social science and art.

Abdulmalik and Ttorpev (2016) examined the impact of the Class-Wide Peer-Tutoring Strategy on secondary school slow learners' performance in redox reactions in Funtua Education Zone, Katsina State, Nigeria. The study is Quasi-experimental design involving a population of 977 SS2 Students. A sample of 108 slow learners from two secondary schools was used guided by three hypotheses tested using t-test at 0.05 levels of significance. Treatment for the experimental group was by class wide peer tutors (CWPT) and the control group was taught by conventional method. Redox Performance Test (REPT) duly validated by experts with a reliability coefficient of 0.85 through the test-retest method. Results revealed that learners taught by peer tutors using CWPT performed significantly better than those taught by a conventional method. The study recommended that chemistry teachers should be trained through workshops, seminars and conferences on the use of class-wide peer-tutoring strategy

in teaching and learning chemistry. Abdulmalik and Ttorpev (2016) study is relevant to the present study because the study is on the same instructional strategy model of tutoring except on different subjects. The study is a quasi-experimental and also the research questions were analysed using mean and standard deviation in the area of similarities.

Akpan, Sylvester, Okworo, Gibson and Emma (2017), examined the effect of peer-assisted cooperative instructional strategy on the ability levels of students. Two research questions and hypotheses were developed to guide the study. A total of 110 Senior Secondary Chemistry students were used. Cognitive Ability Test (CAT) and Chemistry Performance Test (CPT) were the instruments used. Reliability coefficients of 0.82 and 0.80 were obtained for CAT and CPT respectively using Kuder-Richardson formula 21. Data collected were analyzed using mean, standard deviation, independent t-test and analysis of covariance. it was observed that peer-assisted cooperative strategy affected the cognitive ability levels of chemistry students.

Akpan, Sylvester, Okworo, Gibson and Ema (2017), study is relevant to the present study in the sense that the peer-assisted cooperative instructional strategy is a model of the peer tutoring approach. The area of relevance includes; the use of quasi-experimental design and mean and standard deviation to answer the research questions while the area of difference includes the use of t-test to analyse the hypotheses which may not give a valid result because t-test is not suitable for comparing control and experimental groups while the present study uses mean and standard deviation to answer the research questions.

The literature was reviewed from the work of other researchers. The review of the related literature covered many areas such as peer

tutoring strategies and conventional learning methods of teaching mathematics as well as issues of gender differences in mathematics achievements and uniqueness of the study.

Abdulmalik and Ttorpev (2016) study is relevant to the present study as well as that of Akpan, Sylvester, Okworo, Gibson and Ema (2017), are models of peer tutoring approach. I n conclusion, most of the empirical studies rev iewed contain some gaps filled by the present study. None of the reviewed studies was conducted in Borno State; while the present study was conducted in Biu local Government Educational Zone of Borno State.

The literature was reviewed from the works of other researchers. The review of the related literature covers many areas such as peer tutoring strategies and conventional learning methods of teaching mathematics as well as issues of gender differences in mathematics achievement and the uniqueness of the study. Abdulmalik and Ttortpev (2016) study is relevant to the present study as well as that of Akpan Sylvester, Okworo, Gibson and Emma (2017), who are models of the peer tutoring approach. In conclusion, most of the empirical studies reviewed contain some gaps filled by the present study. None of the reviewed studies was conducted in Borno State, while the present study was conducted in Biu local government educational zone of Borno State.

Methodology

The design of this study is quasi-experimental which involves a pre-test, post-test non-equivalent control group design as intact class was used as no sampling of subjects was made Sambo (2005).

Symbolically
Groups
Experimental 1   01   X   02
Control   2   03   04

01 and 03 represent the pre-test scores while 02, 04 represent the post-test of all the groups, X is the treatment or the experimental group taught peer tutoring while the control was taught using the conventional method.

The target population for the study consists of 1,325 SS11 students with the sample of the study consisting of 126 (91 males and 35 females) students from four intact classes randomly selected in four senior secondary schools to participate in the study in Biu Local Government, educational zone, Borno State. (Borno State Ministry of Education Science Technology and Innovation, 2024).

The data for the study was collected with the Ability Grouping Test (AGT) which was a different but equivalent instrument to the (AMT) conducted to the experimental groups to classify the student's high and low-ability groups. The students' numbers were recorded before the experiment, while (AMT) was be used at the beginning of the experiment for the pre-test and post-test using two trained research assistants recruited by the researcher. The study was conducted in four weeks. Descriptive statistics was used to answer the research questions using SPSS version 22. The data was analysed using mean, and standard deviation.

The instrument was constructed from Senior secondary school two (SS11) mathematics syllabus of the West African Examinations Council (WAEC), 2022-2023. The AMT consist of 50 items drawn from four topics approximations, standard form, logarithms and trigonometry which was taught by four recruited research assistants and trained by the researcher. The instruments used for data collection include "Achievement Mathematics Test (AMT) and the Ability Grouping Test (AGT). The AMT consists of 50 item objective tests with one key and   3

distractors is also used for the Ability Grouping Test as it can serve both purposes.

The AMT containing 50 items was given to two experts who are Science Education, Test and Measurement experts from Gombe State University for the face and content validation

Group	N	$\bar{x}$	σ
Male	91	37.45	12.66
Female	35	37.17	11.70
Total	126	37.02	11.31

requested to assess the appropriateness of the

items in terms of clarity of expression, answers accuracy suitability and content coverage. After the validation, six items were considered irrelevant and were removed remaining 44 items. The new observation made was that the four rejected items have wrong answers while two have complicated questions. The remaining 44 items were subjected to pilot study on 40 students (male and female) at Government Senior Science Secondary School Biu. Thus a reliability coefficient of 0.77 was found using Kuder Richardson 20 method (K-R20).

Results

Table 1: Descriptive Statistics of Students' Pre-test and Post-test Mean Difference for Experimental and Control Group

	Pre- test			Post-test		
Group	N	$\bar{x}$	σ	N	$\bar{x}$	σ
1	62	42.05	13.41	62	66.10	14.66
2	64	32.84	9.25	64	49.72	12.21
Total	126	37.37	12.35	126	57.78	15.74

N = Number of Students, $\bar{x}$ = Mean of the Scores, σ = Standard Deviation, Group 1 =Experimental Group, Group 2 = Control Group

Research question 1 was answered using mean and standard deviation in Table 1. The number of students who participated in the study is 126 with 62 students in the experimental group and 64 in the control group. The pre-test mean score of the students in the experimental group is 42.05 with a standard deviation of 13.41 while the pre-test mean score of students in the control group is 32.84 with a standard deviation of 12.35 favouring the experimental group. Also, the analysis of the post-test mean scores of students taught mathematics using the peer tutoring approach and lecture method showed the mean score of the students taught mathematics using peer tutoring approach is 66.10 with a standard deviation of 14.66 while

that of the students taught mathematics by lecture method is 49.72 with a standard deviation of 12.21. The difference in the mean scores of the two groups is 16.38 favouring peer tutoring approach.

Answer to Research Question 2

Research question 2 was answered using descriptive statistics showing that 91 students are male with a mean score of 37.45 and a standard deviation of 12.66 while 35 students were female with a mean score of 37.17 and a standard deviation of 11.70. Based on the result the mean achievement score of male students is slightly higher than that of the female students when taught mathematics the difference in the

mean scores of the male and female students is 0.28 favouring male students.

Summary findings of the study

1. Students showed improvement in their performances when taught mathematics using Peer tutoring approach and lecture method as presented in Table 1, since the mean scores of the students on the post-test is significantly better than their mean scores at the pre-test according to the descriptive statistics. Students taught mathematics using the Peer tutoring approach performed better than those taught using the lecture method with Post-test scores of 42.05 and a standard deviation of 13.41 while the mean scores of mathematics students in the control group is 32.84 with a standard deviation of 12.35favouring the experimental group.

2. Students' achievement scores according to gender differ significantly as presented in Table 2, where the descriptive statistics showed that the mean achievement scores of 91 male students are slightly higher than the mean scores of the 35 female students when taught mathematics using peer tutoring and lecture method since the male has the mean of 37.45 with a standard deviation of 12.66 while females mean scores is 37.17 with a standard deviation of 11.70 favouring male students.

This result is in line with the findings of Abdulmalik, and Ttorpev, (2016) revealed that learners taught by peer tutors using Classwide Peer Tutoring (CWPT) performed significantly better than those taught by a conventional method. Akpan, Sylvester, Okworo, Gibson and Ema, (2017) observed that peer-assisted cooperative strategy affected cognitive ability levels of chemistry students. Also in terms of gender, the study corresponds to that of Astani et al., (2023) Males are intrinsically and genetically superior to females in cognitive abilities which determine excellence, particularly for physical sciences.

Conclusion

Based on the findings and the discussion of the study above, this conclusion was made. One of the major conclusions derived from this study is that the peer tutoring approach is better than the conventional method of teaching mathematics gender difference was also found to be sensitive in Biu LG, Biu of Borno State.

1. Mathematics teachers should be encouraged to learn how to the use peer tutoring approach in teaching since this method enhances achievement and has the potential of developing teamwork through interaction and to benefit from each other's experience.

2. The government should increase resources to carry the peer tutoring approach successfully as the approach requires enough papers, worksheets and flashcards among other stationaries.

References

Abbdulmalik,S., & Ttorpev, T.F(2016). Impact of Classwide Peer Tutoring Strategy on Secondary School Slow Learners Performance in Redox Reaction in Funtua, Katsina State, https://doi:10.15415/iie.2016.42007

Adamu, U.A. &Yabo, A.A.(2024). Addressing poor performance through innovative pedagogies in Nigeria. Mathematics Educational Journal,9(1)12-22

Akpan, A., Sylvester,J. Okworo, P. Gipson, S. & Patience, E. (2017). Peer Instructional

Strategy and cognitive ability level in chemistry student in Etnan Local Government Area Akwa Ibom Nigeria British Journal of Education, Society and Behavioural Science, 19(1), 1-10.

Albaar,M.R., Acim, A.R.& Abdallah, A.(2023). Impact of teacher certification on teacher motivation and performance in senior high school in Termer City. Indonesia. 12. doi:10.60084/deml.v1i1,59

Astalni, et al.(2023) Impact of science process skills on thinking skills in rural and urban schools. International Journal of Instruction, 16(2)803-822.

B S M ESTI, (2024).

Darmaji, Astani,Kurniawan and Adila (2022). The correlation between students' perception and the use of a model with students' science process skills. Journal Pedidikan ipa, Indonesia, 11(1)54-62.

Feza-piyose, G.H.(2012). Language: A cultural and capital for conceptualism mathematics knowledge. The International Electronic Journal of Mathematics education, 7(2)62-79.

Herper, G. & Meheady, L. (2007).Peer-mediated teaching and students with learning disabilities. Intervention in school and clinic 43(2)101-107.

Imoko,I.B.& Agwaga,U.N.(2006). Improving students' interest in mathematics techniques. A focus on gender. Journal of Research in Curriculum and Teaching, 1(1)30-31.

Kuder,G.F.& Richardson, M. W.(1937). The theory of estimation of test reliability Psychometrika, 2(3)151-160.DOI:10.1007/BF02288391

Kunchs, T.W., Jitendra, P.A. & Sood, R.S. (2007). Effect of peer tutoring mediated instruction in mathematics for students with learning problems: A researcher

synthesis learning disability research and practices. 22(1)1-12.

Okoli, G.N. & Egbonunu, R.N.(2012). Effect of blended learning on senior secondary school student achievement in biology. International Journal of Educational Research and Development (IJERD).4(1)91-97.

Purnomo, S.(2021). Improving the Student's reading comprehension through numbered heads together techniques. Journal of English as a foreign language,2(2)37-44.

Rini, H. (2022). Developing RME based on lesson study for learning communities in the learning environment of high school mathematics teachers. Journal of Mathematics Education, 13(3)499-514

Sambo, A.A.(2005). Research method in education. Sterling Horbeen Publisher (Nigeria) Ltd, Lagos, Ibadan, Benin City, Jattu Uzairue.

Syarial, S., Kurniawan,D.A., Asrial, A., Sabil,H., Maryani,S.& Rini, E.F.(2022). Professional teachers: study of ICT capabilities and research competency in urban and rural. Cyprus Journal of Education and Science, 17(7), 2247-2261,doi:1018844/cjes.v17i7.7590

Topping, K.J. & Duran, D. (2017). *Using peer tutoring to improve reading skills*. New York, NY: Routledge.

Vygotsky, L.S.(1978). Mind in society. Development of higher psychology process: Harvard University Press, Cambridge, Massachusetts.

INTEGRATING TRADITIONAL AND TECHNOLOGICAL METHODS OF TEACHING RELIGIOUS STUDIES IN A DIGITAL AGE

Ilesanmi G. Ajibola, PhD

Department of Christian Religious Studies/
TETFund Centre of Excellence for Technology Enhanced Learning
Federal University of Education, Zaria, Kaduna State, Nigeria
gabajibola@gmail.com

This article addresses the pressing challenge of integrating traditional teaching methods with modern digital tools in the field of Religious Studies. It raises questions on how educators can effectively engage students while preserving the essence of religious teachings amidst rapid technological advancements. A comprehensive literature review was conducted, while examining specific case studies from Islamic boarding schools, the Roman Catholic religious education system, and other educational contexts, to illustrate the evolving landscape of religious education. Key findings suggest that leveraging digital resources enhances students' engagement and critical thinking, fostering a more interactive learning environment. The article proposes innovative teaching methods, including the use of multimedia resources and online discussion platforms, which cater to diverse learning styles and promote collaborative learning. The article further emphasizes the importance of addressing the digital divide to ensure equitable access to technology, thus facilitating an inclusive educational experience. Ultimately, the article advocates for a balanced approach that marries tradition with technology, aiming to enrich the educational journey of students in Religious Studies while preparing them for contemporary challenges in a digitally connected world.

Introduction

The field of religious studies, rich with ancient texts, traditions, and practices, finds itself at an intriguing intersection in the digital age. While traditional teaching methods offer depth and reverence, technological advancements provide dynamic tools for engagement and accessibility. Merging these approaches offers a unique opportunity to enrich the study of religion, making it more relatable and impactful for diverse audiences. In a time of fast technological change, the area of religious studies encounters an important problem: finding a way to mix old teaching methods with new digital tools. This mix is not just important for getting students interested in religious studies, but also for keeping the core of religious teachings in a way that makes sense to the learners. For example, in Islamic boarding schools in Indonesia, traditional schools are changing their courses to include modern reading and writing practices, which, in turn, improve the interaction with religious texts and promote a sense of moderation and acceptance among students (Ismail et al., 2022). Similarly, using interactive technologies in character education in some Islamic colleges show a good link with building ethical character, stressing the advantages of these methods in developing critical thinking and moral reasoning among students (Al-Matari AS et al., 2023). Traditional teaching methods in religious studies are rooted in centuries-old practices that emphasize personal interaction,

deep reflection, and communal learning. Reading sacred texts in their original languages, engaging in interpretative discussions, and participating in rituals foster a profound connection to the subject matter. These methods prioritize the transmission of not only knowledge but also spiritual wisdom and cultural value]s.

Moreover, the mentorship model, wherein teachers guide students through complex theological concepts, remains irreplaceable. These practices encourage critical thinking, moral reasoning, and an appreciation of the historical and cultural contexts of religious traditions. Technology, on the other hand, has revolutionized education by offering tools that transcend the limitations of physical classrooms and traditional resources. Digital platforms like learning management systems (LMS), virtual reality (VR), and artificial intelligence (AI) have become instrumental in enhancing the study of religion.

1. **Accessibility to Resources**: Digital archives, e-books, and online databases provide access to sacred texts, commentaries, and historical records from around the world. Students can explore the Dead Sea Scrolls or ancient Vedic texts with a few clicks.

2. **Interactive Learning**: Tools like VR can recreate historical religious sites, allowing students to virtually "visit" places like Jerusalem, Mecca, or Bodh Gaya. This immersive experience enhances understanding and engagement.

3. **Customization and Flexibility**: Online courses and apps allow students to learn at their own pace. AI-driven tools can tailor content to individual learning needs, whether it involves mastering Sanskrit grammar or exploring interfaith dialogues.

4. **Global Collaboration**: Technology connects learners and scholars across the globe, fostering interfaith discussions and cross-cultural exchanges. Virtual classrooms bring diverse perspectives into conversation, enriching the study of religion.

An overview of the importance of religious studies in contemporary education

The importance of religious studies in today's education goes beyond just looking at different belief systems; it helps in critical thinking, knowing about cultures, and bringing people together among varied groups of students. By looking at religious texts and practices, students learn to understand the differences in traditions, which is very important in a world that is getting progressively connected. As evident in traditional Islamic boarding schools in Indonesia's pesantren, there is a focus on mixing traditional education with modern literacy skills, which enables students to handle both religious and non-religious knowledge well (Ismail et al., 2022). At the pesantren, the focus on religious moderation in educational settings has shown how religious studies can encourage tolerance and conversations, thus working against extremist views (Asrori et al., 2024). Thus, religious studies may rightly be said to add depth to an inclusive religious pluralistic curriculum, and also help in creating responsible citizens who can take part positively in multicultural settings.

Theoretical Framework for Traditional and Technological Approaches to Teaching Religious Studies

Bringing together tradition and technology in teaching Religious Studies requires a strong theoretical base that aligns teaching methods with the distinct features of religious education. Such a theoretical base

would focus on culturally embedded teaching, as well as recognise the motivating factors that are present in religious learning settings. For example, a study has demonstrated that understanding what motivates students is crucial for improving skills in Quranic recitation and promoting interactive methods that boost student interest and cultural ties (Munzir et al., 2023). Likewise, looking at the teaching methods in the Catholic education system, a need for fresh techniques that not only use technology but also maintain religious principles is indicated. Even though teachers have different ways of using technology, results point to a mainly basic level of cognitive emphasis, which needs to be improved by creating settings that support advanced thinking and creativity (Swallow et al., 2014). Thus, a successful theoretical base that balances thinking and creativity must be deployed to connect educational progress with a safeguard of religious traditions, ultimately enriching the overall learning journey.

Historical Context of Religious Education and its Evolution

The history of religious education retells a narrative of a complicated mix of tradition and new technology. The correlation of tradition and technology has played a big role in how teaching methods have developed in the history of religious education. According to *Fiveable* (2025), religious teaching was at first, mainly based on oral traditions and religious texts, focusing on memorising and reciting the traditions. This way of learning began to change with the invention of the printing press, which made it easier for people to access religious texts and think critically about them. As the twentieth century progressed, the growth of digital technology transformed religious education even more, requiring changes in teaching methods to include digital skills. This development syncs with the observation of Ajibola (2024) who noted

that using online platforms in religious education helps students explore a wide range of resources; this in turn, ultimately shapes how they view religion today. Knowing about these historical changes is important as it demonstrate the need for teaching students the skills they need to critically examine and engage with digital contents in their religious studies (Sinclair et al., 2013; Soukup et al., 2004).

The role of Technology in Transforming Traditional Teaching Methods

The use of technology in education has changed how traditional teaching methods work, especially in religious studies. Previously focused on in-person interactions and standard teaching practices, education is now supported by digital tools that make learning more engaging and accessible. For example, using online platforms provides various resources that help students grasp complicated theological ideas and understand the role of religion in modern life. This change not only expands the range of questions explored but also helps develop important digital skills, which are necessary for navigating today's information-heavy environment. As mentioned in Sinclair et al., (2013), giving students these skills help them to evaluate the problems and possibilities that digital technology brings to their studies. Also, O'Loughlin et al. (2010), noted that the ability of doctrinal teachings to support sustainable education highlights the need to adjust traditional methods to encourage a well-rounded understanding in a digital age.

The impact of digital tools on pedagogical approaches

The use of digital tools in religious studies teaching has continued to challenge the old methods, making learning more interactive and livelier. The modern mode of deploying digital tools to teaching and learning allow teachers to include different multimedia

resources, which helps students engage better with religious texts and ideas. For example, digital platforms aid online discussions and group projects that encourage thinking critically among students, and help them in talking with each other, which aligns with the main goals of religious education to promote understanding and tolerance.

Similarly, Ismail et al. (2022), pointed out in a recent study in Islamic education that digital tools have the power to bridge the gap between traditional practices with modern literacy needs thereby supporting an environment that promote ethical behaviour and interfaith discussions. Imagine a world where students can learn about the Holy Qur'an, or the Holy Bible while using interactive apps and websites. Such intervention would make learning more engaging and also help students to understand how Islamic, and Christian principles can be applied to their lives.

Furthermore, by using technology to connect with people from different faiths, students can engage in meaningful interfaith discussions. By such efforts, empathy, respect, and a deeper understanding of diverse perspectives, ultimately contributing to a more ethical and harmonious world, would be promoted.

Ultimately, in an age where technology permeates every aspect of our lives, the intersection of faith and digital innovation presents both opportunities and challenges for religious institutions. The rapid advancement of technology pushes stakeholders of religious education to reconsider their approaches, integrating modern tools without losing sight of their foundational beliefs. Similarly, as congregations increasingly turn to online platforms for services, educational resources, and community engagement, it becomes essential to view this transition not merely as a response to the digital age, but as a vital

evolution of religious practice. The core values that have sustained faith communities for centuries—compassion, justice, and fellowship—should remain at the forefront of any technological adaptation.

Ultimately, the integration of technology in religious institutions should be seen as a way to amplify their mission rather than diminish it. By carefully considering the implications of these advancements, Elihami et al. (2024) admonish a larger picture consideration of these technologies in a balanced adaptation of religious teaching to today's world, ensuring that institutions keep their core values while welcoming the benefits that digital progress offers.

Innovative Teaching Methods

As education changes due to new technology, new teaching ways are important in religious studies. Using interactive technology makes learning better and helps build good character (Al-Matari AS, et al., 2023). As in the example previously cited, the traditional pesantren system in Indonesia shows how the schools are changing by adding modern literacy skills while keeping their core values, which helps teach students about religious moderation (Ismail et al., 2022). By mixing old teaching methods with technology, teachers can make a more lively and adaptable learning space that supports discussion, tolerance, and good behaviour, which prepares students to deal with the challenges of understanding religion in today's digital world and improves their overall learning experience.

Utilizing multimedia resources to enhance engagement and understanding

Using multimedia resources gives a big chance to improve interest and understanding in teaching religious studies. By using different formats like videos, interactive simulations, and online discussions, teachers can make a

livelier learning space that suits different ways of learning. For example, Mursidin et al., (2023) stated that technology helps improve religious education by improving character growth and moral thinking, making a stronger link to religious ideas.

Furthermore, as demonstrated in the work of Al-Matari AS et al., (2023), interactive technology greatly increases student interest and critical thinking, making difficult ideas easier to grasp. This multimedia method not only provides a more engaging learning experience but also helps students to think deeply about religious materials in ways that normal teaching methods might not be able to do. ultimately, using multimedia resources in a careful way connects traditional teaching to modern educational needs, encouraging a complete understanding of religious studies in today's digital world.

Incorporating online discussion platforms for collaborative learning

Using online discussion platforms is a new way for collaborative learning in religious studies, letting students connect with different views outside the usual classroom (Ajibola, 2024). These platforms help students talk with each other and also link them with global communities, improving their grasp of tough theological ideas. A study by Al-Matari AS et al., (2023), demonstrated that using technology can really boost student engagement and critical thinking skills, as shown by research on moral character in Islamic colleges, which reveals how tech positively affects moral thinking and student participation. Moreover, creating a social networking system designed for higher education highlights how these platforms can support collaborative learning (Alqahtani et al., 2018). In the end, by using online discussion platforms in religious studies, teachers can build inclusive and lively spaces that encourage critical discussion and enhance students' theological exploration.

Addressing the digital divide and ensuring equitable access to technology

The use of technology in religious studies has many problems and issues that teachers must deal with to improve learning results. A key problem is that teachers have different levels of technical skills, which can make it hard to use digital tools well. This is especially clear in places where teachers do not want to adapt or do not have enough resources. For example, Al-Matari AS et al., (2023) noted that lecturers see poor resources and lack of technical skills as big obstacles to using interactive technology in character education. Also, old teaching methods often clash with the fast changes in digital learning spaces, which makes adding these technologies harder. However, when technology is carefully combined with traditional methods, as mentioned by Nursalim et al., (2024), it can greatly improve the learning experience. Therefore, it is crucial for institutions to come up with plans that tackle these problems and also make the most of the benefits that come from this technology blend.

As schools use more technology to improve learning, it is important to tackle the digital divide for all students to have fair access. This is especially important in religious studies, where blending tradition and technology can help create inclusive teaching methods. Research shows that using interactive technology can boost students' ethical character development, with findings suggesting that it increases engagement, critical thinking, and moral reasoning (Al-Matari AS et al., 2023).

In adapting the new technology to religious studies, issues like low technical skills and lack of resources need to be solved to make the most of their benefits. It is important to

explore teacher training programs in this direction, as they are crucial in preparing future teachers with the skills to effectively teach a multicultural curriculum that includes technology.

Furthermore, dealing with the clash of old teachings and new technologies brings both problems and chances in religious studies education. As online platforms are used more in teaching, teachers have the important job of keeping religious content true while also making it easier to access and more engaging. The need to change old teaching methods to fit current times is shown in a study by Munzir et al., (2023). The researchers noted challenges brought on by globalisation and new technologies, and suggested, that by using new methods that blend tradition with technology, teachers can create valuable learning experiences that speak to students from different backgrounds, helping to build a stronger connection to their religious heritage in a modern setting.

Integrating the Two Approaches

Successfully blending traditional and technological methods requires thoughtful integration, ensuring that the strengths of both are leveraged without undermining the essence of religious studies. Here are some strategies:

1. **Blended Learning Models**: Combine in-person classes with online resources. For example, a course on biblical studies could include traditional text analysis in class and supplementary video lectures or online forums for further exploration.

2. **Digital Enhancements for Traditional Practices**: Use digital tools to complement traditional practices. Sacred texts can be studied with interactive annotations and linguistic tools, while online platforms can host discussions that extend beyond the classroom.

3. **Experiential Learning through Technology**: Leverage VR and AR to provide experiential learning. For instance, students can participate in a virtual pilgrimage or observe religious ceremonies from different cultures.

4. **Preserving Sacredness in a Digital World**: While integrating technology, it is crucial to maintain the sacredness and respect that religious studies demand. Digital tools should be used to enhance, not trivialize, the spiritual and ethical dimensions of the subject.

5. **Training Educators**: Equip teachers with the skills to effectively use technology in their pedagogy. Workshops and training sessions can bridge the gap between traditional expertise and digital fluency.

Issues of Consideration

Integrating traditional and technological methods is not without challenges. Issues such as digital equity, potential distractions, and the risk of oversimplifying complex religious concepts must be addressed. Additionally, educators must be mindful of the varying degrees of technological receptiveness among students and communities.

Furthermore, the ethical use of technology in religious studies is paramount. For instance, ensuring accurate representation of sacred texts and avoiding cultural appropriation are critical responsibilities.

Recommendations

Considering the need to enhance the integration of tradition and technology as effective methods for teaching Religious Studies in the digital age, it is recommended as follows:

1. **Professional Development for Educators**: Education and religious stakeholder should implement ongoing training programs that equip teachers with the necessary

technological skills and pedagogical strategies to effectively integrate digital tools into religious education. This will empower educators to utilize technology thoughtfully while maintaining the integrity of traditional teachings.

2. **Development of Multimedia Resources**: School administrators should create and curate a diverse range of multimedia resources, including videos, podcasts, and interactive simulations, that complement traditional religious texts. These resources can help engage students with different learning styles and promote a deeper understanding of religious concepts.

3. **Utilization of Online Collaboration Platforms**: Teachers of religious studies should endeavour to engage in collaborative learning by incorporating online discussion forums and social media platforms that allow students to engage with peers from diverse backgrounds. This will encourage critical dialogue and broaden their perspectives on religious practices and beliefs.

4. **Integration of Culturally Relevant Content**: The Federal Government through the Ministry of Education should ensure that the curriculum reflects students' cultural backgrounds and experiences by incorporating locally relevant religious texts and practices. This approach can bridge the gap between traditional knowledge and contemporary digital contexts, making learning more relatable and meaningful.

5. **Addressing the Digital Divide**: Religious Studies Adminstrators and Supervidors should develop strategies to ensure equitable access to technology for all students. This includes providing necessary resources, such as devices and internet access, particularly in underprivileged areas, to facilitate a more inclusive and effective learning environment in Religious Studies.

Conclusion

In conclusion, mixing tradition with technology is a key step forward in teaching Religious Studies. The integration of traditional and technological methods in teaching religious studies presents an exciting frontier in education. By honoring the depth and wisdom of traditional approaches while embracing the innovation and accessibility of technology, educators can create a holistic and transformative learning experience. This connection helps explain historical context and makes it relevant today. Using digital resources makes the curriculum better and creates a learning space that suits the varied needs of today's students. By using a range of methods like interactive platforms, multimedia content, and discussions, teachers can help students understand religious beliefs and practices more deeply, promoting cultural understanding and empathy. Also, this combination of old and new invites students to look at spiritual stories in new ways, helping them appreciate faith more in the digital world. In the end, accepting these new teaching methods not only boosts academic exploration but also gives students important skills for living in a more connected world. In a digital age, this synthesis not only preserves the essence of religious studies but also makes it relevant and accessible to future generations.

References

Ajibola, I. G. (2024). The Impact of Chatbots in the Writings of Undergraduate Students of Christian Religious Studies at Federal College of Education Zaria. Zaria Journal of Educational Studies (ZAJES), 24(2), 12–21. Retrieved from https://zarjes.com/ZAJES/article/view/1379

Ali Said Al-Matari, Mashur Abadi, Nina Khayatul Virdyna, Rabbianty, Eva Nikmatul, Siti Azizah (2023) Nurturing Ethical Character in Islamic Colleges through Interactive Technology: Lecturers Perspective. doi: https://core.ac.uk/download/595720598.pdf

Alqahtani, Sulaiman Ghazi B (2018) Developing and Assessing a Social Networking Framework for Universities in Saudi Arabia. doi: https://core.ac.uk/download/195697947.pdf

Asrori, Saifudin, Ismail, Muhammad (2024) Colonialism and Islamic Modernism: Differences in the Development Paths of Islamic Boarding Schools in Indonesia. doi: https://core.ac.uk/download/620112564.pdf

Bowser, Audrey Denise (2008) Transforming teacher education to support multicultural technology pedagogy: an assessment of preservice teachers\u27 beliefs about multiculturalism and diversity. doi: https://core.ac.uk/download/38911714.pdf

Elihami, Elihami, S, Sukman, Sicat, Sing (2024) Adapting Islamic Education to Modern Realities: Trends and Challenges in 2024. doi: https://core.ac.uk/download/618245671.pdf

Fivabale (2025) Ancient Religion Unit 13 – Ancient Religion: Sacred Texts & Literature, https://library.fiveable.me/ancient-religion/unit-13.

Ismail, Faisal Husen, Nafisah, Raudhatun, Saleh, Syaiful Hisyam (2022) Situating Indonesian Pesantren within Literacy Practice and Religious Moderation in Post-Truth Era. doi: https://core.ac.uk/download/588348751.pdf

Munzir, Munzir (2023) Motivational Influences and Challenges in Quranic Recitation Proficiency: A Study Among Islamic Educational Teacher Training Department State Islamic University Ar-Raniry Banda Aceh Students. doi: https://core.ac.uk/download/599112189.pdf

Mursidin, Muthmainnah (2023) Shaping Future Leaders: How Technology is Transforming Islamic Education in The Digital Age. doi: https://core.ac.uk/download/595383606.pdf

Nursalim, Eko (2024) Integrated Technology and Traditional Pedagogy: Echancing Islamic Education in Digital in a Digital Age. doi: https://core.ac.uk/download/609771823.pdf

O'Loughlin, Rebecca, Smith, Simon M., Stuerzenhofecker, Katja (2010) Sustainability in the theology curriculum. doi: https://core.ac.uk/download/364676.pdf

Sinclair, Stefanie (2013) Digital literacy in religious studies. doi: https://core.ac.uk/download/28929720.pdf

Soukup, Paul A. (2004) Walter J. Ong, S.J.: A retrospective. doi: https://core.ac.uk/download/215444171.pdf

Swallow, Meredith (2014) Exploring Catholic Education In The Twenty-First Century: Teaching Practices, Technology Integration, And Educational Goals. doi: https://core.ac.uk/download/51066903.pdf

MATHEMATICAL MODEL FOR HOUSING ALLOCATION AND RESETTLEMENT OF HOMELESS POPULATION DUE TO BOKO HARAM INSURGENCY IN ASKIRA UBA, BIU, DAMBOA AND GWOZA LOCAL GOVERNMENT AREAS OF BORNO STATE, NIGERIA

Hassan Habib Ph.D

Department of Mathematics, College of Education,
Waka-Biu, Borno State, Nigeria.
+2348034463968
habibkantoma@gmail.com

In this study, a model of optimum resettlement pattern for internally displaced persons due to Boko Haram insurgency in Askira Uba, Biu, Damboa and Gwoza Local Government areas of Borno State that suffered all kinds of impacts by Boko Haram insurgency is defined and established. Interview and observation methods of data collection are used to collect data in the four Local Government areas which is interpreted into the ordinary differential equation for developing the model by considering the havoc of the insurgency on the individuals. The system of ordinary differential equations was solved using Cauchy's solution and the stability of the system was also analyzed using asymptotic analysis. The results established show the flow for optimum resettlement of internally displaced families in the study area which may be used as a scheme by the Borno State government in the distribution of resources to victims in any natural disaster. It is concluded that the possible extension of this work is to make the system of equations of the model non-autonomous and use a small time scale to drive the stability and asymptotic behaviours.

Introduction

Mathematical model is an abstract description of a concrete system using mathematical concepts. The use of mathematical models to solve problems is a large part of the field of operational research. Eiselt, Bhadury and Burkey (2011). Mathematical modelling of course accentuates the beauty of mathematics and can help produce urgent results for handling insurgency thereby making it possible to achieve the housing allocation and resettlement plan. Rajan, Singh, Shubham and Vipin (2002).

Violent militia groups sprang up in the Northeastern part of Nigeria and formally denounced any ties with the federal government of Nigeria and its Western belief system. The militia strongly opposed Western influence and education. Referring to Western education as "Haram," which simply means taboo, the group has been consequently tagged Boko Haram, which means "Western education is taboo."

Boko Haram forcefully unseated local council administrators and ruled with their version of Sharia law. They established caliphates in more than thirteen local council areas in the northeastern part of the country, crippling economic, social and political activities. The group burnt houses, churches and mosques that oppose their belief system. Insani, Taheri, and Abdollahian (2024).

This reign of terror in the northeast region led to Nigeria's worst internal crisis in history, recording millions of deaths, destruction of properties, and the displacement of millions of

people. Internal displacement on a large scale became a grave situation within Nigeria. The National Emergency Management Agency (NEMA) of Nigeria reported 2.1 million internally displaced persons (IDPs) at the beginning of 2016. These people represented more than 300,000 households in the northern part of the country making it the highest displacement incidence in Africa. Bettina and Walz (2009).

The ongoing insurgency in northern Nigeria, called "Boko Haram," and the government's often brutal attempts to suppress it, have produced a tide of refugees and internally displaced in one of the world's poorest regions. With the "fog of war," government restrictions on news agencies, and a poor communications infrastructure, it is difficult to survey needs with precision.

IRIN published that an estimated 350,000 people have been displaced since 2013. Of that number, 290,000 are internally displaced and the rest have fled to Cameroon, Chad, and Niger. The UN High Commissioner for Refugees (UNHCR) has a higher estimate of internally displaced persons, at 470,000. Hasti, Reza and Roya (2019). Local Nigerian officials are telling me that the real number is dramatically higher than these estimates; in Bauchi, according to one official, internally displaced persons number more than a million. They come, he said, from the ethnic conflict in Plateau state as well as from further north where "Boko Haram" is active. According to IRIN, there are no official camps for the internally displaced. They shelter with family and friends where they can find them. That reality also disguises how large the internally displaced numbers are likely to be. Eziyi and Dominic (2010).

The psychological impact of terrorism on the people in terms of displacement cannot be undermined coupled with the immediate effort to get them resettled. People living in areas affected by insurgency have migrated to other relatively safe areas in the region temporarily. The activities of the Boko Haram sect have increased the displacement of people in the form of internally displaced persons (IDPs) fleeing to safer havens within the nation and refugees fleeing into neighbouring nations. Those whose homes have been damaged or destroyed by the insurgent attacks have nowhere to go back to. Most internally displaced persons live and share resources with host communities. Johnson and Caulkins (2006).

The problem of protecting and assisting IDPs is not a new issue. In international law, it is the responsibility of the government concerned to provide assistance and protection for the IDPs in their country. However, many of the displaced in Nigeria are a result of the Boko Haram insurgency. Therefore, in this study, the interview and observation method of data collection will be to collect data in some sampled areas in the four selected Local Governments which are

1) Sampled areas in Askira Uba Local Government Area affected by Boko Haram insurgency are: i) klangar ii) Alagarno - Blakurke iii) Ngulde iv) Ngwahi v) Bapa vi) lasa vii) Wuba viii) Vile ix) Bagajau x) Maikadir xi) Yafa xii) Kirchina

2) Sampled areas in Biu Local Government Area affected by Boko Haram insurgency are:
   i) Buratai ii) Miring iii) Gunda iv) Gur v) Kurnari vi) Mandaragrau vii) Bam Buratai viii) Kamuya ix) Debiro

3) Sampled areas in Damboa Local Government Area affected by Boko Haram insurgency are:
   i) Sabon Gari ii) Bulablin iii) Wajirago iv) Alagarno v) Ajigin vi) Talala

4) Sampled areas in Gwoza Local Government Area affected by Boko Haram insurgency are:

i) Ngoshe ii) Pulka iii) Bita iv) Izge v) Yamtage vi) Kirawa vii) Agapalwa viiii) Wala ix) Habagda x) Kuranabasa

The large number of internally displaced persons in Borno State, combined with the inadequate housing and welfare planning by both the Borno State Government and NGOs to address the challenges created by insurgency, prompted me to conduct this research. Consequently, the number of homeless individuals in the selected study area was used to develop a model for housing allocation to internally displaced persons in these Local Government Areas, along with an analysis of the model's stability.

Statement of the problem

Inadequate housing and welfare planning by Borno State Government to cope with the problems created by activities of insurgency harms the estimation of the cost of resettlement for victims of insurgency. Nikolopoulos and Tzanetis (2003) considered a model for housing allocation of a homeless population due to a natural disaster. This model applies to any type of disaster, whether natural or man-made, as long as the affected population is displaced, considering the nature of the compartments involved in the model. In their model, they derived a non-linear system of ordinary differential equations and analysed the stability of the system limiting their system of model into five categories not taking into consideration the havoc of the natural disaster

Method

Model Assumptions:

R - Number of populations resettled

Q - Number of populations accommodated in a temporary state.

W - Number of population homeless after the disaster

on the individuals. Therefore, in this research work, I will devise an optimum resettlement scheme to curtail housing needs and even distribute resources to victims due to Boko Haram insurgency in some selected Local Government areas of Borno State.

Objectives of the study

The objectives of this research are;

i. Derive a non-linear system of ordinary differential equations

ii. Analyze a model by considering housing allocation and resettlement of internally displaced persons due to Boko Haram insurgency in Askira Uba, Biu, Damboa and Gwoza Local Governments.

iii. Analyze the stability of the system.

iv. Design a model of the flow of settlement of internally displaced persons.

Research questions

i. What is the effect of the non-linear system of ordinary differential equations on the housing allocation and resettlement process of internally displaced persons?

ii. How can the model be analysed, considering the housing allocation and resettlement process of internally displaced persons due to Boko Haram insurgency in Askira Uba, Biu, Damboa and Gwoza Local Governments?

iii. What is the stability of the system?

iv. What is the effect of the model on the flow of settlement of internally displaced persons.

K_2

Existing Model Diagram

```
                                                         ┌──────────┐
┌──────────┐            ┌──────────┐       K1            │          │
│          │    K₃      │          │  ◄──────────────    │    W     │
│    R     │ ◄───────── │    Q     │                     │          │
│          │            │          │                     └──────────┘
└──────────┘            └──────────┘
```
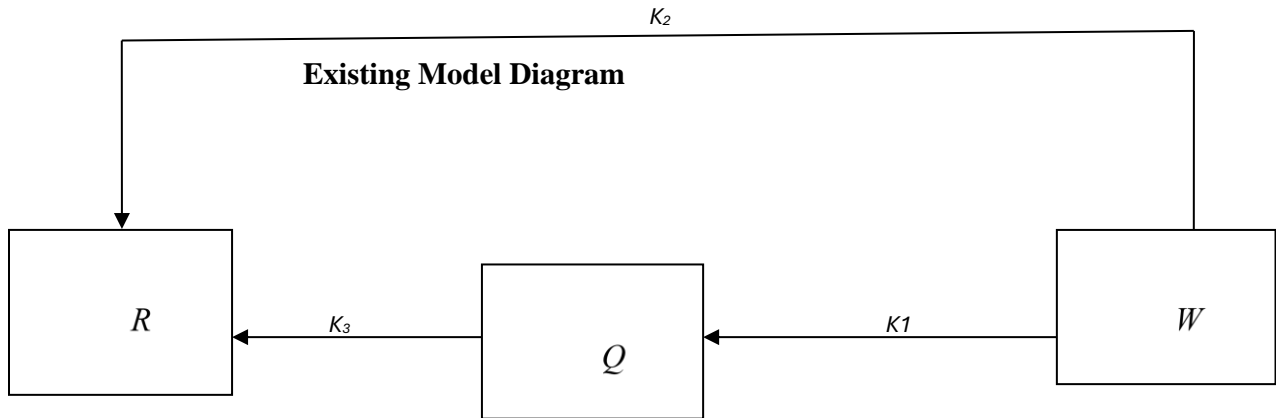
$$D'(t) = -k_1 w(Q_a - Q) - k_2 w(R_a - R) \tag{1}$$

Where k_1 and k_2 are positive constants of proportionality. The rate of change in the number of populations living in temporary accommodation is proportional to $W(Q_a - Q)$ and number of populations that are resettled $Q(Ra - R)$

Thus,

$$Q'(t) - k_1 W(Q_a - Q) - k_3 Q(R_a - R) \tag{2}$$

$$R'(t) = (k_2 w + k_3)(R_a - R) \tag{3}$$

$$W_o = W(o) = W(t) + R(t) \tag{4}$$
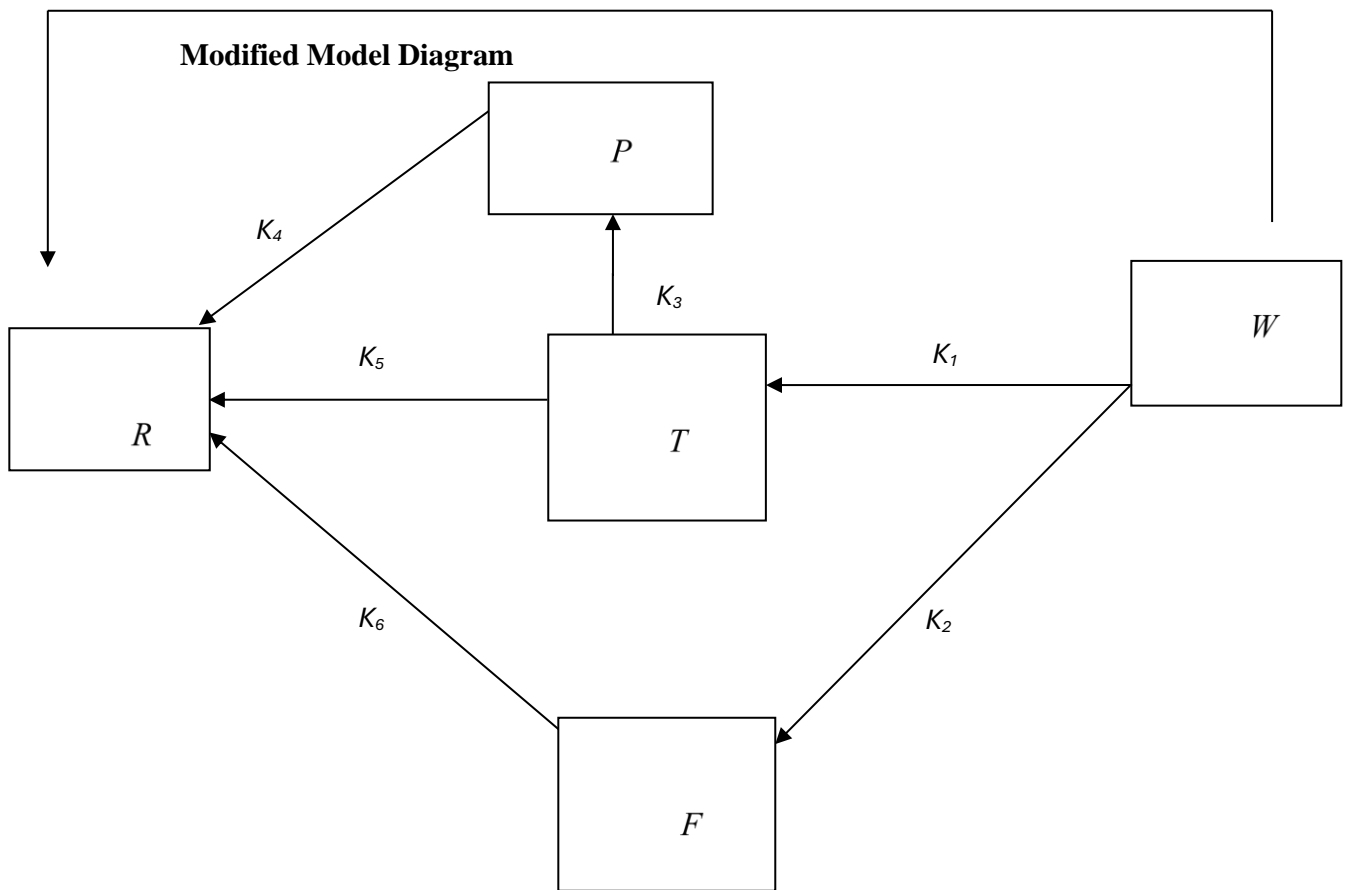
K_7

Modified Model Diagram

Model Assumptions:

R	-	Number of populations resettled
Q	-	Number of populations accommodated in temporary state.
W	-	Number of populations homeless after the disaster
P	-	Number of populations in camps by State
T	-	Number of populations living in available tents by state
F	-	Number of populations living with friends or relatives.

$$W'(t) = -k_1 W(T_a - T) - k_2 W(F_a - F) - k_7 W(R_a - R) \tag{5}$$

$$P'(t) = -k_4 P(R_a - R) + k_3 T(P_a - P) \tag{6}$$

$$T'(t) = k_1 W(T_a - T) - k_3 T(P_a - P) - k_5 T(R_a - R) \tag{7}$$

$$F'(t) = k_2 W(F_a - F) - k_6 F(R_a - R) \tag{8}$$

$$R'(t) = k_7 W(R_a - R) + k_4 P(R_a - R) + k_5 T(R_a - R) + k_6 F(R_a - R) \tag{9}$$

Equations 5, 6, 7, 8 and 9 are the equations ordinary differential equations obtained from the existing model diagram above by considering the number of populations resettled, accommodated in temporary state, homeless after the disaster, in camps, living in available tents by state and those living with friends or relatives.

Model Assumptions:

R	-	Number of individuals resettled
W	-	Number of individuals homeless after the insurgency
P	-	Number of individuals in camps by Borno State
T	-	Number of individuals living in available tents
F	-	Number of individuals living with friends or relatives.
H	-	Number of individuals accommodated in hospitals due to injuries sustained.

$$W'(t) = -k1W(Ta - T) - k2W(Fa - F) - k3W(Ha - H) - k10W(Ra - R) - k11(Pa - P) \tag{10}$$

$$H'(t) = k3W(Ha - H) - k8H(Ra - R) - k9H(Fa - F) \tag{11}$$

$$T'(t) = k1W(Ta - T) - k4T(Pa - P) - k6T(Ra - R) \tag{12}$$

$$F'(t) = k2W(Fa - F) - k7F(Ra - R) + k9H(Fa - F) \tag{13}$$

$$P'(t) = k4T(Pa - P) - k5P(Ra - R) + k11W(Pa - P) \tag{14}$$

$$R'(t) = k10W(Ra - R) + k5P(Ra - R) + k6T(Ra - R) + k7F(Ra - R) + k8H(Ra - R) \tag{15}$$

Equations 10, 11, 12, 13, 14 and 15 are the ordinary differential equations obtained from the modified model diagram above, derived by considering the number of individuals resettled, homeless after the insurgency, in camps, living in available tents, with friends or relatives and those accommodated in hospitals due to injuries sustained.

Results

Derivation of Non-linear System of Ordinary Differential Equations

Estimation of the $k's$ value in the modified model diagram. Given the system of equations 10, 11, 12, 13, 14 and 15. I assumed that the values R, W, P, T, F, M are consistent to the data $R_s, W_s, P_s, T_s, F_s, M_s$ from the Boko Haram insurgency in four sampled local government areas of Borno State at time $t = 3$ months. Therefore, $t = t_s$ we must have $R(t_s) = R_s = 1,550$ families, $W(t_s) = W_s = 1,022$ families, $P(t_s) = P_s = 1,225$ families, $T(t_s) = T_s = 1,071$ families, $F_1(t_s) = F_{1,s} = 2028$ families, $F_2(t_s) = F_{2,s} = 1104$ families, $F_3(t_s) = F_{3,s} = 71$ families, $F_4(t_s) = F_{4,s} = 469$ families, $M(t_s) = M_s = 710$ families.

The results of the Boko Haram insurgency are demonstrated in Table 1. In the analysis, I considered all categories and we also considered that at time $t = 0$, $W(0) = W_0 = 9,250$. We also considered as well a function. Consider the functions $H(k_1, k_2, k_3, k_4, k_5, k_6, k_7, k_8, k_9, k_{10}, k_{11}) = R(t_s) - R_s, W(t_s) - W_s, P(t_s) - P_s, T(t_s) - T_s, F(t_s) - F_s M(t_s) - M_s$. In the derivation of the model, I used the following assumptions.

   a) Birth or death rates can be neglected.
   b) The number of families is large enough so all the symbols are considered to be a non-negative real function of time.
   c) There is an infinitely fast rate of rehousing.
   d) I will apply the conservation principle to the number of people in the sample.

Table: 1: Summary of the data collected from the sampled areas of the study

Sampled local Government	Number of populations	Total
Askira Uba	12 villages $\times 250$ people	3,000
Biu	9 villages $\times 250$ people	2,250
Damboa	6 villages $\times 250$ people	1,500
Gwoza	10 villages $\times 250$ people	2,500

F

igure 1: Chart Description of the Sampled Areas of the Study
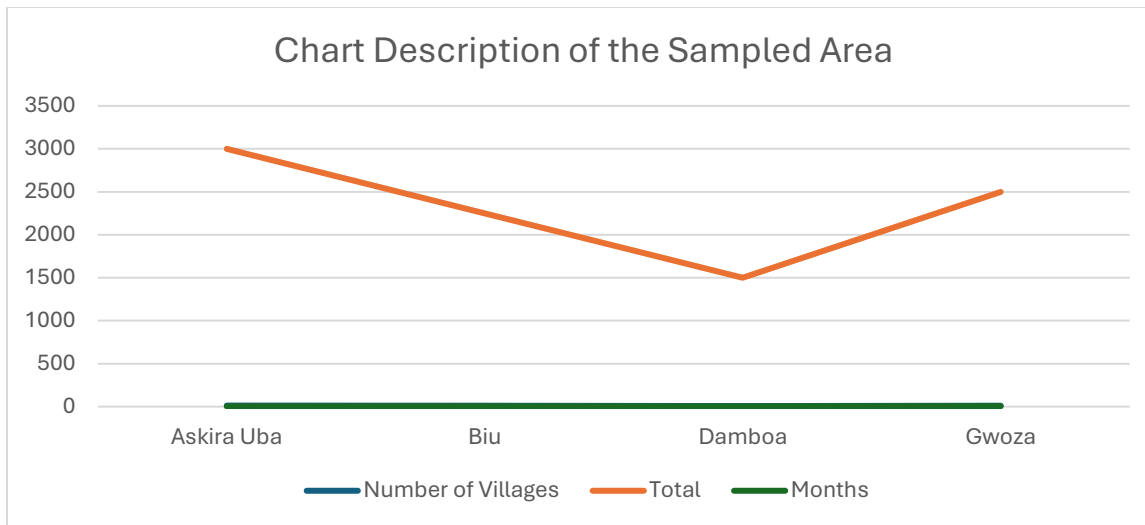
Figure 4.1 above is a chart depicting the sampled local government areas. The chart clearly shows that Askira Uba has the highest number of internally displaced persons, followed by Gwoza, Biu, and then Damboa. The blue line represents the number of villages in each local government area, the red line indicates the number of villages sampled, and the green line shows the time frame for the research.

Table 2: Sampled population from the four selected local government areas of Borno State   affected by the Boko Haram insurgency

Symbols	Categories (The four sampled Local Governments)	Number of Families
R	Number of populations resettled	1,550
W	number of populations are accommodated in a temporary state.	1,022
P	Number of populations homeless after the disaster	1,225
T	Number of populations in camps by State	1,071
F_1	Guests with friends or relatives	2,028
F_2	Families living in temporary accommodation	1,104
F_3	Families renting houses	71
F_4	Families living in Schools	469
M	Number of individuals accommodated in hospitals due to injuries sustained	710
W_0	Summary of all categories	9,250

Figure 2: Chart Description of the Data Collected

Chart Description of the Data
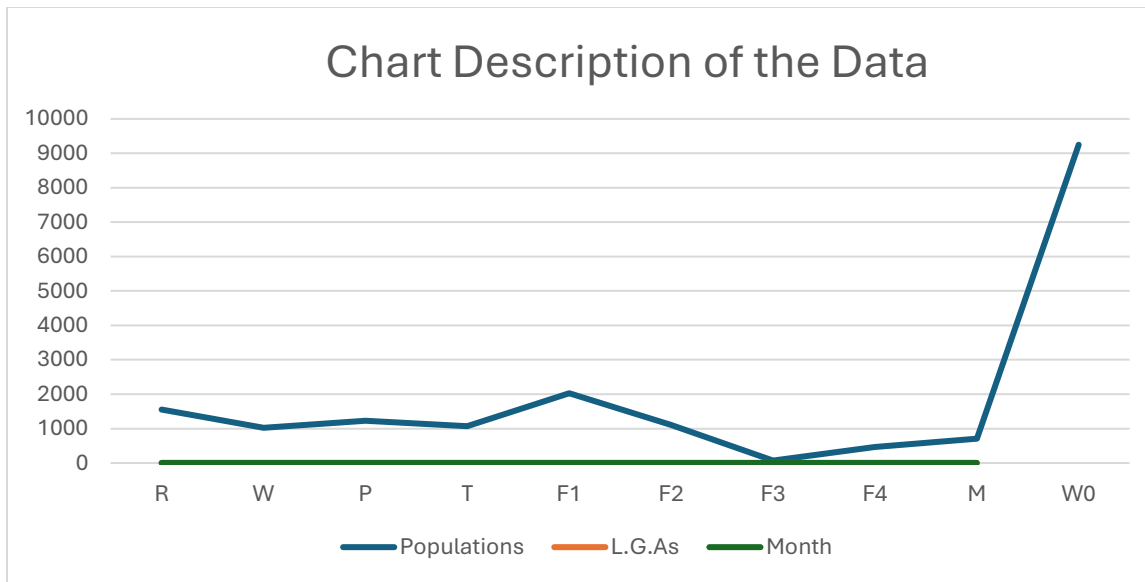
Figure 4.2 above is a chart illustrating the data collected for this research, based on the nine categories of internally displaced persons considered in the study. The blue line represents the population in each category, the red line indicates the sampled local government areas and the green line shows the time frame for the research. Solving the system of equations in the existing model numerically, as a transcendental equation with an iteration scheme. I started with an initial guess of the $k's$ value and at each step of the iteration I solved the system of the equations numerically using $RK4$ the method to give $R_s, W_s, P_s, T_s, F_s, M_s$. I make the initial guest in such a way that the values of the $k's$ increases from smallest to highest. This is because I expect to see a very quick decrease in the number of homeless populations settled in temporary accommodation supplied by Borno State government or permanent accommodation for those families that have the financial ability to do so. I also expect to have flow which is weak from people already from temporary accommodations to a permanent residence. Moreover, I also assumed that there is enough availability in both temporary and permanent accommodations that is

$R_x = 100 \times 10^3$ units of permanent accommodation, $T_x = 80 \times 10^3$ units of temporary accommodation. This set of values corresponds to a situation where initially the number of homeless people decays rapidly while, because constants of availability are not very large, the majority of families are accumulated to temporary accommodation.

Note that the first of the above considerations corresponds to a situation where a respectable number of families move to permanent accommodation immediately while the second consideration corresponds to a situation where initially, families can only settle to a temporary accommodation due to financial inability. In general, I consider these two cases which be close to reality. Therefore, I consider following a system of ordinary differential equations by reducing the modified model equations.

Consider the following system of ordinary differential equations below

$$W'(t) = -k1W(Ta-T) - k2W(Fa-F) - k3W(Ha-H) - k10W(Ra-R) - k11(Pa-P)$$
(16)

$$H'(t) = k3W(Ha-H) - k8H(Ra-R) - k9H(Fa-F)$$
(17)

$$T'(t) = k1W(Ta - T) - k4T(Pa - P) - k6T(Ra - R)$$

(18)

$$F'(t) = k2W(Fa - F) - k7F(Ra - R) + k9H(Fa - F)$$

(19)

$$P'(t) = k4T(Pa - P) - k5P(Ra - R) + k11W(Pa - P)$$

(20)

$$R'(t) = k10W(Ra - R) + k5P(Ra - R) + k6T(Ra - R) + k7F(Ra - R) + k8H(Ra - R)$$

(21)

I assumed throughout this study that the population would remain constant during this research process and therefore

$$W_0 = W(0) = W(t) + H(t) + T(t) + F(t) + P(t) + R(t)$$

(22)

Finally, using equation (22)

substitute equation (16) in (17) we have

$$x'(t) = W'(t)H'(t)$$
$$= -k_1k_{11}w^2(T_a - T)(P_a - P) - k_2k_9wH(F_a - F) - k_3k_8k_{10}w^2H(H_a - H)(R_a - R)$$
$$= -x_1z - x_2a - x_3y$$

(23)

where $x_1 = k_1k_{11}w^2$, $z = (T_a - T)(P_a - P)$

$x_2 = k_2k_9wH$ $a = (F_a - F)$ $x_3 = k_3k_8k_{10}w^2H$

$y = (H_a - H)(R_a - R)$

substitute equation (18) in (19) we have

$$y'(t) = T'(t)F'(t)$$
$$= k_1k_2w(T_a - T)(F_a - F) - k_4k_6k_7k_9T^2HF(P_a - P)(R_a - R)$$
$$= x_1y_1 - by_2$$

(24)

where $x_1 = k_1k_2w$, $y_1 = (T_a - T)(F_a - F)$,

$b = k_4k_6k_7k_9T^2HF$, $y_2 = (P_a - P)(R_a - R)$

substitute equation (20) in (21) we have

$$z'(t) = P'(t)R'(t)$$
$$= k_4k_{11}Tw(P_a - P) - k_5k_6k_7k_8k_{10}P^2wTF(R_a - R)$$
$$= x_1z_1 - cz_2$$

(25)

where $x_1 = k_4k_{11}Tw$, $z_1 = (P_a - P)$,

$c = k_5k_6k_7k_8k_{10}P^2wTF$, $z_2 = (R_a - R)$

to have equations (26), (27) and (28) respectively with

$$x'(t) = -xz - ax - xy$$

(26)

$$y'(t) = xy - by$$

(27)

$$z'(t) = xz - cz$$

(28)

where $x(t) \geq 0$, $y(t) \geq 0$, $z(t) \geq 0$ with $a, b, c > 0$

Stability of the Stationary Points $(0,0,0)$, $(b,a,0)$ **and** $(c,0,a)$

To investigate the stability of the system, consider the equilibrium points i. e stationary, steady-state, fixed point which are solutions of equations (26), (27) and (28). The stability of this point also depends crucially on the value of the eigenvalues λ. i.e. on the availability for resettlement. If λ is positive, then the system is asymptotically stable and if λ is negative then the point is unstable, and if $\lambda = 1$ then further analysis will be required to investigate the possible points.

Where λ eigenvalue is obtained from the system of ordinary differential equations (26), (27) and (28) which is used to interpret the stability of the system.

Analysis of the Model

Center Manifold Analysis

The following theorem characterizes all equilibrium points. Equating (26), (27) and (28) to zero solving we obtain the following equilibrium point because I expect to have no homeless families in temporary accommodation after enough time has elapsed.

Equation (29) is obtained by equating the differential equation (26) to zero to obtain the equilibrium point

$$-xz - ax - xy = 0$$

(29)

Equation (30) is obtained by equating the differential equation (27) to zero to obtain the equilibrium point

$$xy - by = 0$$

(30)

Equation (31) is obtained by equating the differential equation (28) to zero to obtain the equilibrium point

$$xz - cz = 0$$

(31)

solving equation (29) gives

$ax - xy - xz = 0$, when $x = 0$, we have $(0,0,0)$

solving equations (30) gives

$-by + xy = 0$, $y(-b + x) = 0$, $y = 0$ or $-b + x = 0 \Rightarrow x = b$ and

solving equations (31) gives

$ax - xy = 0$, $x(a - y) = 0$, $x = 0$ or $y = a$

we have $(b,a,0)$

$-cz + xz = 0$, $z(-c + x) = 0$, $z = 0$ or

$x = c$ $ax - xz = 0$, $x(a - z) = 0$, $x = 0$ or

$z = a$ we have $(c,0,a)$

Based on the solutions of equations (29), (30) and (31), the three equilibrium points obtained are as follows

Equilibrium points $(0,0,0)$ obtained from the solution of equation (29)

Equilibrium points $(b,a,0)$ obtained from the solution of equation (30) and

Equilibrium points $(c,0,a)$ obtained from the solution of equation (30)

Theorem 4. 1: System (29), (30) and (31) have three equilibrium points:

- $(0,0,0)$ which is a saddle point,

- $(b,a,0)$ which is a nonhyperbolic point, and

- $(c,0,a)$ which is a nonhyperbolic point,

   where and a,b,c are positive

Proof: Consider the continuous map obtained by combining equations (29), (30) and (31)

$$f(x) = \begin{pmatrix} ax - xy - xz \\ -by + xy \\ -cz + xz \end{pmatrix}$$

(32)

Clearly, $f(x) = 0$ at

$$x_1 = (0,0,0)^T,$$

$$x_2 = (b,a,0)^T \text{ and }$$

$$x_3 = (c,0,a)^T.$$

We first compute the Jacobian matrix of partial derivatives:

$$Df = \begin{pmatrix} a - y - z & -x & -x \\ y & -b + x & 0 \\ z & 0 & -c + x \end{pmatrix}$$

(33)

The derivative at equilibrium point x_1

$$Df(x_1) = \begin{pmatrix} a & 0 & 0 \\ y & -b & 0 \\ z & 0 & -c \end{pmatrix}$$

(34)

To find the eigenvalues,

$$Df(x_1) = \begin{pmatrix} a & 0 & 0 \\ y & -b & 0 \\ z & 0 & -c \end{pmatrix} = \begin{vmatrix} a - \lambda & 0 & 0 \\ y & -b - \lambda & 0 \\ z & 0 & -c - \lambda \end{vmatrix}$$

$$a - \lambda \begin{vmatrix} -b - \lambda & 0 \\ 0 & -c - \lambda \end{vmatrix},$$

$$a - \lambda((-b - \lambda)(-c - \lambda)) = 0$$

$$(a - \lambda)(\lambda^2 + b\lambda + c\lambda + bc) = 0$$

$$\lambda_1 = a, \lambda_2 = b, \lambda_3 = c$$

$Df(x_1)$ has eigenvalues with different signs, from which we conclude that x_1 is a saddle point So, equilibrium point x_1 is unstable.

The derivative at equilibrium point x_2

$$Df(x_2) = \begin{pmatrix} 0 & -b & -b \\ a & 0 & 0 \\ z & 0 & -c + b \end{pmatrix}$$

(35)

To find the eigenvalues,

$$Df(x_2) = \begin{pmatrix} 0 & -b & -b \\ a & 0 & 0 \\ z & 0 & -c+b \end{pmatrix} = \begin{vmatrix} -\lambda & -b & -b \\ a & -\lambda & 0 \\ 0 & 0 & -c+b-\lambda \end{vmatrix}$$

$$-\lambda \begin{vmatrix} -\lambda & 0 \\ 0 & -c+b-\lambda \end{vmatrix} + b \begin{vmatrix} a & 0 \\ 0 & -c+b-\lambda \end{vmatrix} = 0$$

$$-\lambda(\lambda c - \lambda b + \lambda^2) + b(-ac + ab - a\lambda) = 0$$

$$-\lambda^3 + \lambda^2 b - \lambda^2 c + ab^2 - abc - ab\lambda = 0$$

$$\lambda^3 - \lambda^2(b-c) + ab\lambda - ab(b-c) = 0$$

$b-c$ is one of the factors of the above equation, therefore, $\lambda_1 = b-c$

Applying long division to the above polynomial, we have the following

$$\begin{array}{r} -\lambda^2 + a\lambda - ab - a\lambda \\ b-c \overline{)-\lambda^3 + \lambda^2 b - \lambda^2 c + ab^2 - abc - ab\lambda} \\ - \\ -\lambda^2 b + \lambda^2 c \\ ab\lambda - ab^2 + abc \\ - \\ ab\lambda - ac\lambda \\ -ab^2 - ac\lambda + abc \\ - \\ -ab^2 + abc \\ -ac\lambda \\ - \\ -ac\lambda \\ 0 \end{array}$$

$$-\lambda^2 + a\lambda - ab - a\lambda = 0$$

$$-\lambda^2 - ab = 0$$

$$\lambda^2 = -ab$$

$$\lambda = \pm i\sqrt{ab}$$

And corresponding eigenvalues are $\lambda_1 = b-c$, $\lambda_2 = i\sqrt{ab}$ and $\lambda_3 = -i\sqrt{ab}$. Since eigenvalues λ_2 and λ_3 are pure imaginary, then equilibrium x_2 is a non-hyperbolic point. So, we cannot conclude anything at this stage about the stability of this equilibrium point. Similarly,

$$Df(x_3) = \begin{pmatrix} 0 & -c & -c \\ 0 & -b+c & 0 \\ a & 0 & 0 \end{pmatrix}$$

(36)

To find the eigenvalues,

$$Df(x_3) = \begin{pmatrix} 0 & -c & -c \\ 0 & -b+c & 0 \\ a & 0 & 0 \end{pmatrix} = \begin{vmatrix} 0 & -c & -c \\ 0 & -b+c & 0 \\ a & 0 & 0 \end{vmatrix}$$

$$-\lambda \begin{vmatrix} -b+c-\lambda & 0 \\ 0 & -\lambda \end{vmatrix} - c \begin{vmatrix} 0 & -c+b-\lambda \\ a & 0 \end{vmatrix} = 0$$

$$-\lambda(-\lambda c + \lambda b + \lambda^2) - c(-ac + ab + a\lambda) = 0$$

$$\lambda^3 + \lambda^2 b - \lambda^2 c - ac^2 + abc + ac\lambda = 0$$

$$\lambda^3 - \lambda^2(c-b) + ac\lambda - ac(c-b) = 0$$

$c-b$ is one of the factors of the above equation, therefore, $\lambda_1 = c-b$

Applying long division to the above polynomial, we have the following

$$\begin{array}{r} -\lambda^2 + a\lambda - ac - a\lambda \\ c-b \overline{)\lambda^3 + \lambda^2 b - \lambda^2 c - ac^2 + abc + ac\lambda} \\ - \\ -\lambda^2 c + \lambda^2 b \\ ac\lambda - ac^2 + abc \\ - \\ ac\lambda - ab\lambda \\ -ac^2 - ab\lambda + abc \\ - \\ -ac^2 + abc \\ -ab\lambda \\ - \\ -ab\lambda \\ 0 \end{array}$$

$$-\lambda^2 + a\lambda - ac - a\lambda = 0$$

$$-\lambda^2 - ac = 0$$

$$\lambda^2 = -ac$$

$$\lambda = \pm i\sqrt{ac}$$

And $\lambda_1 = c-b$, $\lambda_2 = i\sqrt{ac}$ and $\lambda_3 = -i\sqrt{ac}$, from which we conclude that x_3 is a non-hyperbolic point and we cannot conclude anything about the stability of this equilibrium point.

Stability Analysis of the System

Asymptotic Analysis

In the next theorem, we will predict the behaviour of the resettlement model and

the resettlement of the internal displacement by considering the theorem below

$$x'(t) = -by$$

(37)

$$y'(t) = -cz$$

(38)

and analyzing x axis we can predict the resettlement of the internal displacement.

Model of Flow of Settlement of Internal Displaced Persons

Derivation of a More Sophisticated Model

Consider the following system of ordinary differential equations below

$$x'(t) = ax - bxy$$

(39)

$$y'(t) = cxy - dy$$

(40)

With eigenvalues $\lambda_1 = c - b$, $\lambda_2 = i\sqrt{ac}$ and $\lambda_3 = -i\sqrt{ac}$. Using the theory of center manifold analysis. The eigenvalue corresponds to $\lambda_1 = c - b$ $\lambda_2 = i\sqrt{ac}$ and $\lambda_3 = -i\sqrt{ac}$ is predicted as the existence of curves invariant under the flow and tangent, where the function $x(t)$ represents the total population of the study area at time $t = 3$ Months and also the function $y(t)$ represents the populations in the temporary tent by the Borno State government also at time $t = 3$ Months with a, b, c, d positive constants.

The modified resettlement model is given by the following system

$$x'(t) = ax - bx^2 - cxy$$

(41)

$$y'(t) = -dy + exy - fy^2$$

(42)

Where the scale quantities representing the number of families in temporary accommodations.

The modified three-dimensional resettlement model also uses a nonlinear system of equations

$$x'(t) = ax - bx^2 - cxy$$

(43)

$$y'(t) = fxy - ey$$

(44)

$$z'(t) = ixz + jyz - gz - hzx$$

(45)

Using a change of coordinates, system (43) can be transformed into the system of ordinary differential equation (46)

$$x'(t) = x - bx^2 - xy - xz$$

(46)

Using a change of coordinates, system (44) can be transformed into the system of ordinary differential equations (47)

$$y'(t) = xy - by$$

(47)

Using a change of coordinates, system (45) can be transformed into the system of ordinary differential equations (48)

$$z'(t) = exz + fyz - cz - dzx$$

(48)

The transformations in equations (43), (44) and (45) above which gives equations (46), (47) and (48) will be unstable for positive initial conditions and the equilibrium point $(0,0,0)$ which is the origin, is an attractor.

Since equations (46), (47) and (48) are unstable for positive initial conditions and the equilibrium point $(0,0,0)$ is an attractor, this system of ordinary differential equations is true because I expect to have no homeless families or families in the temporary accommodation after enough time has elapsed.

Discussion

Two models were derived regarding the movement of the homeless population due to Boko Haram insurgency in four selected local government areas of Borno State. In the second

of these, the number of families in temporary accommodation was divided into three categories while in the first model, it was taken as one category. In both cases, I analyzed the stability of the system of derived ordinary differential equations. I obtained the steady states of the system and looked at the zero solutions because I am interested in the state of the system where the origin is attracting with the presence of zero eigenvalues when the availability of the accommodation is equal to the demand. The Jacobian matrix of the system for this steady state indicates that more analysis is needed to be able to see the behaviour of the system with positive initial conditions. Also, an asymptotic solution of the system was given for the first model based on its determinant flow. The models were solved and the results were analyzed.

All the numerical estimates are based on the data taken from the four sampled local government areas of Borno State which are Askira Uba, Biu, Danmboa and Gwoza local government areas.

Conclusion

In this research work, I derived a model by considering the number of homeless population due to Boko Haram insurgency. I analyzed the flow of this population to a temporary state (tends, prefabricated houses, relatives etc.) until their resettlement in a permanent residence.

A fairly simple model was derived. This model consists of a system of ordinary differential equations. The population was divided into nine (9) categories regarding their allocation state. These are a) the number of populations resettled b) the number of populations accommodated in a temporary state c) Number of populations homeless after the disaster d) Populations in camps f) Guests in friends or relatives g) Families living in temporary accommodation h) Families renting houses i) Families living in Schools j)

Individuals accommodated in hospitals due to injuries sustained. Modelling the flow between them leads to a system of ordinary differential equations.

I also studied the possible steady state of the system and analyzed the stability of the model for the possible positive equilibrium points. For some specific cases, the stability of the system cannot be deduced directly and central manifold analysis was applied.

Moreover, data from sampled study areas which are Askira Uba, Biu, Damboa and Gwoza local government areas of Borno State were considered in the estimation of the flows in the model. Also, for certain choices of the coefficient of the flow, the asymptotic solution of the system was obtained.

A similar analysis to a more sophisticated version of this model was applied by considering the number of families in temporary accommodations divided among those living in camps organized by Borno State government, those living in self-provided temporary accommodation and those living with relatives and friends' houses.

Prediction of at least qualitative characteristics of homeless and non-homeless population flows could lead to better programming by the Borno State government to cope with the problems created by the Boko Haram insurgency. Planning appropriate stock of tents or prefabricated houses etc. also another aspect could be the estimation of the cost and time of resettlement for the victims of the Boko Haram insurgency. The results obtained will be useful to the welfare planning of Borno State government for housing allocations and distribution of resources to IDPs etc.

Recommendations

The model obtained in this research work was based on the assumption that the availability of accommodation is constant. This means that

initially there was a sufficient number of tents or accommodations in an organized camp and fabricated houses supplied by the Borno State government according to the demand. Another approach will be to have $R_s, W_s, P_s, T_s, F_s, M_s$ as function of time and assume for example that $R_s = W_s = P_s = T_s = F_s = M_s$. This would express the fact that fabricated houses are supplied after some time. This modification will make the system of equations of the model non-autonomous which will be considered in such a case that the time scale of the system is small and drives the stability and asymptotic behaviours.

Another modification would be to consider the time that the populations or families need to settle in temporary accommodation or to resettle as far as such a possibility is available for the families. This would lead to a system of delayed ordinary differential equations.

Contribution to knowledge

i. Mathematical model for optimum resettlement of internally displaced families due to Boko haram insurgency is established.

ii. New system of ordinary differential equations based on the established mathematical model is formulated and solved.

iii. New mathematical scheme is formulated based on the data collected in the study area which can be used Borno State government, NGOs, Researchers etc. for resettling the IDPs as well as distribution of relief materials.

Acknowledgement

References

Bettina, K. & Walz, H. (2009). *Farsighted House Allocation*. Departement de Sciences Economiques and CIREQ. Universite de Montreal, Montreal, Quebec H3C 3J7, Canada.

Eziyi, j. & Dominic, G. (2010). *Evaluation of the impact of public housing programmes on sustainable development in Nigeria.*

Eiselt, H. A., Bhadury, J. & Burkey, M. L. (2011). An Optimization-Based Framework for Modeling Counterterrorism Strategies. Online at https://mpra.ub.uni-muenchen.de/47260/MPRA Paper No. 47260, posted 29 May 2013 13:20 UTC.

Hasti, S., Reza T. M. & Roya, S. (2019). A two-stage mathematical model for evacuation planning and relief logistics in a response phase. Journal of Industrial and Systems Engineering Vol. 12, No. 1, pp. 129-146.

Insani, N., Taheri, S. and Abdollahian, M. A. (2024). A Mathematical Model for Integrated Disaster Relief Operations in Early-Stage Flood Scenarios. Mathematics 2024, 12, 1978.

https://doi.org/10.3390/ math12131978.

Johnson, M. P. & Caulkins, J. P. (2006). Can Housing Mobility Programs Make a Long-Term Impact on the Lives of Poor Families and the Health of Middle-Class Communities: A Policy Simulation. Heinz School Working Paper Series 2005-33; under review at *Housing Policy Debate*.

Lippman, B. J. (2006). National Housing Conference. *A Heavy Load: The Combined Housing and Transportation Burdens of Working Families*. Washington, D.C.: Center for Housing Policy.

http://www.nhc.org/pdf/pub_heavy_load_10_06.pdf.

Nikolopoulos, C.V. & Tzanetis, D. E. (2003). A model for housing allocation of a homeless population due to natural disasters. *Public Policy and Public Affairs Faculty Publication Series.* Paper 4. http://scholarworks.umb.edu/pppa_faculty_pubs/4.

Rajan, S., Singh, B. K., Shubham, K. & Vipin, K. (2002). Mathematical Modeling of Effective Distribution System for Resources and Facilities in Disaster Management by using Optimization Techniques. Mathematical Statistician and Engineering Applications ISSN:2094-0343,2326-9865. Vol 71 No. 3 (2022).

ASSESSING THE IMPACT OF INSURGENCY ON EDUCATION AND FOOD SECURITY IN CHIBOK LOCAL GOVERNMENT AREA, BORNO STATE, NIGERIA

Mary Baranzi

Department of Educational Psychology
College of Education Waka Biu, Borno State
07039078124
Baranzimy@gmail.com

The study examines the impact of insurgency on educational systems and food security in Chibok Local Government Area of Borno State, Nigeria. Data for the study were collected using primary source from a randomly sampled respondents of 200 in the area. Descriptive statistical tools of analysis were used in analysing the data. Finding of the study revealed a considerable decline in student's enrolment in the study area likewise, the productive capacities of the rural farmers were slightly affected as a result of the activities of the insurgent groups and positive indication of the activities of security apparatus. However, lack of constant visitation of farmlands and fears of attacks have resulted to food insecurity. Therefore, the study recommends Government in prioritizing dialogues toward finding an end to the insurgent activities so as to boost agricultural activities that could lead to a rise in their purchasing power in order to sustain education and food security.

Introduction

Security and safety are found to be among the basic human needs of a society and is essential for human survival and welfare. Virtually, every human activity has affected its economy directly or otherwise. The alarming level of insecurity in the world has fuelled crime rate and terrorist attacks in some parts. This has also resulted in leaving unpalatable consequences for the economic growth. These threats have led to national insecurity, increasing military budgets globally towards combating the increasing waves of crime, death toll by weakening all economic activities and remain a treat to food security Fact Sheet (2019). Education in this modern economy has become a basis for growth of the national economy. This is because, education is seen as an important factor of human capital investment. It has been discovered that, after the Second World War, several economists,

including Friedman and Kuznets (1945) in Bilyaminu, Baba Iya & Purokayo (2017) were instrumental in the development of the human capital theory to determine the importance and benefits of education for individuals in particular and society in general. The Boko Haram insurgency began in 2009, which have resulted to loss of lives and property in northeastern Nigeria, with Borno State bearing the brunt of it. This conflict has claimed an estimated figures of over 20,000 (thousands) lives, significantly destroying physical infrastructure, schools, disrupt social services, and discourages social cohesion among the people (World Bank, 2023).

The number of people dashing into serious food security challenges in the world and Nigeria in particular is increasing by the day. Currently, according to Food and Agricultural Organization (FAO); International Fund for Agricultural Development (IFAD); United

Nations Children Emergency Fund (UNICEF); World Food Programme (WFP) and World Health Organization (WHO), estimated over 822 million people are suffering from severe hunger in the world (FAO, IFAD, UNICEF, WFP& WHO, 2023). Although, in line with the Sustainable development Goals (SDG) indicators, an estimates of over 2 billion people are expected to be food insecure, including moderately food insecure individuals (FAO, 2022). By implication, this means that, for every nine people in the world, at least one is suffering from a severe food security problem. The insurgent group strategies of attacks, includes targeting schools, abduction of students as famously exemplified by the Chibok schoolgirls, killing of teachers, places of worships, burning houses, farm produce and animals which have severely crippled the educational system and economic activities of the locals and the nation at large. The resulting insecurity has led to school closures, displacement of students and teachers as well as breakdown in educational infrastructure. Over 20,000 people have died as a result of the violence, which has also severely damaged physical infrastructure, interrupted social services, and displaced social cohesion among the populace (World Bank, 2016). Approximately 2.3 million individuals are internally displaced, become refugees abroad, or return to their communities (United Nations High Commissioner for Refugees UNHCR, 2020).

Furthermore, the insurgent's activities has disrupted their agricultural activities leading them to food shortages and malnutrition. This in other ways has created a vicious cycle of poverty and insecurity resulting to exacerbating the already fragile food security situation. Even before the insurgency Chibok Local Government (LGA) and the state at large who boarders with Zambisa forest do have a

significant challenges in terms of educational rating in the country likewise food security, poverty, limited access to resources and inadequate infrastructure which have affected them in terms of provision of quality education and food security.These pre-existing vulnerabilities have been significantly implied by the conflict, creating a severe crisis. Factors such as land degradation, climate change and limited access to markets further exacerbated the food insecurity situation. Similarly, existing inequalities in access to education, particularly for girls, have been worsened by the insurgency.

Statement of the Problem /Justification

It so obvious that the activities of the insurgents groups has wreaked havoc in the Northeast Nigeria, with which Chibok LGA being one of the most affected region. Their activities has virtually lead to the destruction of infrastructures and displacement of communities. Its impacts on education and food security in the study area cannot be denied off also. Such frequent attacks has triggered school closure, both teachers and students have experienced significant psychological trauma due to violence, abduction of over 250 girls this has highlights the gender specific threats and the disrupted agricultural activities which form the backbone of Chibok economy leading to food insecurity in the region. Therefore, assessing the impact of insurgency on education and food security in the region is crucial for dignity and development of individuals and communities, strengthening education and food security as well as inform policy makers and other agencies on guiding the development and to support affected communities.

Objectives of the Study

The main objective of the study is to assess the Impact of the Insurgency on Education and

Food Security in Chibok Local Government Area of Borno State, Nigeria, while the specific objectives were to:-

i. assess the impact of the insurgency on the educational sector in the Chibok Local Government Area of Borno State,

ii. assess the impact of insurgency on food security status of the people of Chibok Local Government Area of Borno State

Research Questions

i. How has the impacts of insurgency affected the educational sector in Chibok Local Government Area of Borno State?

ii. To what extent has the insurgency affected food security status of respondents in Chibok Local Government Area in Borno State,

Concepts

➢ *Insurgency*- insurgency is seen as a "struggle between a non-ruling group and the ruling authorities in which the non-ruling group consciously uses political resources and violence to destroy, reformulate, or sustain the basis of one or more aspects of politics

➢ *Terrorism* - Terrorism and insurgency have been an insidious act and also an activity conducted daily over a long period and have been responsible for the physical and structural violence experienced by many people in Nigeria.

➢ *Food Security*- Food security is the availability of food in a country or rejoin and the ability of individuals within that country to access, afford, and source adequate foodstuffs.

➢ *Education*- Education is a right, like the right to have food and security. Article 26 of the 1996 universal declaration of human right states that, "everyone has the right to education

Literature Review

Related literatures were reviewed based on the objectives of the study which were as follows: Ogbozor (2016) examined the causes and extent of Boko-Haram violent radicalism in Northeast, Nigeria. The research addressed some fundamental questions; what are the socioeconomic causes of the conflict? What are the core causes of conflict and its magnitudes? Result indicated a negative correlation between the conflict and socioeconomic condition; direct or indirect effects were also observed between the conflict and the rural livelihood. Likewise Mukhtar (2019) investigated the impact of Boko-Haram among households in Kano Municipal, using regression analysis and FSI. Finding showed that all the variables under conflict have negative influence on the food security status of households. FSI further reveals that 31% of the households are food insecure.

Mukhtar (2020) studied the extent to which conflict has impacted negatively to food security of households in Kano is of serious concern. The objective of this study is to examine the impacts of Boko-Haram conflict on food security status among households in Kano. Primary data were drawn from a sample size of one hundred (100) household heads from Gwale and Kano municipal areas. The research investigated household food security status by using Food Security Index (FSI) and Binary regression. Result from the FSI divulges that 69% of the households are food secure, with daily per capita energy consumption of 3,086 kcal while binary regression shows that all the variables under conflict have a negative impact on households' food status. Furthermore, food scarcity, market closure and high cost of foodstuff are significant at 10 percent, while unemployment and destruction of property are statistically significant at 1 percent. Households classified as food insecure adopt extremely severe coping strategies, severe coping strategies and less severe coping strategies in some cases.

Methodology

Study Area.

The study was carried out in Chibok Local Government Area of Borno State, North-east Nigeria. It has an area of 1,350 km². It shares boundaries with Damboa Askira/Uba and Biu Local Government Areas. It is located between latitude 90026', and 10010'N and between 130111 and 130-44'E. It has land area of 500 km2. (Borno State Minister of Land and Survey, 2008). Administratively, the Area is made up of eleven (11) wards with a projected population of 92,000 thousand people with an annual growth rate of 2.83% per annum (National Population Commission, 2006). Its people are predominately Kibaku (Chibok), with few Bura and Fulani. Majority of the people in the area are farmers involved in growing food crops such as maize, sorghum, cowpea, groundnut, Bambara nuts, soya bean, and they rear animals such as cattle, goats, and sheep (BOSADP, 2005). Chibok gained international attention in April 2014 following the abduction of over 200 school girls by militant group Boko Haram.

Sources of Data

Data for the study were source directly from primary source, administering of structured interview and Secondary sources of data were used. 200 respondents were conveniently randomly sampled. Questionnaires were also validated by two senior academic staff of C.O.E Waka-Biu, with a reliability level at 5% confidence interval and the data collected were analyzed using descriptive statistics such as frequency distribution, mean and percentages and also using a statistical tool (SPSS 2.0).

Results and Discussions

Table 1: Impact of Insurgency on Education in Chibok

Variable	Frequency	Percentage (%)
Have schools been forced to close down due to insurgency		
Yes	192	96
No	8	4
For how long was the school shut down due to insurgency		
Not applicable	8	4
Less than 1 year	125	63.5
1-2 years	57	28.5
3-5 years	2	1
Above 5 years	8	4
How has the insurgency affected the functioning of school		
Very high	127	63.5
High	64	32.0
Low	4	2.0
Very low	5	2.5
Are structures being destroyed		
Yes		
No	198	99.0
	2	1.0

How serious was the destruction of the structures		
Not applicable		
Very high	2	1.0
High	108	54
Low	84	42
Very low	3	1.5
	3	1.5
What is the educational infrastructure mostly affected by insurgency?		
Classrooms	185	92.5
Libraries	10	10
Laboratories	5	2.5
Have teachers and students been displaced or unable to attend school		
Yes		
No	191	95.5
	9	4.5
How many times did you experience it?		
Some time		
1 term	10	5
2 terms	5	2.5
A whole session	1	0.5
1-6 times	2	1.0
Many times	8	4.0
Always	172	86.0
	2	1.0
Have schools been used for purposes other than education		
Yes	190	95.0
No	10	5.0
If yes, how has it affected the learning environment		
Very high	10	5.0
High	125	62.5
Low	62	31
Very low	3	1.5
What are the psychological distress or trauma as a result of the conflict's impact on education?		
Depression		
Anxiety	55	27.5
Post-traumatic stress disorder	25	12.5
Bipolar	79	39.5
1Others	41	20.5
	0	0

Source: Field Survey, 2024

Table 1. Impact of Insurgency on Education in Chibok. The results indicates that 99 percent of responds that schools have been forced to close due to insurgency, with 62.5 percent were shut down for less than a year, 28.5percent for 1-2 years, and 4% for over 5 years. Majority of the

respondents (95.5%) agreed that insurgency has a very high effect on school functioning, 4.5percent low and very low. Most of the respondents (96%) agreed that structures are destroyed during insurgency attacks, regarding the types of school structures destroyed, 91.5percent agreed that classrooms are mostly affected, 5percent, libraries, and 2.5 percent laboratories. 95.5percent agreed that students and teachers are displaced and unable to attend school due to insurgency, with 86% experiencing this many times. Most schools (99%) have been used as IDP camps or military bases, affecting the learning environment. Among these, 82.5 percent had a very high, 12percent high effect. Finally, 27.5 percent of respondents believe that the insurgency have cause depression, 12.5 percent anxiety, 39.5 percent, post-traumatic stress disorder (PTSD), and 20.5percent bipolar disorder.

Table 4: Impact of Insurgency on Source of livelihood of the Respondents

Respondent occupation	Frequency	Percentage (%)
Farming as a Primary source of livelihood	106	53
Farming as a Secondary source Other sources of income in 2009	94	47
No. other source of income	198	99
₦35000	2	1.0
Other sources of income in 2023	198 (99)	99
No. other source of income ₦20000	2	1.0

Source: Field Survey, 2024

The impact of insurgency on livelihood of the respondents indicates that 53 percent of the respondents reported that farming is their primary source of livelihood while 47 percent reported that farming is their secondary source. Other source of income in 2009, reported that 99 percent agree with 35000 Naira/ annum while in 2023 income from other source, 99 percent indicates that 2000 Naira was their income from other source, this indicate a decline in income as a result of the insurgency.

Conclusion

The study revealed that there is severe impact of insurgency on livelihoods and the education sector in Chibok Local Government Area of Borno State. The high dependency on farming as the primary source of income indicates vulnerability to disruptions in farming activities, leading to food insecurity and economic hardship. The closure of schools and disruption of education have long-term consequences, with attacks on schools exacerbating fear and insecurity. Fluctuations in livestock ownership and value suggest challenges in maintaining livestock populations. The research also points to challenges in the effectiveness of humanitarian response and aid, with many respondents feeling that support was inadequate. The reliance on local vigilante groups for security highlights the importance of community-based approaches in enhancing security in the areas.

Recommendations

Based on the findings of this study, it is recommended that;

(i) The community should explore alternative source of livelihood. This can include exploring opportunities in off- farm

activities to reduce vulnerability to food insecurity and economic hardship due to reliance on farming. The role of community-based security initiatives should be strengthen, such as local vigilante groups

(ii) Government and NGOs. Should investigate the long-term consequences of school closures and education disruptions on individuals and the communities. This can include studying the effects on future employment opportunities, mental health outcomes, and overall community development.

Acknowledgement

References

Borno State Agricultural Development Programme (BOSADP) (2005). Government Printing Press, Maiduguri, Borno State, Nigeria.

Bilyaminu, M, Baba Iya, I & Purokayo,S.,G (2017). Analysis of the Impact of Boko Haram Insurgency on Education in Adamawa State, Nigeria. *International Journal of Academic Research and Reflection 5* (6), *Progressive Academic Publishing, UK 45-56. ISSN 2309-0405*

Factsheets (2019): *Norwegian Refugee Council Prinsens-gate*, 0152 Oslo Norway, (NRC in Nigeria). *Food and Agriculture Organization of the United Nations. (2022). Nigeria food security and vulnerability survey 2022. FAO Rome, Italy.*

Food and Agriculture Organization (2023). The state of Food Security and Nutrition in the World FAO Rome, Italy.

Ministry of Land and Survey (MLS) (2008). Maiduguri, Borno State, Nigeria. Office Memo File. 14

Mukhtar, M. (2019). Impacts of Boko Haram insurgency on households' food security status in Kano metropolitan, Nigeria. *In 3rd USM-International Conference on Social Sciences (USM) – ICOSS (.52)*

Mukhtar, M. (2020). Examining the Impacts of Boko-Haram Conflict and Food Security Status among Households in Kano Metropolis. *Lapai Journal of Economics; 4* (1); 134-147

National Population Commission (NPC (2006), Population Census Data Borno State, Nigeria. Federal Republic of Nigeria Official Gazette, National and State Provisional Totals Census. Printed and Published in 2007 by the Federal Government Printer, Lagos, Nigeria. No. 21(94). 175 – 198.

Ogbozor, E. (2016). *Causes and Consequence of Violent Extremism in Northeast Nigeria* (No. 227). Households in Conflict Network, Working Paper 227 presented in the Institute of Department Studies at the University of Sussex – Falmer – Brighton.

United Nations High Commissioner for Refugees (UNHCR). (2020). Global Report 2019. Retrieved from https://www.unhcr.org/globalreport2019/

World Bank. (2016). North-East Nigeria Recovery and Peace Building Assessment: Component Report. World Bank.

World Bank. (2023). North-East Nigeria Recovery and Peace Building Assessment: Component

EVALUATION OF THE IMPLEMENTATION OF GENERAL STUDIES ENTREPRENEURSHIP CURRICULUM IN COLLEGES OF EDUCATION IN BORNO STATE, NIGERIA

Hussaini Mohammed Kyarma

College of Education Waka-Biu, Borno State
Department of Curriculum Studies
+2348060643768
hussainikyarmakyarma@gmail.com

This study evaluated the implementation of the General Studies Entrepreneurship (GSE) curriculum in colleges of education in Borno State, Nigeria. The research aimed to assess the adequacy of instructional materials and facilities, ascertain the professional qualifications of lecturers, and identify challenges faced during curriculum implementation. Employing a descriptive survey research design, data were collected from 344 students and 19 lecturers across three colleges using structured questionnaires and checklists. Results revealed significant inadequacies in essential facilities, particularly in Information and Communication Technology, automobile, and film/photography resources. Although lecturers possessed relevant academic qualifications, many lacked practical entrepreneurial experience, undermining the quality of instruction. Key challenges included overcrowded classrooms, inadequate funding, and limited institutional support, exacerbated by the region's socio-economic and security issues. Despite these obstacles, the GSE curriculum holds potential for fostering self-reliance and reducing unemployment if systemic issues are addressed. Recommendations include improving infrastructure, enhancing lecturer training, and strengthening institutional support to ensure the curriculum's effectiveness in preparing students for entrepreneurial success.

Introduction

Entrepreneurship education in Nigeria was introduced as part of the government's strategy to address the nation's growing unemployment crisis and dependency on white-collar jobs. For decades, the Nigerian educational system prioritised theoretical knowledge over practical skills, resulting in graduates who were ill-equipped for the realities of the job market. Recognising this gap, the Federal Government mandated the inclusion of entrepreneurship education across tertiary institutions, including colleges of education, to instill self-reliance and job-creation skills among students. This move aligned with broader global trends emphasising entrepreneurial competencies as essential tools for economic growth and development.

In colleges of education, the General Studies Education (GSE) curriculum became a critical platform for delivering entrepreneurship education. This curriculum was designed not only to enhance the entrepreneurial abilities of student-teachers but also to ensure they could impart these skills to their future students. The long-term vision was to foster a generation of innovators and self-reliant individuals, creating a cascading effect that would transform communities and reduce dependency on government employment. The GSE curriculum thus played a dual role: equipping student-teachers with entrepreneurial knowledge and enabling them to serve as agents of change in their communities.

In Borno State, the implementation of entrepreneurship education carries even greater significance due to the region's unique socio-economic context. For years, the state has been plagued by challenges such as insecurity, poverty, and limited access to education and infrastructure. These issues have stifled economic growth and increased unemployment rates, particularly among the youth. The introduction of the GSE entrepreneurship curriculum in colleges of education offers a potential pathway to empowerment and recovery. By equipping students with entrepreneurial skills, the curriculum seeks to enable them to overcome systemic barriers, create sustainable livelihoods, and contribute to rebuilding the region's economy.

This study was prompted by several interrelated factors, all of which are crucial to understanding the implementation and effectiveness of the GSE entrepreneurship curriculum in Borno State.

First, the adequacy of facilities and instructional materials required for implementing the curriculum is a pressing concern. Entrepreneurship education relies heavily on access to well-equipped classrooms, practical tools, and instructional resources such as textbooks, case studies, and multimedia aids. In many colleges of education, particularly in underprivileged regions like Borno State, these resources are often insufficient or entirely lacking. For example, practical entrepreneurial activities may require workshops, laboratories, or digital tools, yet these facilities may be unavailable or outdated. This study seeks to determine whether the colleges in Borno State have the necessary infrastructure and materials to deliver the curriculum effectively, as this is a fundamental prerequisite for achieving its goals.

Second, the professional qualifications of lecturers implementing the GSE entrepreneurship curriculum play a critical role in its success. The delivery of entrepreneurship education requires not only academic knowledge but also practical experience in entrepreneurial activities. Lecturers must possess relevant qualifications, such as degrees in entrepreneurship or related fields, alongside professional certifications and hands-on experience in running businesses or managing enterprises. However, in many cases, lecturers may lack these qualifications, which can undermine the quality of instruction. This study investigates whether the lecturers in Borno State colleges of education are adequately trained and qualified to deliver the entrepreneurship curriculum effectively.

Third, the challenges encountered by lecturers in implementing the GSE entrepreneurship curriculum warrant thorough examination. Lecturers in Borno State face a unique set of difficulties that may impede their ability to teach effectively. These challenges include limited access to professional development opportunities, inadequate funding for educational initiatives and security concerns due to the region's instability. Additionally, systemic issues such as large class sizes, outdated teaching methods, and a lack of institutional support further complicate the implementation process. For instance, lecturers may struggle to provide hands-on entrepreneurial training due to overcrowded classrooms or the absence of practical facilities. This study aims to identify these challenges comprehensively, offering insights that can inform solutions and improve the implementation process.

Notable entrepreneurs like Aliko Dangote, Peter Obi, Tony Elumelu, and Bill Gates have leveraged their entrepreneurial skills to solve societal problems and achieve success. Entrepreneurship education is vital for personal and national economic development as it fosters innovation to meet ever-changing

societal needs. During the Covid-19 pandemic, countries with strong entrepreneurial cultures capitalized on producing essential items like masks and vaccines, generating significant foreign exchange. Entrepreneurs also facilitated online learning, ensuring education continuity during lockdowns.

Recognizing the benefits of entrepreneurship, the Nigerian government integrated entrepreneurship education at all tertiary education levels. The goal is to bridge the gap between theory and practice, fostering a mindset shift from seeking employment to creating jobs. Objectives include providing functional education for self-employment, training youth to be creative and innovative, reducing poverty and rural-urban migration, and supporting graduates in establishing careers in small and medium-sized businesses. Achieving these objectives will equip students with the necessary skills for their chosen ventures, enhancing their career prospects both during and after their studies (Ukoha, 2017; Okoro, 2015).

Statement of the Problem

The aim of teaching entrepreneurship education at colleges of education is to produce graduates capable of using creativity and innovation to identify new economic opportunities, create jobs, and generate wealth. This approach is intended to reduce poverty and rural-urban migration, and to support graduates in establishing careers in small and medium-sized businesses (Okoro, 2015).

However, despite these objectives, many graduates have not shown commitment to starting or maintaining businesses using the knowledge acquired during their training. This has led to increasing unemployment among NCE graduates (NBS, 2022). As a result, many are underpaid by private schools or resort to menial jobs and commercial cycling ("Okada").

This suggests that the goals of entrepreneurship education are not being met.

High unemployment and poverty among NCE graduates could lead to increased criminal activity and insecurity, threatening economic development. Ekpo (2015) warned that the country faces a potential crisis due to uncontrolled unemployment. Issues with the implementation of the GSE 224 curriculum, such as unqualified teachers, inadequate infrastructure, and outdated teaching methods, may be hindering the effectiveness of entrepreneurship education (Aderogba & Targema, 2013). Therefore, it is crucial to evaluate the implementation of the entrepreneurship education curriculum in Borno state's colleges of education to ensure it meets the required standards and achieves its intended outcomes.

Objectives of the Study

The aim of the study is to evaluate the implementation of General Studies Entrepreneurship curriculum in Borno State. Specifically, the study seeks to

i. Determine the level of adequacy of facilities and availability of instructional materials for the implementation of the GSE entrepreneurship curriculum

ii. Ascertain the professional qualification of the lecturers implementing the GSE entrepreneurship curriculum.

iii. Examine the challenges encountered by lecturers in implementing the GSE entrepreneurship curriculum.

Research Questions

This research will be guided by the following research questions;

i. What is the level of adequacy of facilities and availability of instructional materials for the implementation of the GSE entrepreneurship curriculum?

ii. What are the professional qualifications of the lecturers implementing the GSE entrepreneurship curriculum?

iii. What are the challenges encountered by lecturers in implementing the GSE entrepreneurship curriculum?

Literature Review

Chukwuma-Nwuba & Yayock, (2014) examined the developments and pedagogical methods in entrepreneurship education in Nigerian colleges, finding that conventional classroom teaching predominates over more effective non-conventional methods. Despite this, students were motivated to create new ventures post-graduation. (Gyamfi, 2014) studied Ghanaian graduates and found that 20% had established their own businesses, with entrepreneurship education in Ghana still in its introductory stage, focusing more on theory than practice.

Mani (2018) explored students' perspectives on entrepreneurship education in engineering, revealing high interest in starting businesses but facing hurdles like lack of experience and funds. (Oyebola, 2015) evaluated Nigerian universities' entrepreneurship education, finding it adequate for venture creation but noting that other factors besides education are crucial for success.

Slavtchev et al., (2014) found that entrepreneurship education stimulates long-term entrepreneurial intentions but can discourage short-term intentions due to a realistic perspective on entrepreneurship. (Zhao et al., 2022) showed that incubation programs significantly boost new venture creation and performance, while theoretical and competition-based education had less impact.

Ugodulunwa, (2020) demonstrated that entrepreneurial education and prior experiences enhance students' perceived feasibility and usefulness, motivating entrepreneurial intentions, with technological innovativeness moderating these effects. Deng & Wang (2023), highlighted the positive impact of entrepreneurship education on students' entrepreneurial intentions, with significant effects across different demographics.

Hahn et al., (2020), noted that both elective and compulsory entrepreneurship education enhance students' entrepreneurial skills, with family background playing a moderating role. (Zhao et al., 2022) reaffirmed the significant impact of incubation programs on new venture creation and performance, suggesting implications for policymakers and educators.

Schumpeterian Entrepreneurship Theory

Joseph Schumpeter, a renowned economist, introduced the concept of entrepreneurship as a driving force for economic growth. His theory, often referred to as Schumpeterian Entrepreneurship, places innovation at the core of entrepreneurial activity.

Key Principles of Schumpeterian Entrepreneurship

➤ **Innovation as the Engine of Growth:** Schumpeter argued that entrepreneurs are the catalysts for economic development through their ability to introduce new products, processes, or organizational structures. These innovations disrupt existing markets and create new ones.

➤ **Creative Destruction:** This is a core concept in Schumpeter's theory. It refers to the process by which old industries and technologies are replaced by new ones. Entrepreneurs, as agents of change, drive this process.

➤ **The Entrepreneurial Spirit:** Schumpeter emphasized the role of the entrepreneur as a

visionary and risk-taker. They are individuals who see opportunities where others don't and are willing to invest time, resources, and effort to capitalize on them.

➤ **Entrepreneurship as a Dynamic Process:** Schumpeter viewed entrepreneurship as a continuous process of innovation and adaptation. It's not a one-time event but a recurring activity that drives economic evolution.

Types of Innovation According to Schumpeter

Schumpeter identified five types of innovation:

1. Introduction of new products: Creating entirely new products or services.
2. Introduction of new production methods: Developing more efficient and cost-effective ways to produce existing products.
3. Opening new markets: Identifying and tapping into previously unexplored markets.
4. Development of new sources of supply: Finding new raw materials or suppliers.
5. New industry structure: Creating new organizational forms or industry structures.

Implications of Schumpeterian Entrepreneurship

Schumpeter's theory has had a profound impact on our understanding of entrepreneurship and economic growth. It emphasizes the importance of fostering innovation, supporting risk-taking, and creating an environment conducive to new business formation.

This research adopts the Schumpeterian entrepreneurship theory because it helps in the understanding of entrepreneurship which can be done through institutions of learning such as colleges and universities as part of their curriculum.

Methodology

This study adopted a descriptive survey research design, which is suitable for describing and explaining the characteristics of a population from a representative sample. The design was chosen because it allows the researcher to evaluate the implementation of the GSE entrepreneurship curriculum by collecting data from students and lecturers in colleges of education in Borno State. This approach facilitated the generalisation of findings to the larger population.

The population of the study consisted of 2,454 NCE III students who had undergone GSE entrepreneurship education in NCE II and 19 lecturers teaching the course in three colleges of education in Borno State. A sample size of 344 students was determined using Yamane's (1967) formula, and stratified random sampling was employed to ensure proportional representation across the colleges. The distribution of the sample was as follows: 169 students and 8 lecturers from the College of Education Waka-Biu, 99 students and 6 lecturers from Mohammed Lawan College of Agriculture Maiduguri, and 76 students and 5 lecturers from Mohammed Goni College of Legal and Islamic Studies Maiduguri. All 19 lecturers were included in the study without additional sampling.

Three instruments were used for data collection. The General Studies Entrepreneurship Implementation Checklist (GSEEIC) assessed the availability and adequacy of instructional materials and facilities. The General Studies Entrepreneurship Education Students Interest Inventory (GSEESII) measured students' interest in entrepreneurship education. The General Studies Entrepreneurship Education Implementation Questionnaire for Lecturers (GSEEIQL) captured lecturers' teaching methods and challenges in implementing the curriculum. These instruments were validated by

experts to ensure content and construct validity. Reliability was confirmed through trial testing, with Cronbach's alpha coefficients of 0.78, 0.91, and 0.88, indicating high internal consistency.

The procedure for data collection involved direct contact with respondents in the sampled colleges. The GSEEIC was used to observe and assess the adequacy of instructional materials and facilities. The GSEESII was administered to students to gauge their level of interest, while the GSEEIQL was distributed to lecturers to identify teaching methods and challenges. All instruments were retrieved on the spot to ensure completeness and accuracy.

Data analysis was performed using descriptive and inferential statistical techniques with the Statistical Package for the Social Sciences (SPSS). Average mean scores and simple percentages were employed to answer the research questions. A decision mean of 2.50 was set as the benchmark, with scores above 2.50 considered adequate or favourable, and scores below 2.50 deemed inadequate or unfavourable.

Results

Table 1: Adequacy of Learning Facilities for Implementing the GSE Entrepreneurship Curriculum

S/N	Items	SA	A	D	SD	$\bar{X}$	S.D
1	Entrepreneurship Centre	3	10	3	3	2.68	0.95
2	Lecture Hall (1000-1500 capacity)	7	4	4	4	2.74	1.19
3	Facilities for Cosmetology	7	3	5	4	2.68	1.20
4	Facilities for Confectionaries	4	7	3	4	2.71	1.13
5	Facilities for Information and Communication Technology	3	5	7	4	2.37	1.01
6	Facilities for Culture and Tourism	7	3	3	6	2.66	1.07
7	Facilities for Construction	9	6	2	2	3.16	1.02
8	Facilities for Agro-allied	7	3	6	3	2.74	1.15
9	Facilities for Automobile	3	6	6	4	2.43	1.02
10	Horticulture/Landscaping	5	6	4	4	2.77	1.12
11	Facilities for Power and Energy	8	3	4	4	2.79	1.23
12	Facilities for Film/photography	3	3	9	4	2.26	0.99
13	Facilities for Environment	7	6	4	2	2.95	1.03
	Average Total					**2.69**	**1.09**

Source: Researcher's field survey 2024

Table 1 presents the response on adequacy of learning facilities for implementing the GSE entrepreneurship curriculum in colleges of Borno State. The table shows that the colleges had learning facilities such as entrepreneurship centre, lecture hall (1000-1500 capacity), facilities for cosmetology, facilities for confectionaries, facilities for culture and tourism, facilities for construction, facilities for agro-allied, horticulture/landscaping, facilities for power and energy, facilities for environment since the respondents responses were above the criterion mean of 2.5, however responses for item 5, 9 and 12 with mean score of were rejected since the mean score was below the criterion mean of 2.37, 2.43 and 2.26 respectively, which implies there are no adequate facilities for information and communication technology, automobile and film/photography in colleges of Borno state.

Table 2: Materials Available for Implementing the GSE Entrepreneurship Curriculum

S/N	Items	SA	A	D	SD	$\bar{X}$	S.D
1	Entrepreneurship journals	7	7	3	2	3.00	1.00
2	Entrepreneurship books	7	4	6	2	2.63	1.21
3	Magazines on Entrepreneurship	4	7	4	4	2.58	1.07
4	Business plans	6	6	4	2	2.55	1.01
5	Computer laboratory	3	3	7	6	2.16	1.07
6	Documentary CDs on business/ Entrepreneurs	5	5	5	4	2.58	1.12
7	Pictures of role models/investments	4	8	5	2	2.74	0.93
	Average Total					**2.61**	**1.06**

Source: Researcher's field survey 2024

The table provides an analysis of the adequacy of instructional materials and facilities for implementing the GSE entrepreneurship curriculum in colleges of education. Seven key items were assessed, with responses measured on a four-point Likert scale ranging from Strongly Agree to Strongly Disagree. Among the instructional resources, **entrepreneurship journals** had the highest mean score of **3.00** (S.D. = 1.00), indicating relatively better availability. Similarly, **pictures of role models/investments** and **entrepreneurship books** also received relatively higher mean scores of **2.74** (S.D. = 0.93) and **2.63** (S.D. = 1.21), respectively, reflecting moderate adequacy. However, resources such as **computer laboratories** were rated the lowest, with a mean score of **2.16** (S.D. = 1.07), highlighting significant inadequacy in this area.

Other resources, including **magazines on entrepreneurship**, **documentary CDs on business/entrepreneurs**, and **business plans**, had mean scores ranging from **2.55** to **2.58**, suggesting moderate availability but falling below an ideal adequacy threshold. The variability in responses, indicated by standard deviations between **0.93** and **1.21**, points to inconsistencies in resource availability across different colleges. The overall average mean score of **2.61** (S.D. = 1.06) reflects a

slightly below-adequate level of instructional materials and facilities.

These findings suggest that while some resources, such as journals and visual aids, are moderately provided, critical facilities like computer laboratories are lacking. This calls for targeted efforts to address the inadequacies, particularly in areas with lower mean scores, to enhance the effective implementation of the GSE entrepreneurship curriculum.

Table 3: Percentages of Lecturers' Responses on Professional Qualifications

Qualification	Frequency	Percentage (%)
MSc. Business management	4	21.1
M.Ed Business Administration	5	26.3
Ph.D Economic Education	2	10.5
M.Ed Economic Education	1	5.3
M.Sc Economics	2	10.5
B.Ed Economic Education	2	10.5
B.Ed Business Education	3	15.8
Total	**19**	**100.0**

Source: Researcher's field survey 2024

Table 3 presented the percentages of lecturers' qualifications. The responses of the lecturers revealed that, 21.1% of the lecturers had MSc. Business management, 26.3% had M.Ed Business Administration, 10.5% had doctorate degree in Economic Education, 5.3% had M.Ed Economic Education, 10.3% had M.Sc Economics, 10.5% had B.Ed Economic Education, while 15.8% had B.Ed Business Education. This implies that most of the lecturers have the knowledge of the content and qualifications to teach the GST entrepreneurship education in the universities.

Table 4: Common Challenges Encountered by Lecturers in the Implementation of the GSE Entrepreneurship Curriculum

S/N	Items	SA	A	D	SD	$\bar{X}$	S.D
1	The overload of students offering GSE entrepreneurship in college, the lecturers find it difficult to accomplished their primary task.	138	91	89	26	2.99	0.98
2	Lack of instructional materials	106	113	95	30	2.86	0.96
3	Inadequate facilities	115	120	88	21	2.96	0.91
4	Insufficient time to cover the specified syllabus	95	33	120	96	2.99	0.98
5	Poor maintenance of instructional materials/faculties by the management	165	77	80	22	3.12	0.98
6	Students/lecturers ratio is high	143	82	95	24	3.00	0.99
7	Lack of students interest towards entrepreneurship	175	75	82	12	3.20	0.92
8	Student negative attitude towards skills acquisition	170	68	86	20	3.13	0.98
	Average Total					**3.03**	**0.96**

Source: Researcher's field survey 2024

Table 4 shows the responses on common challenges encountered by lecturers in the implementation of the GSE entrepreneurship curriculum. The table reveals that all the items

responses were above the criterion mean of 2.5 which implies that there is overload of students offering GSE entrepreneurship in college which makes it difficult for lecturers accomplished their primary task effectively, lack of instructional materials, inadequate facilities, insufficient time to cover the specified syllabus, poor maintenance of instructional materials/faculties by the management, students/lecturers ratio is high, lack of students interest towards entrepreneurship and student negative attitude towards skills acquisition where among the challenges encountered in effectively implementing GSE entrepreneurship curriculum in college of Borno State.

Discussion on Findings

The findings of this study on the implementation of the General Studies Education (GSE) entrepreneurship curriculum in colleges of education in Borno State provide valuable insights into the current state of entrepreneurship education and its challenges. The study aimed to assess the adequacy of facilities, the professional qualifications of lecturers, and the challenges faced by lecturers in implementing the curriculum.

One of the key findings is that while some learning facilities are available, many essential resources are either inadequate or completely lacking. For example, the colleges in Borno State have facilities such as entrepreneurship centers, lecture halls, and spaces for specific trades like cosmetology, confectionaries, culture and tourism, construction, agro-allied activities, horticulture, power and energy, and the environment. However, there are notable gaps in facilities for Information and Communication Technology (ICT), automobile, and

film/photography. The mean scores for these areas were below the threshold of 2.5, indicating that these critical facilities are not sufficiently available. The lack of proper ICT infrastructure, in particular, is concerning as it limits the ability to teach students the modern technological skills necessary for entrepreneurship in the digital age. These inadequacies highlight a significant barrier to the effective implementation of the GSE entrepreneurship curriculum in the region.

The study also examined the professional qualifications of the lecturers delivering the entrepreneurship curriculum. The findings suggest that while some lecturers possess the necessary academic qualifications, there is a notable lack of practical entrepreneurial experience. Many lecturers are academically qualified but may not have sufficient hands-on experience in running businesses or managing entrepreneurial ventures. This gap between theoretical knowledge and practical experience can undermine the quality of instruction and limit the students' ability to gain real-world entrepreneurial skills. The lack of professional development opportunities and exposure to entrepreneurial activities further compounds this issue.

In addition to these infrastructural and professional challenges, the study also identified several difficulties that lecturers face in implementing the GSE entrepreneurship curriculum. Lecturers in Borno State encounter a range of obstacles, including overcrowded classrooms, inadequate funding for entrepreneurial initiatives, and security concerns due to the region's instability. These challenges are exacerbated by outdated teaching methods and a lack of institutional support. Lecturers may struggle to provide hands-on entrepreneurial training due to overcrowded classrooms or the absence of practical facilities. Moreover, limited accesses to professional development programs

and insufficient financial resources for entrepreneurial projects hinder the effective delivery of the curriculum.

Overall, the study highlights that while the GSE entrepreneurship curriculum in Borno State holds promise for empowering students and promoting self-reliance, several challenges need to be addressed to ensure its successful implementation. These include improving the availability of key facilities, enhancing the practical qualifications of lecturers, and providing better institutional support to overcome the unique challenges posed by the region's socio-economic and security situation. Addressing these issues is crucial for the effective delivery of entrepreneurship education, which in turn can contribute to reducing unemployment and poverty in Borno State and beyond.

Conclusion

The following conclusions were made:

1. **Inadequate Facilities**: There is a significant shortage of essential facilities required for effective entrepreneurship education, particularly in the areas of ICT, automobile, and film/photography. The lack of proper infrastructure in these areas limits the quality of practical training that can be provided to students, particularly in a technology-driven entrepreneurial landscape.

2. **Lecturers' Professional Qualifications**: While some lecturers have academic qualifications, many lack sufficient practical entrepreneurial experience, which hampers their ability to deliver real-world entrepreneurial skills. The gap between theoretical knowledge and practical experience among lecturers undermines the effectiveness of the curriculum in preparing students for actual business ventures.

3. **Challenges Faced by Lecturers**: Lecturers face several challenges, including overcrowded classrooms, inadequate funding for entrepreneurial initiatives, and security concerns in the region. Out-dated teaching methods and lack of institutional support further exacerbate the difficulties faced by lecturers in delivering the curriculum effectively.

4. **Lack of Institutional Support**: There is insufficient institutional support for both lecturers and students, particularly in terms of professional development opportunities and financial resources for entrepreneurial projects. The absence of robust support systems hinders the growth of entrepreneurship education and its ability to produce skilled entrepreneurs.

5. **Need for Enhanced Professional Development**: There is a need for more professional development opportunities for lecturers, especially those with limited practical entrepreneurial experience, to bridge the gap between academic knowledge and real-world application.

6. **Curriculum Relevance and Delivery**: The current GSE entrepreneurship curriculum, while promising, faces implementation challenges that need to be addressed to make it more relevant and impactful for students. Teaching methods should be updated to reflect the evolving needs of the entrepreneurial landscape, incorporating more hands-on training and practical exposure.

7. **Regional Security and Socio-Economic Challenges**: Security concerns in Borno State and the socio-economic challenges faced by the region significantly impact the ability to effectively implement the entrepreneurship curriculum. These external factors should be considered when planning for the improvement and delivery of the curriculum, as they present additional barriers to successful implementation.

8. **Potential for Empowerment and Self-Reliance**: Despite the challenges, the GSE

entrepreneurship curriculum holds potential for empowering students and promoting self-reliance if the identified issues are addressed. A well-implemented curriculum could help reduce unemployment and poverty in Borno State by equipping students with the necessary skills to become successful entrepreneurs.

Recommendations

The following recommendations were made:

1. **Improvement of Facilities and Instructional Materials:** Ensure that classrooms, libraries, and technology resources are improved to support effective teaching of the GSE entrepreneurship curriculum. Provide Adequate Teaching Materials and establish Entrepreneurship Labs.

2. **Enhance Lecturer Qualifications and Professional Development:** Provide Professional Training by organize regular workshops, seminars, and training sessions for lecturers to improve their knowledge of entrepreneurship and modern teaching methodologies. Encourage Industry Experience and offer Certification Programs by encourage lecturers to pursue certifications in entrepreneurship education and related fields to ensure they are equipped with the latest pedagogical skills.

3. **Address Challenges Faced by Lecturers:** Implement measures to control class sizes, allowing lecturers to engage with students more effectively and provide personalized attention. Provide adequate security measures for lecturers and students, especially in regions with safety concerns, to ensure a conducive teaching and learning environment. Support from Management by Strengthen the institutional support for lecturers, including providing access to research grants, teaching resources, and collaboration with local businesses to enhance the curriculum's practical relevance. Create opportunities for lecturers to collaborate with other institutions, business leaders, and entrepreneurs to gain new insights and share best practices in entrepreneurship education.

References

Aderogba, A. A., & Targema, N. T. (2013). *An assessment of implementation of basic technology curriculum for entrepreneurial skills acquisition among student in Benue State.* International Journal of Educational Studies, 1(4), 84 – 90.

Awotunde, P.O, & Ugodulunwa, C. (2004). *Research methods in education Jos*: Fab ANieh (Nig) Ltd.

Chukwuma-Nwuba, E. O. & Yayock, E. S. (2014) *on main developments in entrepreneurship education (2018). The influence of culture on entrepreneurial intentions: A Nigerian university graduates' perspective.* Transnational Corporations Review, 10(3), 213-232.

Deng, W. & Wang, J. (2023). *The effect of entrepreneurship education on the entrepreneurial intention of different college students: Gender, household registration, school type, and poverty status.* PLoS One.

Ekpo, A. (2015). *Unemployment crises worse than NBS. Statistics*. Retrieved from https://.www.vanguardngr.com>Home>Business.

Gyamfi, G. D. (2014). *Evaluating entrepreneurship education as a tool for economic growth: The Ghanaian experience*. British Journal of Education,

Society & Behavioural Science, 4(3), 318-335.

Hahn, D., Minola, T., Bosio, G. & Cassia, L. (2020). The impact of entrepreneurship education on university students' entrepreneurial skills: a family embeddedness perspective," Small Business Economics, Springer, 55(1), 257-282.

Kuratko, D.F (2016). *Review of entrepreneurship theory, process and practice.* Ireland Journaof Teaching and Learning in Higher Education, 8(1), 2731.

Mani, M. (2018). *Entrepreneurship education: A students' perspective*. In Business Education and Ethics: Concepts, Methodologies, Tools, and Applications (526-540). IGI Global.

Ojerinde, D. (2013). *Classical test theory vs item responds theory (IRT): An evaluation of the comparability of item analysis results. A lecture presented at the Institute of Education* University of Ibadan, delivered on May 23.

Okoro, J. (2015). *Lecturer's perception of constraints facing the teaching of entrepreneurship Education in Colleges of Education in South – South Nigeria.* World Journal of Education, 5(3), 99 – 106.

Oyebola, M. A. I., Irefin, S. A., & Olaposi, T. O. (2015). *Evaluation of Entrepreneurship Education in Selected Nigerian Universitites*. Journal of entrepreneurship and innovation management, 4(2), 49-75.

Schumpeter, Joseph A. (1954). Economic doctrine and method: an historical sketch. Translated by Aris, Reinhold. New York: Oxford University Press. OCLC 504289265. Translated from the 1912 original German, *Epochen der dogmen – und Methodengeschichte*.

Slavtchev, V., Laspita, S., & Patzelt, H. (2014). *Effects of entrepreneurship education at*

universities (No. 2012, 025). Jena Economic Research Papers.

Ugodulunwa, C. A. (2020). *the impact of entrepreneurship knowledge on students' e-entrepreneurial intention formation and the moderating role of technological innovativeness in colleges.* Jos: Fab Educational Books.

Ukoha, A. U. (2017). *Assessing entrepreneurship education pedagogies in three Federal Colleges of Education in Nigeria's South-South geo-political Zone.* African Journal of Teacher Education, 6(1), 1 – 21.

Zhao, Y., Shic, J., Du, H., Marjerison, R. K. & Peng, C. (2022)

Zhao, Y., Shi, J., & Peng, C. (2022). *Impact of entrepreneurship education in colleges and universities on entrepreneurial entry and performance. Economic research-Ekonomska istraživanja*, *35*(1), 6165-6184.

EFFECT OF INTEGRATING A COOPERATIVE LEARNING MODEL INTO IDEAL PROBLEM-SOLVING INSTRUCTIONAL STRATEGY ON SENIOR SECONDARY SCHOOL STUDENTS' REASONING ABILITY AND ACHIEVEMENT IN MOLE

Markus Mhya Landas

Department of Chemistry
College of Education Waka Biu
Landa_2009@yahoo.com

The study examines the impact of integrating a cooperative learning model into a problem-solving instructional strategy on senior secondary school students' reasoning ability and achievement in the mole concept in chemistry. The research used a quasi-experimental design and involved four schools in Nigeria. Results showed that the cooperative learning strategy improved reasoning ability, but had limited impact on academic achievement. The weak correlation between reasoning ability and achievement highlights the need for integrating cognitive skills with foundational conceptual understanding. Recommendations include teacher training, curriculum adjustments, and further research to optimize these strategies.

Introduction:

The teaching and learning of chemistry, particularly at the secondary school level, have long been recognized as challenging due to the abstract nature of many of its concepts. Among these, the mole concept stands out as one of the most complex topics for students to grasp. This difficulty often stems from the abstract and quantitative reasoning required to understand and apply the concept in problem-solving contexts. Despite its foundational importance in chemistry, traditional instructional approaches, such as lecture-based teaching, have frequently proven inadequate in fostering deep understanding, critical reasoning, and long-term retention of the mole concept.

To address these challenges, educators and researchers have explored various pedagogical strategies aimed at enhancing student engagement, reasoning ability, and academic achievement. One promising approach is the integration of cooperative learning models into problem-solving instructional strategies.

Cooperative learning, grounded in the theories of social constructivism, emphasizes active student collaboration, positive interdependence, and individual accountability. When combined with structured problem-solving frameworks such as the IDEAL model (Identify, Define, Explore, Act, Look back), this approach has the potential to transform the teaching and learning experience.

This study investigates the effect of integrating a cooperative learning model into the IDEAL problem-solving instructional strategy on senior secondary school students' reasoning ability and achievement in the mole concept in chemistry. The focus is on evaluating how this combined instructional approach enhances students' ability to reason through abstract concepts, solve complex problems, and achieve better academic outcomes. This research addresses the need for innovative teaching strategies in chemistry education and contributes to the growing body of knowledge on effective pedagogical

practices for improving learning outcomes in science education.

Statement of the Problem

Despite the critical role of the mole concept in chemistry education, it remains one of the most challenging topics for senior secondary school students to understand and master. Traditional teacher-centred instructional methods, which emphasize rote memorization and procedural learning, often fail to promote the deep conceptual understanding and reasoning ability necessary for solving complex problems associated with the mole concept. Consequently, many students exhibit low achievement and struggle to apply their knowledge in problem-solving contexts. Research suggests that integrating innovative pedagogical strategies, such as cooperative learning models and structured problem-solving frameworks like the IDEAL model, can enhance students' engagement, reasoning ability, and academic performance. However, there is limited empirical evidence on the effectiveness of combining these approaches in teaching abstract and quantitative topics like the mole concept in chemistry.

This study seeks to address this gap by investigating the effect of integrating a cooperative learning model into the IDEAL problem-solving instructional strategy on senior secondary school students' reasoning ability and achievement in the mole concept. The findings aim to provide actionable insights into improving chemistry education and fostering critical thinking and problem-solving skills among students.

Objectives of the study

The main purpose of this study is to determine the effect of integrating a cooperative learning model into the IDEAL problem-solving instructional strategy on secondary school chemistry students' reasoning ability and achievement of the mole concept. Specifically, the study will seek to;

i. Find out the effect of integrating a cooperative learning model into IDEAL problem-solving instructional strategy on senior secondary school chemistry students' reasoning ability on the mole concept in chemistry.

ii. Determine the effect of integrating a cooperative learning model into a problem-solving instructional strategy on senior secondary school chemistry students' achievement of the mole concept in chemistry.

iii. Find out the relationship between senior secondary school students' reasoning ability and their achievement in the mole concept when taught using integrating cooperative learning into IDEAL problem-solving instructional strategy

Literature Review

This research work is based on Bruner, (1966) theoretical framework. A major theme in the theoretical framework is that learning is an active process in which learners construct new ideas or concepts based on their current/past knowledge. The learner selects and transforms information, constructs hypotheses, and makes decisions, relying on a cognitive structure to do so. Constructivism is a theory that is based on observation and scientific study about how people learn. It says that people construct their understanding and knowledge of the world, through experiencing things and reflecting on those experiences. Cognitive structure (i.e., schema, mental models) provides meaning and organization to the experiences and allows the individual to "go beyond the information given".

Constructivism's point of view is that students are not blank slates upon which knowledge is etched. They come to learning

situations with already formulated knowledge, ideas, and understandings. This previous knowledge is the raw material for the new knowledge they will create through experiments, asking questions and trying things that don't work. In the actual sense, learning activities require the student's full participation (like hands-on experiments). An important part of the learning process is that students reflect on and talk about their activities. Students also help set their own goals and means of assessment. They control their learning process, and they lead the way by reflecting on their experiences.

However, the difficulty is not an intrinsic characteristic of a problem because it depends on the solver's knowledge and experience so a problem may be genuine for one individual but may not be for another (Schunk, 2000). Problem-solving therefore is seen as a model of complex cognition that is part of our everyday experience.

Studies have supported the view that the interplay between macroscopic and microscopic worlds is a source of difficulty for many chemistry learners. A few examples include; chemical bonding (Taber, 2002; Taber & Coll, 2003; Coll & Treagust, 2003; Özmen, 2004), and solution chemistry. Chemistry, by its very nature, is highly conceptual, and students may learn names as well as definitions of chemical substances theoretically by rote learning (this often being reflected by efficient recall in examination questions) but true mastery of the chemical reactions has not been attained. As a matter of fact, chemistry certainly is full of abstract concepts that are perceived as difficult to beginners at colleges or degree levels. Hence real understanding demands the bringing together of conceptual understandings in a meaningful way right from the secondary school level. To this effect, the

attention of many science educators has continued to be directed at searching for appropriate methods of science instruction. Researchers like Fajola, (2007) have focused on several dynamic and pragmatic teaching methods and strategies such as problem-solving, projects, field trips, concept mapping, and computer instruction as a way forward. Also Salami, (1991) states that mastery learning strategy and individualised programmed instruction respectively have been used by researchers in their bid to improve students' achievement in different science subjects.

In chemistry for instance stoichiometry is a study of the quantity of a substance that was involved in the chemical reaction. It lays the foundation for the understanding of the number of substances that will react in a definite proportion and demands proportional reasoning skills on the part of learners. As such, an understanding of the principles of stoichiometry has an important place in chemistry learning. To understand the stoichiometry of reactions and solve problems in this area, students need to know atomic masses, chemical formulas of substances that are involved in a reaction, as well as an understanding of the law of conservation of mass.

Besides the main language which influences science understanding is the application of mathematics to chemistry in these topics and no meaningful learning could be done without adequate knowledge of mathematics in chemistry and science in general (Chiu, 1993). He further stressed that science being mathematically based has made it so unpopular among students at both secondary school and college levels. Furthermore, (Adeoye, 2000), stated that problem-solving is a prominent feature in the

learning of science and neglecting it could hurt students' learning outcomes in the sciences as a result students see chemistry as a subject and its teaching as unpopular and repelling. In light of this, the knowledge of how teaching methods affect students' learning will help educators select methods that will improve teaching quality, effectiveness, and accountability to learners and to society.

To address this issue many problem-solving models have been proposed to teach the different aspects of science. To this effect, an enhanced knowledge of the conditions for effective learning based upon which a range of student-centred teaching methodologies, such as cooperative learning, problem-solving, inquiry etc have become the latest thing but little guidance as to how teachers might apply these to the teaching of particular chemistry topics such as reaction kinetics, mole concept, molar volume or stereochemistry.

In teaching through problem-solving students learn and understand important aspects of the concept or idea by exploring the problem situation as most of the problems used tend to be more open-ended and allow for multiple correct answers and multiple solution approaches. Actually, it could be said that in this approach, problems do not only form the organizational focus and stimulus for students' learning, but they also serve as a vehicle for mathematical exploration and manipulation as most of the chemistry problems are quantitative.

Problem-solving has been defined in various ways. Dewey, (1938) states that a problem is anything that gives rise to doubt and uncertainty. Also, problem-solving can be seen as a way of thinking in which a learner discovers a combination of previously learned rules that he can use to solve an unusual problem. Ausubel (1969) opined that problem-solving is a form of discovery learning in which the gap between a learner's existing knowledge and the solution to the problem is bridged. Thus, somewhere between open-ended, creative thinking and the focused learning of content, lies the problem-solving.

Problem-solving is viewed as a fundamental part of learning science in regular schools (Yerushalmi & Magen, 2006; Loucks, 2007) after the instructor introduces the concepts, students apply these concepts to the problems. Problems in this context should follow some well-defined criteria: all information needed to solve the problem should be given; a limited set of rules is needed to solve the problem; in many cases, only one procedure leads to the right answer; and there is only one correct answer.

Generally speaking, a problem is any situation or matter that is challenging to solve, thus requiring one to make a difficult decision. The decision to make can be about anything; how to answer a perplexing question, how to handle a complicated situation, how to convince someone to see one's point of view, or even how to solve a puzzle or mystery. Every problem has at least three components: givens, goals, and operations. The givens are the facts or pieces of information presented to describe the problem, the goal is the desired end state of the problem and operations are the actions to be performed in reaching the desired goal. Based on how the problem and the goal are represented. Problems are categorized as ill or well-defined problems i.e. those with complex representations and/or more than one solution are termed ill-defined while the ones with discrete representations and finite goals are termed well-defined. The distinction between ill-defined and well-defined problems is a continuum, depending on the complexity of the problem and what is required of mental tasks to solve it.

Clough (1997) suggests that intuition; creativity, imagination, serendipity, aesthetics,

and logic all play a role in solving problems. Solving chemistry problems then requires the students to possess conceptual knowledge, procedural knowledge, and the ability to translate the language of the problem to decode its real meaning. The problem solver in this way creates a cognitive structure according to the problem. The ability of the solver to understand the language of the problem is the first step towards successful problem-solving; this is followed by the separation of the relevant and the irrelevant data, identifying the variables that are involved, and the nature and structure of the problem as being either an open-ended solution or a multiple choice problem. From the foregoing problem-problem-solving in science largely depends on the student's cognitive ability level as a pivot for meaningful and retentive learning. More so**,** in problem-solving, it is thought that working memory is utilized to process information about the problem and maintains its availability during the problem-solving process. Since working memory has limited storage capacity, it is impossible for information in a problem to exceed the working memory limit and to interfere with attempts to seek a solution. If one is to use short-term memory in problem-solving, it is required that relevant information from the solvers' previous knowledge base about the problem be accessed and retrieved from the storage of long-term memory.

Chemical changes that do occur always involve discrete numbers of atoms that rearrange themselves into new configurations. These are huge numbers of atoms far too large in magnitude to be able to count or even to visualise (Atkins, Peter, and Jones, Loretta, 2002). However, they are still numbers so useful in the study of chemistry particularly in the understanding of the quantitative aspect of it. Therefore, there is a need to have a way to count them and also a way to bridge these numbers which cannot be measured

directly with the weight of substances which we can measure and observe.

The mole fits into this gap and is central to all of the quantitative chemistry. In chemistry, the mole is a fundamental unit in the Système International d'Unités, the SI system, and it is used to measure the amount of substance. This quantity is sometimes referred to as the chemical amount. In Latin mole means a "massive heap" of material. The mole therefore is the SI measure of quantity of a "chemical entity'' which can be an atom, molecule, formula unit, electron photon etc (Lide, (2000). Hence one mole of anything is just Avogadro's number of that thing (1mole $= 6.022$ x 10^{23}). For example, one mole of Oxygen gas (O_2) contains about 6.022×10^{23} molecules of Oxygen, has a mass of 31.998 grams, and occupies a volume of 22.4 L at standard temperature and pressure (STP; 0°C and 1 atm).

As one of these quantities is measured it allows the calculation of the others and this is frequently done in stoichiometry which is the study of the quantitative relationship between reactants and the products. The reactants and the products are represented by the use of symbols either as atoms, molecules, compounds etc. For the fact that atoms and molecules are incredibly small, and even a tiny chemical sample contains an unimaginable number of them. Therefore, counting the number of atoms or molecules in a sample is impossible.

The mole allows chemists to bridge the gap between the sub-microscopic world of atoms and molecules and the macroscopic world that we can observe. As a result, chemists generally relate moles of a substance to mass rather than to the number of particles. Hence to determine the mole of a sample the molar mass of the substance is used i.e mass per mole of particle. Due to this fact problem - solving is essential to the understanding of the mole concept. It is such that suitable as its application deals with the

quantitative relationship between reactants and products in a chemical reaction. Its usage involves a variety of permutations (moles to grams, the volume of gas at STP to mass, molecules to moles, etc.) when solving mole problems. The mole plays a significant role in mole-mass and mass-mole conversions, per cent composition problems, and the concept of empirical, molecular and formula problems.

Therefore, a good knowledge in mathematics is a favourable companion for one to be successful in the calculations involving the conversions stated above. No doubt any student who cannot reason proportionally will have difficulty in understanding equations, functional relationships between molality, molarity, concentration in grams, concentration in grams per dm^3 and topics such as stoichiometry, empirical and molecular formula which all have direct or indirect relationships with the mole.

Methodology

The study will be quasi-experimental using the Solomon Four Group Design. The Solomon four-group experiment design is a standard pre-test post-test two-group design and a post-tests-only control design. This design contains two extra control groups, which serve to reduce the influence of confounding variables, and extraneous factors and allow the researcher to test whether the pretest itself affects the subjects. It combats many of the internal validity issues that can plague research such as history, maturation, testing and instrumentation. It allows the researcher to exert complete control over the variables and allows the researcher to check that the pretest did not influence the results by the use of various combinations of tested and untested

.

groups with treatment and control groups. (Trochim, 2008) See the schematic diagram of the design in Figure 3.1.

In the figure, E, E1, C and C1 are the same as in the standard two-group design. The first two groups of the Solomon four-group design are designed and interpreted in the same way as in the pre-test-post-test design, and provide the same checks upon randomization. The comparison between the post-test results of groups E1 and C2, marked by line 'G', allows the researcher to determine if the actual act of pretesting influenced the results. If the difference between the post-test results of Groups E2 and C2 is different from the Groups E1 and E2 marked by line 'C' then the researcher can assume that the pre-test has had some effect on the results The comparison between the Group E2 pre-test and the Group C2 post-test marked by line 'E' allows the researcher to establish if any external factors have caused a temporal distortion. For example, it shows if anything else could have caused the results shown and is a check upon causality. The Comparison between Group E1 post-test and the Group C1 post-test marked by line "F" allows the researcher to determine the effect that the pre-test has had upon the treatment. If the post-test results for these two groups differ, then the pre-test has had some effect on the treatment and the experiment is flawed. The comparison between the Group E2 post-test and the Group C2 post-test marked by line "D" shows whether the pre-test itself has affected behaviour, independently of the treatment. If the results are significantly different, then the act of pre-testing has influenced the overall results and needs refinement.

Fig 1 Solomon four group design
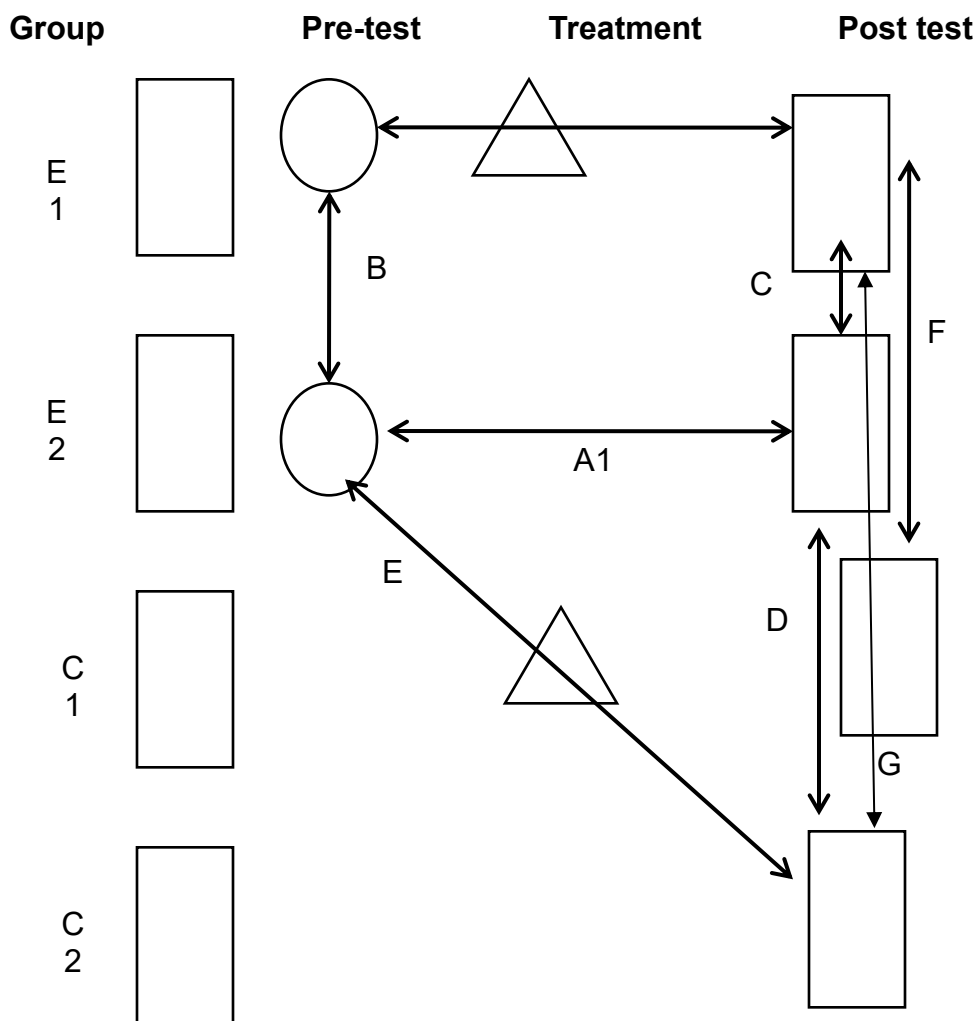
This study is set to find out the effect of integrating cooperative instructional strategy into problem-solving instruction strategy on senior students' achievement and reasoning ability on the mole concept in chemistry. The cooperative learning that will be used is the team, pair-solo strategy. The school's regular chemistry teachers are used in the teaching of the contents to be covered for the study. Both the experiment and control groups are taught the same selected topics under similar conditions; that is the same number of periods and hours of the day. Before the experiment takes off, Group E1 and Group E2 are given pre test examinations on both the chemistry achievement test (CAT) and test of logical thinking (TOLT). The experiment lasted for four weeks and by the end of the fourth week a post-test was administered to all the groups; E1, E2, C1, and C2 respectively. The pre-test and post-test scripts are marked, scored, recorded and analysed.

The study area is Borno State which is one of the thirty-six geopolitical administrative states in Nigeria. Borno State is a state in the Northeast geopolitical zone of Nigeria, bordered by Yobe to the west, Gombe to the southwest and Adamawa to the

south while its eastern border forms part of the national border with Cameroon for about, its northern border forms part of the National border with Niger, and its northeastern border forms all of the national border with Chad Coordinates.

The population for the study is all of the Senior Secondary School three (SSIII) students offering chemistry in the public schools in the southern Borno educational zone. The choice of SS3 chemistry students is because the students were assumed to have acquired a rudimentary knowledge of mole concepts in chemistry. The researcher used only four out of ten secondary schools that offer chemistry in this education zone.

A random sample from the schools was made, and a similar procedure is used in assigning the schools into pretest-post test experiment group and two post-assessment control groups. Where there are more than one chemistry class in the school selected, the process above is repeated to select a class as the experiment will be an intact class.

For this study, two instruments are used for data collection. These are the Test of Logical Thinking (TOLT) and Chemistry Achievement Test (CAT). The Test of Logical Thinking (TOLT), which originally was developed by Tobin and Capie (1981), will be adopted and used to determine the formal reasoning ability of SSIII chemistry students. Although the original test has two versions (A and B) which were developed to provide parallel group testing, however the TOLT, form A is chosen and adopted for the present study. The reason for the choice of this form of the TOLT was because of its reliability and validity results reported by Tobin and Capie (1980, 1981) when they

administered it on samples of students ranging from sixth grade (equivalent SSSIII) to college level. The researcher feels it is appropriate to administer similar to SSIII students whom soon their next level of education pursuit is either Universities, Polytechnics or Colleges of various kinds.

The researcher visits the schools that are selected for this research work together with the help of the schools' chemistry teachers who were trained to be research assistants for the study and administered the instruments to the students where data for the study was collected through their responses to the two instruments the CAT and the TOLT simultaneously.

The data collected for the study was analysed using ANOVA, mean, standard deviation, t-test and Pearson's Moment Correlation coefficient. Research questions 1 and 2 as well as hypotheses 1 and 2 were answered and tested using mean, standard deviation, and t-test while research questions 3 and hypotheses 3 were answered and tested with Pearson's Moment Correlation coefficient at 0.05 confidence level respectively.

Results

Here the result of the study is presented in a tabular form according to the hypotheses. At the end of the presentation, a summary of the results was made.

Hypothesis 1 There will be no significant difference between the mean post-test score on the achievement of students taught mole concepts using integrating a cooperative learning model into IDEAL problem-solving instructional strategy and those taught using the lecture method.

Table 1: Showing the Mean scores of the groups of Participants on Chemistry Achievement and Logical Thinking

	Groups	M	SD	N
CA post-test scores	(E1)	22.9174	10.78006	121
	(E2)	20.5207	11.37402	121
	(C1)	23.3058	9.39667	121
	(C2)	23.2066	11.39877	121
	Total	**22.4876**	**10.79557**	**484**
LOT post-test scores	(E1)	24.1983	9.19658	121
	(E2)	12.1322	7.25941	121
	(C1)	17.8182	6.20752	121
	(C2)	18.4959	8.61696	121
	Total	**18.1612**	**8.96779**	**484**

Source: Field Survey 2024

The results of the post-test scores for **Chemistry Achievement** and **Logical Thinking** as presented in Table 1 reveal some interesting trends regarding the effectiveness of the experimental treatments. In **Chemistry Achievement**, the **experimental groups (E1 and E2)** generally scored lower than the **control groups (C1 and C2)**, with **E1** showing the highest mean among the experimental groups (22.92), but still trailing behind the control groups, which scored around 23.2. This suggests that the experimental interventions may not have had a significant positive effect on chemistry performance. The high **standard deviations** in the experimental groups (particularly in E2) indicate considerable variability, implying that while some students in E1 may have benefitted from the intervention, others may have experienced little improvement or even worse outcomes. In contrast, the **control groups** performed relatively better, with more consistent results, indicating that the

intervention may not have been as effective as expected.

In **Logical Thinking**, the results were more polarized. **E1** performed **significantly better** than the other groups (mean = 24.20), suggesting that this particular experimental treatment effectively enhanced logical reasoning skills. However, **E2** had a **much lower mean (12.13)**, significantly underperforming compared to all other groups, which raises concerns about the effectiveness or possible adverse impact of the intervention in this group. The **control groups** (C1 and C2) showed moderate and consistent performance in logical thinking, with scores around 17.8 to 18.5, signifying that if they had been exposed to the experimental treatments they could have performed reasonably well. These findings highlight the effectiveness of the experimental treatments, though not so glaring on the chemistry achievement but had improved their reasoning ability. Thus, the alternative hypothesis is accepted.

Table 2: Showing the differences between the groups in terms of their performance on both Chemistry Achievement and Logical Thinking tests.

Effect		Value	F	Df	Error df	Sig.
Intercept	Pillai's Trace	.906	2317.628b	2	479	.000
	Wilks' Lambda	.094	2317.628b	2	479	.000
	Hotelling's Trace	9.677	2317.628b	2	479	.000
	Roy's Largest Root	9.677	2317.628b	2	479	.000
Groups	Pillai's Trace	.236	21.414	6	960	.000
	Wilks' Lambda	.765	22.873b	6	958	.000
	Hotelling's Trace	.306	24.338	6	956	.000
	Roy's Largest Root	.300	48.063c	3	480	.000

Source: Field Survey 2024

The results of the **multivariate tests** presented in Table 2 provide evidence for the significance of both the **intercept** and the **grouping factor** in explaining the variance in the dependent variables (Chemistry Achievement and Logical Thinking post-test scores). For the **intercept**, all the multivariate statistics—**Pillai's Trace**, **Wilks' Lambda**, **Hotelling's Trace**, and **Roy's Largest Root**—indicate a very strong significance (p = .000), suggesting that there is a significant overall effect of the intercept (the mean levels) across the groups. This implies that there is a substantial baseline effect, or difference, between the groups when accounting for both dependent variables. Similarly, for **Groups**, all tests again show statistically significant results (p = .000), indicating that there are significant differences between the groups in terms of their performance on both Chemistry Achievement and Logical Thinking tests. These results suggest that the grouping variable (which likely refers to the experimental and control groups) has a meaningful impact on the scores across the two outcome variables.

Table 3: The Tests of Between-Subjects Effects showing the variability in the Chemistry Achievement post-test scores and Logical Thinking post-test scores

Sources	Dependent Variable	SS	df	M	F	Sig.
Corrected Model	CA post-test scores	634.033a	3	211.344	1.823	.142
	TOLT post-test scores	8836.058b	3	2945.353	47.114	.000
Intercept	CAT post-test scores	244755.074	1	244755.074	2110.834	.000
	TOLT post-test scores	159636.570	1	159636.570	2553.558	.000
Groups	CAT post-test scores	634.033	3	211.344	1.823	.142
	TOLT post-test scores	8836.058	3	2945.353	47.114	.000
Error	CAT post-test scores	55656.893	480	115.952		
	TOLT post-test scores	30007.372	480	62.515		
Total	CAT post-test scores	301046.000	484			
	TOLT post-test scores	198480.000	484			
Corrected Total	CAT post-test scores	56290.926	483			
	TOLT post-test scores	38843.430	483			

Source: Field Survey 2024

The results of Tests of Between-Subjects Effects presented in Table 3 provide an analysis of how different sources contribute to the variability in the dependent variables—Chemistry Achievement post-test scores and Logical Thinking post-test scores—across the four groups (Experimental and Control groups). For Chemistry Achievement, the Corrected Model (which includes the groups as the factor) shows a non-significant result (F = 1.823, p = .142), indicating that the grouping factor does not significantly explain the variation in Chemistry Achievement scores. This suggests that the experimental interventions did not have a statistically significant effect on Chemistry achievement when compared to the control groups. The R-squared value for Chemistry Achievement is 0.011, indicating that only 1.1% of the total variation in Chemistry Achievement scores can be explained by the group membership, which is very low and further suggests minimal impact from the interventions.

In contrast, the Logical Thinking post-test scores show a highly significant result (F = 47.114, p = .000), with a substantial effect from the grouping factor. This indicates that the experimental interventions had a significant effect on students' logical thinking abilities. The R-squared value for Logical Thinking is 0.227, meaning that 22.7% of the variation in Logical Thinking scores can be attributed to group membership. This is a considerably higher proportion than in Chemistry Achievement, suggesting that the experimental treatments had a more meaningful impact on improving students' logical thinking skills. The significant F-statistics for the intercepts (both p = .000) for both dependent variables show that the baseline differences between the groups are substantial, with the logical thinking scores showing much stronger effects from the interventions compared to the chemistry scores.

Table 4: LSD Post-hoc-test showing individual group comparison on logical thinking

DV	(I) Groups	(J) Groups	Mean Difference (I-J)	Sig.
TOLT post-test scores	(E1)	(E2)	12.0661*	.000
		(C1)	6.3802*	.000
		(C2)	5.7025*	.000
	(E2)	(E1)	-12.0661*	.000
		(C1)	-5.6860*	.000
		(C2)	-6.3636*	.000
	(C1)	(E1)	-6.3802*	.000
		(E2)	5.6860*	.000
		(C2)	-.6777	.505
	(C2)	(E1)	-5.7025*	.000
		(E2)	6.3636*	.000
		(C1)	.6777	.505

Source: Field Survey 2024

The results presented in Table 4 for **Logical Thinking** show several significant differences. **Experimental Group 1 (E1)** outperformed both **E2** (mean difference = 12.0661, p = .000) and the control groups (**C1** and **C2**, mean differences of 6.3802 and 5.7025, respectively, both p = .000). This suggests that **E1** benefited significantly from the intervention and performed much better than the other groups in logical thinking. **E2**, on the other hand, showed consistently poor performance compared to **E1** and the control groups, with significant negative mean differences across all comparisons (e.g., **E2 vs. C1**, mean difference = -5.6860, p = .000; **E2 vs. C2**, mean difference = -6.3636, p = .000). The **control groups** (**C1**

and **C2**) did not significantly differ from each other in their logical thinking scores (p = .505), but they both performed worse than **E1** and better than **E2**. These results indicate that the interventions had a substantial and positive effect on **E1**'s logical thinking skills, but **E2** experienced a significant decline, suggesting that the intervention for **E2** was either ineffective or possibly harmful.

Ho$_2$ There will be no significant difference between post-test reasoning ability means score of students taught using integrating a cooperative learning model into IDEAL problem-solving instructional strategy and those taught using lecture method.

Hypothesis 2

Table 5: One-way ANOVA showing differences in the groups of participants on logical thinking

Sources	SS	df	MS	F	Sig.
Between Groups	8836.058	3	2945.353	47.114	.000
Within Groups	30007.372	480	62.515		
Total	38843.430	483			

Source: Field Survey 2024

The significant **F-value** (47.114, p = .000) results presented in Table 5 confirm that the group membership significantly affects logical thinking performance, with **E1** outperforming the other groups and **E2** performing the worst. The large F-value between-group variance relative to within-group variance suggests that the differences between the groups are substantial and not due to random chance,

confirming that the experimental interventions had a measurable impact on logical thinking.

Ho$_3$ There will be no significant relationship between the post-test reasoning ability means score and achievement on the mole concept test of students taught using integrating a cooperative learning model into IDEAL problem-solving instructional strategy and those taught using the lecture method.

Hypothesis 3

Table 6: Pearson Correlation Matrix showing relationships among study variables

		1	2	3	4	5	6	7	8
1	E1 TOLT Post-test scores								
2	E2 TOLT Post-test scores	-.105							

3	C1 TOLT Post-test scores	-.052	.075					
4	C2 TOLT Post-test scores	.023	-.143	-.014				
5	E1 CAT post-test scores	.125	.196*	.124	.028			
6	E2 CAT post-test scores	.216*	-.110	.099	-.061	-.010		
7	C1 CAT post-test scores	.005	-.092	.045	-.082	.215*	-.098	
8	C2 CAT post-test scores	-.081	.017	.079	-.046	.069	-.073	.080	-

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

Source: Field Survey 2024

Table 6 presents the Pearson correlation coefficients for various post-test scores on logical thinking and chemistry achievement across four groups: E1, E2, C1 and C2. These correlations provide insights into how students' performance in logical thinking relates to their achievement in chemistry. When examining the logical thinking scores, the correlation between E1 logical thinking and the other variables is generally weak. E1 logical thinking scores show a small positive correlation with E1 Chemistry Achievement scores (r = 0.125), but this is not statistically significant (p = 0.170). Similarly, the correlation between E1 logical thinking and the logical thinking scores of the other groups (E2, C1, and C2) are very low, with none being statistically significant. The weakest correlation is between E1 logical thinking and C2 logical thinking (r = 0.023, p = 0.799). These findings suggest that E1 logical thinking does not strongly relate to logical thinking performance in other groups or to chemistry achievement.

On the other hand, E2 logical thinking scores show a few significant correlations. There is a significant positive correlation with E1 Chemistry Achievement scores (r = 0.216, p = 0.017), indicating that higher E2 logical thinking scores are associated with better performance in E1 chemistry. There is also a significant negative correlation with C1

Chemistry Achievement scores (r = -0.215, p = 0.018), suggesting that higher logical thinking scores in E2 might be linked to lower achievement in C1 chemistry. However, the correlation between E2 logical thinking and other logical thinking variables (such as C1 and C2 logical thinking) is weak, with no other significant results.

In terms of C1 and C2 logical thinking post-test scores, the correlations with other variables are mostly insignificant. For example, the correlation between C1 logical thinking and C2 logical thinking is near zero (r = -0.014, p = 0.879), showing no meaningful relationship. Other correlations involving C1 and C2 logical thinking with chemistry achievement scores are also weak and not statistically significant.

Looking at the chemistry achievement scores, the relationships are somewhat stronger in certain cases. E1 Chemistry Achievement scores show a significant positive correlation with E2 logical thinking scores (r = 0.216, p = 0.017), reinforcing the idea that better logical thinking in the E2 group correlates with higher achievement in chemistry. However, the correlation between E1 chemistry achievement and C1 chemistry achievement is also significant (r = 0.215, p = 0.018). This suggests that students who perform well in E1 chemistry are also likely to perform well in C1 chemistry. Despite these significant correlations, many

other chemistry-related correlations are weak, and several, like those between E1 and E2 chemistry achievement or C1 and C2 chemistry achievement, are not statistically significant.

Overall, the results suggest that there are some meaningful, albeit weak, relationships between logical thinking and chemistry achievement. The strongest correlations appear between E2 logical thinking and E1 chemistry achievement as well as between E1 chemistry achievement and C1 chemistry achievement. However, most correlations are relatively weak, and many are not statistically significant, indicating that the relationship between logical thinking and subject-specific achievement is complex and may vary depending on the specific group and test.

Discussion of Findings

The study's findings underscore the transformative potential of integrating cooperative learning models with the IDEAL problem-solving instructional strategy in enhancing students' reasoning ability and achievement in the mole concept in chemistry. It was observed that the intervention significantly improved reasoning skills, particularly in Experimental Group 1 (E1), which outperformed all other groups in logical thinking tests. This suggests that the collaborative and structured nature of the instructional strategy facilitated critical thinking, peer learning, and reflective problem-solving. These findings are consistent with constructivist theories, such as Bruner's (1966), which emphasize active engagement and collaboration as pivotal to developing higher-order cognitive skills.

However, the study also revealed that the intervention had a less pronounced effect on students' achievement in chemistry, with no statistically significant differences observed between experimental and control groups. The high variability in performance within the experimental groups, particularly in Experimental Group 2 (E2), highlights potential inconsistencies in the implementation of the strategy, differences in group dynamics, or variations in students' readiness to adopt the instructional approach. These findings align with empirical studies, such as those by Taber (2002) and Coll and Treagust (2003), which emphasize the importance of consistent facilitation and foundational readiness in achieving desired outcomes through cooperative learning.

Moreover, the weak correlation between reasoning ability and achievement suggests that while the instructional strategy fosters critical thinking, its impact on mastering abstract and quantitative topics like the mole concept is not direct. This reflects Chiu's (1993) argument that success in chemistry requires not only reasoning skills but also a strong foundation in mathematical and conceptual understanding. The study's results highlight the complex interplay between cognitive skills and content mastery, underscoring the need for a multifaceted approach that integrates reasoning development with effective teaching of foundational concepts.

In conclusion, the findings affirm the potential of innovative teaching strategies in enhancing reasoning ability and highlight their limitations in improving subject-specific achievement without addressing underlying challenges such as mathematical competency and conceptual clarity. These insights call for further research into optimizing the implementation of cooperative and problem-solving strategies, alongside curricular adjustments that balance cognitive and content-focused learning objectives. This dual emphasis could pave the way for more effective teaching of abstract and quantitative topics in chemistry and other sciences.

Conclusions

The following conclusions were made:

1. **Enhanced reasoning ability:** The integration of a cooperative learning model into the IDEAL problem-solving instructional strategy significantly improved students' reasoning abilities, as evidenced by the superior logical thinking scores of Experimental Group 1 (E1) compared to other groups.

2. **Limited impact on chemistry achievement:** The instructional strategy had a limited impact on student's achievement in the mole concept, with no statistically significant differences observed between the experimental and control groups in chemistry achievement post-test scores.

3. **Variability in effectiveness across groups:** There was notable variability in the outcomes among experimental groups, with Experimental Group 2 (E2) underperforming in logical thinking compared to both E1 and the control groups. This suggests inconsistencies in the implementation or contextual factors affecting the strategy's success.

4. **Weak correlation between reasoning ability and achievement:** The weak correlation between reasoning ability and chemistry achievement indicates that improvements in logical reasoning do not necessarily translate into better performance in subject-specific tasks like solving mole concept problems.

5. **Influence of foundational knowledge:** The findings highlight the importance of foundational competencies, such as mathematical skills and conceptual understanding, as prerequisites for success in abstract and quantitative topics like the mole concept.

6. **Need for consistent implementation:** The study emphasizes the importance of well-structured and consistent implementation of innovative teaching strategies to achieve optimal outcomes in both reasoning ability and academic achievement.

7. **Potential of student-centred approaches:** The study affirms the potential of student-centred, collaborative, and problem-solving approaches in fostering higher-order cognitive skills but suggests that these approaches require refinement to address specific challenges in chemistry education effectively.

Recommendations

1. **Improving reasoning ability in chemistry:** Teachers should adopt and implement the integration of cooperative learning models with the IDEAL problem-solving instructional strategy to enhance students' reasoning abilities. To maximize effectiveness, teacher training programs should focus on how to facilitate group activities, encourage critical thinking, and create an interactive learning environment that promotes logical reasoning in challenging topics like the mole concept.

2. **Enhancing academic achievement in the mole concept:** Instructional strategies should address the specific challenges students face in mastering the mole concept by combining cooperative learning and problem-solving with foundational reinforcement in mathematics and chemistry concepts. Incorporating visual aids, real-world applications, and hands-on experiments can make the abstract nature of the mole concept more relatable and enhance students' academic performance.

3. **Strengthening the relationship between reasoning ability and achievement:** Teachers should design lessons and assessments that integrate reasoning skill development with content mastery to create a stronger connection between students'

logical thinking and academic achievement. Collaborative problem-solving tasks, guided discussions, and reflective learning activities should be emphasized to help students apply their reasoning skills in solving complex problems in chemistry effectively.

Acknowledgement

References

Abazov, R. (2016). How to improve your problem-solving skills. Available at: https://www.researchgate.net/publication/305062877_How_to_Improve_Your_Problem-Solving_Skills. (Accessed January 19, 2023).

Adeoye, F. A. (2000). Assessment Procedure, Students' Cognitive Style and Gender as Determinants of Physics Performance of Cognitive Level of Thinking. *Journal of Educational Research*, 5(1), 39-49.

Atkins, Peter, and Jones, Loretta (2002). *Chemical Principles*, 2nd edition. New York: W. H. Freeman and Company

Ausubel, D.P., Robinson HYPERLINK "https://en.wikipedia.org/wiki/Floyd_G._Robinson". (1969). *School Learning: An Introduction to Educational Psychology*. New York: Holt, Rinehart & Winston.

Clough, M.P. (2000). *The unnatural nature of science: Implications for science education*. Paper presented at the Association for the Education of Teachers in Science International Conference, Akron, OH. January 6-9.

Coll, R. K. & Treagust, D. F., (2003). Investigation of Secondary School, Undergraduate and Graduate Learners' Mental Models of Ionic Bonding, *Journal of Research in Science Teaching*, 40(5), 464–486.

Dewey, J. (1938). **Experience and Education**. New York, NY: Collier.

Ebenezer, J. V., (2001). A Hypermedia Environment to Explore and Negotiate Students' Conceptions: Animation of The Solution Process of Table Salt, *Journal of Science Education and Technology*, 10(1), 73–92.

Fajola, O.O (2000) Effects of three modes of computer-based instructional strategies on students learning outcome in biology. Unpublished

Friedel, A and Maloney, D "An Exploratory, Classroom-Based Investigation of Students Difficulties with Subscripts in Chemical Formulas," *Science Education, 76(1):65-78(1992)*.

Grauwe, A. D. (1999). The challenges for the school of the future: *International Institute for Educational Planning, XVII* (4), 10 and 11.

Laurens, T., Batlolona, F. A., Batlolona, J. R., and Leasa, M. (2018). How does realistic mathematics education (RME) improve students' mathematics cognitive achievement? *Eurasia J. Math. Sci. Technol. Educ. 14, 569–578. doi: 10.12973/ejmste/76959*

Lide, D. R., ed. (2000). The CRC Handbook of Chemistry & Physics, *81st* edition. New York: CRC Press**.**

Loucks A.B. (2007). *Low energy availability in the marathon and other endurance sports: 37(4-5):348-52*

Mandina, S., and Ochonogor, C. (2018). Comparative effect of two problem-solving instructional strategies on students' achievement in stoichiometry. *Eurasia J.*

Math. Sci. Technol. Educ. 14, 1–9. doi: 10.29333/ejmste/95125

Melawati, O., Evendi, E., Halim, A., Yusrizal, Y., and Elisa, E. (2022). The influence of the use of student worksheets to increase problem-solving skills and learning outcomes. *Jurnal Penelitian Pendidikan IPA 8:2022. doi: 10.29303/jppipa.v8i1.1205*

Oliveri, M. E., Lawless, R., and Molloy, H. (2017). A literature review on collaborative problem solving for college and workforce readiness. ETS Res. Rep. Ser. 2017, 1–27. doi: 10.1002/ets2.12133

Özmen, H., (2004). Some Student Misconceptions in Chemistry: A Literature Review of Chemical Bonding, *Journal of Science Education and Technology,* 13(2), 147–159.

Ravialo, A., (2001). Assessing Students' Conceptual Understanding of Solubility Equilibrium, *Journal of Chemical Education,* 78(5), 629–631.

Reid, N and Yang, M.J. (2002). The solving of problems in chemistry: the more open-ended problems. *Research in Science & Technological Education*, 20, 83-98.

Salami, A. (1992). *Secondary education programme under the national policy on education.* An assessment based on the WAEC senior secondary school certificate examination paper presented at the WAEC monthly seminar 28th August.

Schunk, D. H. (2000). Learning theories: an educational perspective. New Jersey: Prentice-Hall.

Sutarmi, K., and Suarjana, I. M. (2017). Peningkatan hasil belajar siswa menggunakan metode problem solving dalam pembelajaran. *Jurnal Ilmiah*

Sekolah Dasar 1, 75–82. doi: 10.23887/jisd.v1i2.10141

Tabar, K. S., (2002). Alternative Conception in Chemistry: prevention, Diagnosis and Cure.London: *The Royal Society of Chemistry.*

Taber, K. S. & Coll, R. K., (2003). Bonding, in: J. K. Gilbert, O. De Jong, R. Justi, D. F.Treagust & J. H. Van Driel (Eds) *Chemical Education*: Towards Research-Based Practice. Dordrecht: Kluwer.

Trochim, W. M. K., & Donnelly, J. P. (2008). The research methods knowledge base. Mason, Ohio, USA: Atomic Dog.

Tobin, K., & Capie, W. (1980). *The development and validation of a group test of logical thinking.* Paper presented at the annual meeting of the American Educational Research Association, Boston.

Tobin, K., & Capie, W. (1981). The development and validation of a group test of logical thinking. *Educational and Psychological Measurement, 41, 413-423.*

WAEC. (2005). *Chief Examiners' Reports.* Lagos: Nigeria Animo press Ltd 114-135West African Examinations Council (2005): The West African Senior School Certificate Examinations, May/June (2005) Chief Examiners reports (Nigeria). Lagos 157-196.

WAEC *Chief Examiners reports* (2007): The West African Senior School Certificate Examinations, May/June (Nigeria). Lagos 158-189.

WAEC *Chief Examiners reports* (2009): The West African Senior School Certificate Examinations, May/June (Nigeria). Lagos.

Zadra, E. (2000, April-June). Learning as a gateway to the 21st century. *International Institute for Educational Planning* Newsletter, 18 (2), 14.

ASSESSMENT OF CHALLENGES AFFECTING TEACHING AND LEARNING OF BIOLOGY IN SECONDARY SCHOOLS IN BIU, BORNO STATE, NIGERIA

Magdalene Abel

College of Education Waka – Biu
Department of Home Economics Education
+234 8065350605
Magdaleneabel000@gmail.com

This study examines the challenges affecting the teaching and learning of Biology in secondary schools in Biu, Borno State, Nigeria. Employing a cross-sectional survey design, data were collected from 150 students and 25 teachers across five schools using structured questionnaires. Analysis with SPSS and MS Office Excel revealed that teacher competence, resource availability, learning environment, and teaching methods significantly impact Biology education. Teachers demonstrated strong subject knowledge but faced challenges in accessibility and feedback provision. Inadequate resources, such as laboratory equipment and textbooks, hindered effective learning, while environmental factors like noise and insufficient laboratory facilities further reduced teaching efficacy. Interactive, student-centred teaching methods proved effective, though reliance on traditional approaches limited critical thinking and practical application. The study concludes that addressing these challenges through improved teacher training, resource provision, enhanced infrastructure, and innovative teaching strategies is essential for fostering better learning outcomes in Biology education.

Introduction

Biology, as a foundational science subject, plays a vital role in secondary education, equipping students with essential knowledge and skills necessary for addressing real-world challenges in health, agriculture, and environmental sustainability. Despite its significance, the teaching and learning of biology in secondary schools often face numerous challenges, particularly in regions such as Biu, Borno State, Nigeria. These challenges hinder students' academic performance and reduce their interest in science-related careers, ultimately affecting the development of human capital in science and technology.

One critical factor influencing the effectiveness of biology education is teacher competence. The knowledge, skills, and instructional strategies employed by teachers significantly impact students' understanding and engagement. Inadequate training, lack of professional development opportunities, and insufficient mastery of the subject matter often lead to suboptimal learning outcomes. This study seeks to identify the effect of teacher competence on the effectiveness of learning biology in secondary schools in Biu.

Another major issue is the lack of teaching resources. The availability of instructional materials such as textbooks, laboratory equipment, and visual aids is crucial for facilitating interactive and practical learning experiences. In many secondary schools in Biu, these resources are either unavailable or insufficient, forcing teachers to rely on theoretical instruction. This study will explore

the effect of resource scarcity on the effective teaching and learning of biology.

The teaching and learning environment also plays a significant role in determining the success of educational activities. Factors such as class size, school infrastructure, and the availability of functional laboratories contribute to creating a conducive environment for learning. In Biu, schools often face overcrowded classrooms, poorly maintained facilities, and inadequate support systems, all of which can undermine the teaching and learning process. This research aims to examine whether the current teaching and learning environment is conducive to biology education.

Finally, the methods used in teaching biology have a profound impact on students' comprehension and retention of knowledge. Innovative, student-centred approaches such as inquiry-based learning and hands-on experiments are known to enhance engagement and academic achievement. However, traditional lecture-based methods remain prevalent in many schools, potentially limiting students' ability to fully grasp biological concepts. This study will evaluate whether the teaching methods used affect the teaching and learning of biology in secondary schools in Biu.

Statement of the problems

The poor performance of secondary school students in biology is largely due to the lack of qualified teachers and ineffective teaching methods. Many schools employ under-qualified educators who lack the expertise to deliver biology lessons effectively. Additionally, some teachers rely on outdated methods, such as reading notes without engaging students, which reduces interest and comprehension. Corruption in teacher recruitment further worsens the situation, as unqualified individuals secure teaching positions, compromising the quality of education.

Institutional deficiencies also contribute significantly to this issue. Many schools lack essential resources, including laboratory equipment, teaching aids, and updated textbooks, making it difficult for students to grasp practical concepts. Poorly maintained infrastructure and overcrowded classrooms further hinder effective teaching and learning. The absence of well-planned biology-related activities, such as field trips and science fairs, deprives students of opportunities to apply their knowledge in real-world settings.

Students' attitudes and behaviours are another critical factor affecting biology performance. Many students show a lack of interest in the subject, viewing it as difficult or irrelevant to their future aspirations. This often leads to poor study habits, disengagement, and indiscipline, including truancy and disruptive behaviour. Such attitudes prevent students from fully benefiting from biology lessons, especially when they miss practical sessions or fail to complete assignments.

The interplay of these challenges issues, institutional shortcomings, and student attitudes has led to persistently poor outcomes in biology. High failure rates in national examinations highlight the need for urgent interventions, including improved teacher training, provision of resources, and efforts to foster student interest and discipline. Addressing these challenges holistically is essential for improving biology education in secondary schools.

Objectives

This research aims to establish factors that affect the effective teaching and learning of Biology in secondary schools in Borno State.

1. To identify the effect of teacher's competence on the effectiveness of learning of Biology in secondary schools.

2. To find the effect of lack of teaching resources on effective teaching and learning of Biology in secondary schools.

3. To examine whether the teaching and learning environment is conducive to the teaching and learning of Biology in secondary schools.

4. To evaluate whether the teaching method used has an effect on teaching and learning of Biology in secondary schools.

Research Question

1. What is the effect of teacher competence on the effectiveness of learning Biology in secondary schools in Borno State?

2. How does the lack of teaching resources impact the effective teaching and learning of Biology in secondary schools in Borno State?

3. Is the teaching and learning environment conducive for the teaching and learning of Biology in secondary schools in Borno State?

4. How does the teaching method used affect the teaching and learning of Biology in secondary schools in Borno State?

Literature review

Biology education in secondary schools plays a crucial role in students' academic and career development. It fosters interest in biological topics relevant to everyday life and future vocations (Mutanen & Uitto, 2020). However, current science curricula, including biology, often lack coherence and relevance for many students, leading to decreased interest in science-based subjects and careers (Ottevanger et al., 2016).

Research indicates that teacher competence significantly impacts student outcomes in science education. Teacher pedagogical content knowledge, self-efficacy, and enthusiasm positively influence students' interest and achievement in elementary science (Fauth et al.,

2019). A study of biology teachers in select schools found them generally competent in subject content, instruction, and assessment practices, though some deficiencies were noted (Salaguinto, 2024). Nigeria experiences similar issues, including bureaucratic bottlenecks, lack of transparency, and inadequate funding in its recruitment process. To address these challenges, suggestions include policy reforms, increased financing, and merit-based selection criteria. Implementing these changes could improve the recruitment process and, consequently, the quality of education in secondary schools (Abimbowo & Issa, 2024).

Recent research highlights the limitations of traditional lecture-based instruction in biology education and emphasizes the benefits of interactive and inquiry-based approaches. Traditional methods often struggle to fully engage students and foster deep comprehension (Egamberdiyeva Nigora Akhmadkulovna, 2024). In contrast, interactive teaching methods, such as hands-on experiments, group discussions, and technology-enhanced learning, stimulate curiosity and critical thinking (Egamberdiyeva Nigora Akhmadkulovna, 2024).

Research indicates that learning resources, particularly audiovisual aids, play a crucial role in enhancing biology education. Studies have shown a positive relationship between available learning resources and students' academic performance in biology (Etim, 2021). Recent studies have highlighted challenges in biology education in Nigeria. Action research has shown that redesigned course materials with higher cognitive levels can significantly improve student achievement in biology (Udeani et al., 2016). However, a lack of functional audio-visual instructional aids in higher institutions hinders effective teaching and learning (Suraj et al., 2021). While the use of instructional

materials shows positive results, teachers face challenges such as inadequate lecture periods, poor monitoring, and lack of technical assistance (Suraj et al., 2021).

Research indicates that school infrastructure and environment play a crucial role in shaping the effectiveness of biology education. Well-designed and equipped school facilities, including functional laboratories, contribute significantly to student achievement and overall educational quality (Deassy Yunita et al., 2023).

Students' attitudes and motivation towards biology reveal several key findings. Students' interest and attitude towards biology are significantly correlated with their academic performance (Awodun Adebisi Omotade et al., 2016). Biology pre-service teachers in Nigeria demonstrate readiness to implement ICT skills in teaching and learning, showing confidence, awareness, motivation, and knowledge. However, they lack necessary equipment (Francisca & Samsudin, 2018). These findings suggest a need for improved resources, teacher training, and infrastructure to enhance biology education in Nigeria.

This research aims to address the gaps in resources, teacher training, and infrastructure, ultimately improving the teaching and learning outcomes in biology. With enhanced teacher competence, better teaching methods, adequate resources, and improved school environments, biology education can become more effective and engaging for students in secondary schools.

Methodology

The study employed a survey method using structured questionnaires for both teachers and students, where the variables were not directly manipulated by the researcher. The teachers' survey gathered information on curriculum delivery, qualifications, teaching methods, and the availability of teaching resources, while the students' survey focused on their interest, perceptions, competencies, and attitudes toward Biology. Quantitative methods were used to assess the respondents' knowledge, attitudes, and beliefs (Berg, 2005; Bouma, 2015).

The study involved five randomly selected secondary schools, with five biology teachers from each school participating in the survey. Ten students from each class (SS1, SS2, SS3) were surveyed, using random stratified sampling to select the students.

Primary data was collected through questionnaires and interviews. Teachers completed their own questionnaires, while students were guided by the researcher. The questionnaires included both open and closed-ended questions, such as Likert-type items, and were selected for their efficiency in administering to a large group and simplifying data analysis.

To ensure reliability, the study aimed for consistent results, where the findings would be repeatable under similar conditions (Moskal et al., 2010). For validity, the questionnaires were tested in three additional schools to ensure they measured the intended constructs accurately.

The data was analyzed using qualitative methods, with statistical calculations performed through SPSS and MS Office Excel, presenting the results in percentages based on the respondents' answers.

Results

Answer to Research Questions

Research question one

What is the effect of teacher competence on the effectiveness of learning Biology in secondary schools in Borno State?

Table 1. Answers to Research Question One

Statement	SD	D	N	A	SA	Mean
1. My biology teacher is knowledgeable about the subject.	16	15	10	44	65	3.85
2. My biology teacher uses real-life examples to explain concepts effectively.	33	20	18	38	41	3.23
3. My biology teacher makes complex biology topics easier to understand.	22	13	20	35	60	3.65
4. My biology teacher manages the classroom well to support learning.	28	19	15	43	45	3.39
5. My biology teacher uses different teaching methods to make learning engaging (like experiments or group work).	14	23	28	44	41	3.50
6. My biology teacher regularly assesses our understanding through quizzes and assignments.	12	30	22	40	46	3.52
7. My biology teacher is approachable and available for extra help outside class.	30	20	27	50	23	3.11
8. My biology teacher gives constructive feedback on my assignments and tests.	26	31	28	27	38	3.13
9. My biology teacher motivates me to study and pursue Biology.	12	29	15	43	51	3.61
10. Overall, my biology teacher's competence positively impacts my performance and interest in Biology.	14	43	18	45	30	3.23
Average Mean						**3.42**

The table reflects students' perceptions of their biology teacher's effectiveness, with varying degrees of agreement across different aspects of teaching. A significant strength lies in the teacher's knowledge of the subject, as indicated by a high mean score of 3.85 for the statement "My biology teacher is knowledgeable about the subject." This suggests that students recognize the teacher's expertise in biology, which is essential for providing accurate and reliable information to support student learning. Additionally, the teacher's ability to make complex topics more accessible, with a mean score of 3.65, indicates that students appreciate the teacher's efforts in simplifying challenging material, which helps in enhancing comprehension and retention of difficult concepts.

The teacher's use of engaging teaching methods, such as hands-on experiments and group work (mean score of 3.50), is also seen as a strength. This suggests that the teacher incorporates a variety of strategies to make lessons more interactive and engaging, which can foster curiosity, critical thinking, and deeper understanding among students. The

regular assessment of students' understanding through quizzes and assignments (mean score of 3.52) is another positive aspect, as it indicates that the teacher actively monitors student progress, reinforcing learning and providing opportunities for feedback and improvement.

However, the responses related to teacher approachability (mean score of 3.11) and feedback (mean score of 3.13) indicate areas for improvement. While some students find the teacher approachable and available for extra help, others may feel that they do not have adequate access to the teacher outside of class, which could hinder additional learning support. Similarly, while the teacher provides feedback on assignments and tests, the neutral mean score suggests that students may not always find the feedback detailed or timely

enough to be fully helpful in improving their performance.

Lastly, the statement "Overall, my biology teacher's competence positively impacts my performance and interest in Biology" received a mean score of 3.23, which suggests that while students generally agree that the teacher's competence contributes positively to their academic outcomes and interest in the subject, there may still be areas where the teacher could further inspire or motivate students. The sectional mean of 3.42 reflects a generally positive assessment of the teacher's performance, indicating that students appreciate the teacher's expertise and teaching methods but also point to potential areas for improvement, particularly in teacher-student interactions, classroom management, and feedback processes.

Research questions two:

How does the lack of teaching resources impact the effective teaching and learning of Biology in secondary schools in Borno State?

Table 2. Answers to Research Question Two

S/N	Statement	SD	D	N	A	SA	Mean
1.	To what extent does the lack of adequate teaching resources (e.g., textbooks, laboratory equipment) affect your understanding of Biology in school	14	17	14	42	63	3.82
2.	Do you believe that the absence of sufficient teaching materials limits the effectiveness of your biology lessons	28	33	15	40	34	3.13
3.	How does the lack of practical teaching resources, like laboratory tools, influence your ability to grasp Biology concepts	27	23	15	35	50	3.39
4.	In your opinion, how does the shortage of visual aids (such as charts, models, and videos) hinder your learning experience in Biology	25	24	12	46	43	3.39
5.	Do you feel that the absence of sufficient biology textbooks affects your ability to study and prepare for exams	34	23	28	34	31	3.03

S/N	Statement						Mean
6.	How often do you encounter challenges in conducting Biology experiments due to the lack of necessary laboratory resources	14	36	22	38	40	3.36
7.	To what extent do you think the lack of teaching resources reduces the overall quality of Biology education in your school	32	30	27	38	23	2.93
8.	How does the scarcity of technology (like computers and projectors) in your biology class affect your learning experience	31	28	31	27	33	3.02
9.	Do you believe that the lack of teaching resources contributes to a lack of interest or motivation in studying Biology	16	25	17	41	51	3.57
10.	In your opinion, how does the inadequate provision of teaching resources impact your teacher's ability to deliver effective Biology lessons	17	40	21	43	29	3.18
	Average Mean						**3.28**

The table reveals how the lack of teaching resources impacts various aspects of Biology education. Respondents strongly agree (Mean = 3.82) that the absence of adequate teaching resources, such as textbooks and laboratory equipment, significantly affects their understanding of Biology. The lack of teaching materials is seen as moderately limiting the effectiveness of lessons (Mean = 3.13), and the absence of practical resources like laboratory tools is perceived to moderately influence their ability to grasp Biology concepts (Mean = 3.39). Similarly, the shortage of visual aids and textbooks is considered to have a moderate impact on learning (Means = 3.39 and 3.03, respectively). Challenges in conducting experiments due to resource shortages (Mean = 3.36) and the scarcity of technology (Mean = 3.02) are also viewed as moderate hindrances to effective learning. Although the lack of teaching resources is recognized as affecting the overall quality and interest in Biology, the impact on the teacher's ability to deliver lessons is considered somewhat less severe (Mean = 3.18). Overall, the table indicates that while resource shortages are seen as significant barriers to effective Biology education, their influence is perceived to be moderate rather than extreme in most areas.

Research questions three:

Is the teaching and learning environment conducive for the teaching and learning of Biology in secondary schools in Borno State?

Table 3. Answers to Research Question Three

S/N	Statement	SD	D	N	A	SA	Mean
1.	To what extent do you think the physical classroom environment supports effective biology learning	10	17	10	46	67	3.82

2.	Do you believe the seating arrangement in your biology classroom is conducive to collaborative learning and group discussions	25	33	10	43	39	3.13
3.	How would you rate the availability of adequate space and ventilation in your biology classroom for effective learning	26	28	13	33	50	3.39
4.	Do you think the level of noise in the classroom affects your ability to concentrate during Biology lessons	25	23	10	48	45	3.38
5.	How does the cleanliness and general maintenance of the biology classroom impact your learning experience	34	23	15	44	34	3.14
6.	In your opinion, does the availability of sufficient lighting in the biology classroom contribute positively to your learning environment	14	36	10	48	42	3.36
7.	How often do you face distractions in the classroom that hinder your ability to focus on biology lessons?	28	30	29	38	25	2.93
8.	Do you think that the availability of laboratory space and equipment enhances your understanding of biology concepts	30	18	14	50	38	3.04
9.	How conducive do you find the overall school environment (e.g., sanitation, infrastructure, safety) for learning biology	25	16	10	45	54	3.57
10.	Do you feel that the school administration supports the creation of a conducive learning environment for the teaching of biology	17	30	32	43	28	3.13
	Average Mean						**3.29**

The table provides an analysis of students' perceptions of various factors influencing the learning environment in Biology classes. The highest mean score of 3.82 is for the statement about the physical classroom environment supporting effective Biology learning, indicating that students generally agree that the physical setup is conducive to learning. On the other hand, the lowest mean score of 2.93 is for the statement about facing distractions in the classroom, suggesting that students frequently encounter challenges that hinder their focus. Other statements, such as the availability of adequate space and ventilation (mean score 3.39), and the level of noise affecting concentration (mean score 3.38), also reflect moderately positive perceptions. The availability of laboratory space and equipment (mean score 3.04) and the overall school environment's conduciveness to learning (mean score 3.57) are rated similarly, indicating some areas for improvement. The mean score of 3.13

regarding the school administration's support for a conducive learning environment suggests a somewhat positive but not overwhelmingly strong perception. Overall, the results show a mixture of positive and neutral responses, with some room for improvement, particularly in reducing distractions and enhancing laboratory resources.

Research questions four:

How does the teaching method used affect the teaching and learning of Biology in secondary schools in Borno State?

Table 4; Answers to Research Question Four

S/N	Statement	SD	D	N	A	SA	Mean
1.	The teaching methods used in Biology classes are effective in helping me understand key concepts.	13	14	8	58	57	3.94
2.	Group discussions and collaborative activities during Biology lessons improve my learning experience.	10	8	14	64	54	3.97
3.	Practical laboratory sessions significantly enhance my understanding of Biology topics.	8	12	15	71	44	3.91
4.	The teaching methods in my biology class are engaging and make the subject interesting.	20	9	7	60	54	3.84
5.	Traditional teaching methods, such as lectures, are sufficient for learning Biology effectively.	42	28	26	43	11	2.65
6.	The lack of variety in teaching methods negatively affects my interest in Biology.	15	36	21	41	37	3.41
7.	Teachers in my school often use technology (e.g., videos, presentations) to teach biology effectively.	37	38	17	38	20	2.80
8.	There are adequate resources (e.g., laboratory equipment) to support the teaching methods used in Biology.	21	45	31	20	33	3.07
9.	I believe that the teaching methods in biology classes prepare me well for exams and assessments.	25	16	17	41	51	3.57
10.	The teaching methods used in biology help me connect theoretical knowledge to real-life applications.	17	30	21	43	39	3.48
	Sectional Mean						**3.46**

The table reveals that interactive and practical teaching methods, such as group discussions and laboratory sessions, are highly valued by respondents, with mean scores close to 4.0, indicating strong agreement on their effectiveness in enhancing learning and

engagement. Traditional lecture-based methods received lower approval (Mean = 2.65), suggesting they are insufficient on their own. While teaching methods are generally seen as effective in preparing students for exams (Mean = 3.57) and linking theory to real-life applications (Mean = 3.48), the integration of technology and adequacy of resources received mixed responses, highlighting areas for improvement. Overall, the findings emphasize the need for diverse, interactive approaches to maintain interest and improve learning outcomes in Biology.

Discussion of the Findings

Empirical evidence consistently underscores the importance of teacher competence in fostering effective learning outcomes in Biology education. The study revealed that while teachers in Biu secondary schools possess adequate subject knowledge and can simplify complex topics, their limited accessibility and insufficient feedback mechanisms hinder optimal student support. (Fauth et al.; 2019). Highlighted that teachers' pedagogical content knowledge and self-efficacy significantly influence student interest and achievement in science education. Furthermore, (Abimbowo & Issa, 2024) emphasized that professional development opportunities are critical for equipping teachers with modern teaching strategies, a gap evident in this study's findings.

The lack of adequate teaching resources emerged as a significant barrier to effective Biology education in the study. Respondents reported that insufficient laboratory equipment, outdated textbooks, and limited visual aids hindered their ability to grasp complex biological concepts. This finding aligns with (Etim, 2021), who found a strong correlation between the availability of instructional materials and student performance in science subjects. (Suraj et al.; 2021) also noted that

resource inadequacies in Nigerian schools, particularly in science education, limit practical learning opportunities, ultimately affecting academic outcomes.

The physical learning environment was found to moderately support Biology education, with some schools offering adequate space, ventilation, and lighting. However, challenges such as noise, distractions, and insufficient laboratory facilities undermined the overall effectiveness of the learning environment. (Deassy Yunita et al.; 2023) Demonstrated that well-maintained school infrastructure, including functional laboratories, plays a critical role in improving educational quality and student achievement. The findings in this study reflect a broader trend in Nigerian schools, where infrastructural deficits remain a significant obstacle to effective teaching and learning.

The teaching methods employed in Biology classrooms also showed mixed effectiveness. Students expressed a strong preference for interactive and student-centred approaches, such as group discussions and laboratory experiments, which were seen as highly effective in enhancing engagement and comprehension. These findings align with (Akhmadkulovna, 2024), who advocated for inquiry-based learning methods to improve science education outcomes. However, the continued reliance on traditional lecture-based instruction, as noted in the study, is consistent with (Ottevanger et al.; 2016), who argued that conventional methods often fail to promote critical thinking and practical application in science subjects.

The broader implications of these findings highlight systemic challenges in Biology education, including teacher training gaps, resource inadequacies, and suboptimal teaching methods. (Udeani et al.; 2016), Emphasized that targeted interventions, such as enhancing

teacher capacity and redesigning course materials, can significantly improve student outcomes. (Akiri, 2009) further stressed the importance of motivation and innovative strategies in sustaining student interest in science subjects like Biology. Addressing these challenges through comprehensive reforms can foster an enabling environment for effective Biology education in secondary schools.

Conclusion

The following conclusions were made:

1. **Effect of Teacher Competence on Learning Biology**
The study concluded that teacher competence significantly impacts the effectiveness of Biology education. While teachers demonstrated adequate subject knowledge and the ability to simplify complex topics, gaps in accessibility and feedback mechanisms were identified. This indicates a need for enhanced professional development to equip teachers with modern teaching strategies and improve their engagement with students.

2. **Impact of Lack of Teaching Resources on Biology Education**
The absence of adequate teaching resources, including laboratory equipment, textbooks, and visual aids, was found to hinder the effective teaching and learning of Biology. These resource inadequacies limit practical learning opportunities and reduce students' ability to grasp complex biological concepts, thereby impacting overall academic performance.

3. **Conduciveness of the Teaching and Learning Environment**
The study found that the physical learning environment moderately supports Biology education. While some schools offer adequate space, ventilation, and lighting, issues such as noise, distractions, and

insufficient laboratory facilities undermine the learning experience. A more conducive environment, with better infrastructure and fewer distractions, is essential for effective Biology education.

4. **Effectiveness of Teaching Methods in Biology Education**
Interactive and student-centred teaching methods, such as group discussions and laboratory experiments, were highly effective in enhancing student engagement and comprehension. However, the reliance on traditional lecture-based methods limits critical thinking and practical application. The integration of diverse and innovative teaching strategies is necessary to improve learning outcomes in Biology.

5. **Overall Challenges Affecting Biology Education**
The study identified systemic challenges, including inadequate teacher training, insufficient resources, suboptimal learning environments, and outdated teaching methods. Addressing these issues holistically through targeted interventions and policy reforms is critical for improving the quality of Biology education in secondary schools.

Recommendations

The following recommendations were made:

1. Teacher Competence: Organise regular in-service training and workshops to improve teaching skills. Encourage teachers to pursue advanced certifications in Biology education and establish mentorship programmes for guidance from experienced educators.

2. Teaching Resources: Provide essential resources such as laboratory equipment, textbooks, and visual aids. Implement policies to ensure equitable distribution of resources, particularly in underserved areas. Invest in

digital teaching aids and tools to enhance traditional learning methods.

3. Learning Environment: Improve classroom infrastructure by ensuring adequate space, ventilation, lighting, and soundproofing. Equip schools with functional and well-maintained laboratories. Strengthen administrative support to create a positive, distraction-free environment.

4. Teaching Methods: Promote interactive, student-centred approaches, such as inquiry-based learning and group discussions. Integrate technology, including multimedia tools and virtual labs, into teaching practices. Reduce reliance on lecture-based methods by adopting strategies that connect theory to real-life applications.

5. Systemic Challenges: Increase education funding to address gaps in teacher training, resources, and infrastructure. Implement transparent recruitment processes to ensure the employment of only qualified teachers. Develop monitoring and evaluation frameworks to assess and improve educational standards.

Acknowledgement

References

Adedeji Damilola Francisca, & S. Samsudin (2018). Are Biology Pre-service Teachers Ready to Implement 21st Century Skills in Teaching and Learning in Nigeria?. International Journal of Academic Research in Progressive Education and Development

Angelie Salaguinto (2024). Teacher's Competence in Teaching Biology in Select Schools in Isabela. Studies in Technology and Education

Awodun Adebisi Omotade, Adekunle Rachael Funke, and Femi-Adeoye Kudirat Oyewumi (2016). Students Attitude and Interest as Correlates of Students' Academic Performance in Biology in Senior Secondary School

Deassy Yunita, Balqis Fadiah, Lainatusshifa Lainatusshifa, and Putri Maulida (2023). Analysis of The Role Of Infrastructure In Effective Learning. Jurnal Pendidikan dan Sastra Inggris

Egamberdiyeva Nigora Akhmadkulovna (2024). Enhancing Biology Education: The Integral Role of Interactive Teaching Methods. International Journal of Advances in Scientific Research

Etim, P. (2021). Influence of Learning Resources on Students' Academic Performance in Biology in Ibesikpo Asutan Local Government Area, Akwa Ibom State. Social Science Research Network

Fauth Benjamin, Decristan Jasmin, Decker Anna-Theresia, Büttner Gerhard, Hardy Ilonca, Klieme Eckhard, and Kunter Mareike (2019). The effects of teacher competence on student outcomes in elementary science education. The mediating role of teaching quality.

Jemila Mohammed Suraj, Maryam Sule Yusuf, Gambo Bukar, M. Tijjani, A. Mallam, and Ibrahim (2021). The impact of instructional aids on academic achievement of biology students in higher institutions of learning in Potiskum Local Government Area, Yobe State

Justus Mutanen and Anna Uitto (2020). Make Biology relevant again! Pre-service teachers' views on the relevance of biology

education This paper was presented at the ERIDOB conference. Journal of Biological Education

Ottevanger, W., Folmer, E., Kuiper, W., (2016). Context-Based Science Education in Senior Secondary Schools in the Netherlands

Udeani, U., Atagana, H., and Esiobu, G. O., (2016). The Implementation of Action Research for the Improvement of Biology Teaching and Learning in Senior Secondary Schools in Nigeria

Yusuff Olatunji Abimbowo, Hammed Okiki Issa (2024).Teachers' Recruitment Procedure in Nigeria: Challenges and Prospects. Jurnal Pendidikan

IMPACT OF LARGE CLASS SIZE ON THE PERFORMANCE OF ENGLISH LANGUAGE STUDENTS OF COLLEGES OF EDUCATION   IN BORNO STATE, NIGERIA

Ibrahim, Musa Bwala

Department of English
College of Education, Waka-Biu
fasahasa@gmail.com.

This study investigates the impact of large class sizes on the academic performance of English Language students in the Colleges of Education Waka-Biu and Bama, Borno State, Nigeria. The objectives include examining the phenomenon of large class sizes, determining their impacts on students' performance, and exploring the problems and prospects of teaching English in such settings. Guided by three research questions, the study employed a descriptive survey design, sampling 430 respondents, including 400 students and 30 teachers, using random sampling techniques. Data were collected through structured questionnaires and analyzed using frequency, mean, and percentage, with a decision mean of 2.5 for interpreting findings. The findings reveal that large class sizes negatively affect student performance by limiting participation, feedback, and teacher-student interaction. Overcrowded classrooms were prevalent, reducing instructional quality. Teachers face challenges such as discipline management and implementing interactive teaching strategies, but innovative techniques and technological tools can mitigate these issues. The study concludes that addressing large class sizes, adopting pragmatic teaching methods, and providing teacher training are essential for enhancing English Language education. Recommendations include regulating class sizes, introducing group discussions and technology-assisted learning, and equipping teachers with skills and tools to manage large classrooms effectively.

Introduction

The quality of education is significantly influenced by various factors, including class size, which plays a pivotal role in shaping the learning experiences of students. In educational institutions, particularly at the tertiary level, the size of a class often determines the extent to which instructors can effectively deliver content and engage with students. This study examines the impact of large class sizes on the academic performance of English Language students in Colleges of Education in Borno State, Nigeria.

The English Language is a core subject that demands active interaction, personalised attention, and effective communication between instructors and students. However, large class sizes present unique challenges, such as limited opportunities for individualised feedback, reduced participation, and diminished teacher-student interaction. These challenges can have a profound impact on the learning outcomes of students, especially in a linguistically demanding discipline like English.

In Borno State, Colleges of Education face the dual challenges of growing enrolments and limited resources, resulting in large class sizes that may impede effective teaching and learning. While the phenomenon of large class

sizes is not unique to this region, the specific socio-economic and educational context of Borno State warrants a closer investigation into its effects on student performance.

This study seeks to explore the extent to which large class sizes influence the academic achievements of English Language students. By analysing the perceptions of students and lecturers, as well as examining academic records, the research aims to provide valuable insights into the implications of large class sizes and propose practical solutions to enhance the teaching and learning environment.

Large class sizes in higher education present significant challenges for teaching and learning. Teachers report negative impacts on instruction, including difficulties with classroom management, student engagement, and individualized attention (Ndethiu et al., 2017; Choudhary & Batwal, 2024). Common issues include limited student-teacher interaction, reduced monitoring of student learning and overreliance on lecturing (Ndethiu et al., 2017; Iipinge, 2018). However, large classes also offer opportunities for innovative solutions (Saravana Kumar, 2020). To address these challenges, educators and administrators suggest implementing professional development programs, reducing teacher workloads, and increasing resources (Ndethiu et al., 2017). Small-group learning strategies have been found to promote greater academic achievement and more favourable attitudes toward learning in large classes (Choudhary & Batwal, 2024). While the definition of a "large class" varies, it generally refers to conditions that collectively impede meaningful teaching and learning (Iipinge, 2018). Despite mixed evidence on effectiveness, large classes continue to play an important role in higher education (Saravana Kumar, 2020).

Statement of the Problem

The effectiveness of teaching and learning in Colleges of Education is crucial for producing skilled educators who will shape future generations. However, one of the pressing challenges in achieving this goal is the issue of large class sizes, which has become a recurring concern in Colleges of Education in Borno State, Nigeria. In the context of English Language Education, where student-teacher interaction, feedback, and active participation are essential for language acquisition and proficiency, large class sizes create significant barriers. Students in overcrowded classrooms often struggle to receive personalised attention, which hinders their ability to grasp complex language concepts and develop critical communication skills. Similarly, lecturers face difficulties in managing large classes, providing timely feedback, and addressing the diverse needs of students.

Despite the recognised importance of class size in educational outcomes, limited resources and increasing enrolment have exacerbated this issue in Borno State. These challenges are further compounded by the socio-economic and security conditions in the region, which place additional strain on the educational infrastructure. The problem of large class sizes not only affects students' academic performance but also undermines their motivation, engagement, and overall learning experience. If left unaddressed, this issue may compromise the quality of education and the preparedness of future educators in the region.

This study, therefore, seeks to investigate the impact of large class sizes on the performance of English Language students in Colleges of Education in Borno State. By identifying the specific challenges and their effects, the research aims to provide evidence-

based recommendations to improve teaching and learning outcomes in this context.

Objectives of the Study

The study aims to examine the impact of large class sizes on students in English language performance in College of Education Bama, and College of Education, Waka-Biu.

To achieve the aim, the following objectives are drawn.

i To examine the phenomenon of large class size in the selected institutions of learning College of Education Waka-Biu and College of Education Bama.

ii. To determine the major impacts of large class sizes on students in English language performances in the selected Colleges, College of Education Waka-Biu and College of Education Bama.

iii. To examine the problems and prospects of teaching the English language in large classes.

Research Questions

The study was guided by the following research questions:

i. To what extent does large class size affect the performance of students in the selected institutions of learning?

ii. What are the impacts of large class sizes on the performance of students in the English language in the selected colleges?

iii. What are the problems and prospects of teaching the English language in large classes?

Literature Review

The large class phenomenon has been a subject of debate in educational research. While often viewed as a challenge (Kofinas & Tsay, 2021), some researchers argue that large classes can be beneficial when used intentionally as a pedagogical tool, offering opportunities for socialized and experiential learning (Kofinas & Tsay, 2021). The phenomenon has been observed in various contexts, including Chinese higher education following enrolment expansion (Shan, 2020).

The impact of large class sizes on English language education in Nigerian tertiary institutions has been a subject of concern. While some studies suggest that larger classes may positively influence student success (Adenike Aderogba Onojah et al., 2023), the majority of research indicates negative effects on both students and academic staff (Kelly Osariemen Okpamen & Adamu Awwal Salman, 2024). Large classes can hinder effective teaching and learning, reducing the quality of education (Babalola Joseph Olurotimi & Awe Olasunbon Nike, 2021). However, creative strategies can be employed to mitigate these challenges and improve teaching effectiveness in large classes (H. Shehu & A. G. Tafida, 2016). The psychological implications of large class sizes on academic staff job performance and student academic performance are significant, with the majority of studies indicating adverse effects (Kelly Osariemen Okpamen & Adamu Awwal Salman, 2024). To address these issues, recommendations include adhering to recommended class sizes and implementing innovative teaching methods to enhance student engagement and learning outcomes in English language education.

These problems are exacerbated in difficult circumstances with inadequate resources (Shamim & Kuchah, 2016). However, researchers suggest various strategies to mitigate these challenges, such as developing contextually appropriate methodologies, improving teacher education programs, and encouraging teacher research (Shamim & Kuchah, 2016). Innovative approaches to administration, evaluation, syllabus design, and

materials development can help maintain quality language programs despite large class sizes (Marcus, 2017). While reducing class size is often proposed, there is growing consensus that improving teacher quality is more critical for enhancing English teaching and learning in large classes (Shamim & Kuchah, 2016).

Research on class size and student performance in English language learning has yielded mixed results. While some studies found negative effects of large classes on student attitudes and academic performance (Babalola & Awe, 2021) others reported positive outcomes with larger class sizes (Onojah et al., 2023). The study identified threshold levels of 25 and 45 students per class, beyond which learning noticeably declined. It observed a small but significant negative correlation between class size and grades across various subject areas. However, the researchers also reported an overall improvement in student performance despite the increase in class sizes over time. (Babalola and Awe, 2021) Reported that teacher productivity was enhanced in smaller classes. Conversely, (Onojah et al.; 2023) concluded that larger class sizes correlated with better academic success in English language learning. These conflicting findings suggest that the relationship between class size and student performance is complex and may be influenced by various factors.

Managing large class sizes presents significant challenges for teachers, but several effective strategies have been identified. These include planning lessons carefully, organizing students into groups, controlling classroom communication, and providing timely feedback (Marzulina et al., 2021; Safura et al., 2023). Other approaches involve using peer tutoring, visual imagery, and translation techniques (Pertiwi & Indriastuti, 2020). Technology-based strategies and perception-driven digitized approaches are also emerging as potential solutions (Molavi, 2024). Common difficulties faced by teachers include giving individual attention, addressing heterogeneous student abilities, and managing diverse background knowledge (Pertiwi & Indriastuti, 2020). However, when implemented effectively, these strategies can lead to better student understanding, mutual respect, and increased enjoyment of lessons (Marzulina et al., 2021). Research gaps exist in understanding stakeholder perceptions of large class sizes and their impact on educational practices, highlighting the need for further investigation in this area (Molavi, 2024).

Methodology

This study adopts a descriptive survey design, which allows the researcher to investigate the phenomenon within a specific context to uncover a problem and propose solutions. This approach enables the researcher to describe the problem in its setting rather than conducting a generalized investigation. A descriptive survey is suitable for the research as it employs Likert-scale questions to gather data.

The study population comprises the teaching staff and students of the College of Education, Waka-Biu, and the College of Education, Bama, during the 2023 and 2024 academic sessions. The College of Education, Waka-Biu, had 121 teaching staff and 4,105 students in 2023, increasing to 4,120 students in 2024. The College of Education, Bama, had 105 teaching staff with a student population of 2,024 in 2023 and 2,215 in 2024.

A simple random sampling technique was used to select 400 students and 30 teachers as respondents for data analysis. This method was deemed appropriate as it ensures that every individual in the population has an equal

chance of being selected. Specifically, 200 students and 15 teachers were chosen from each institution, making a total of 430 respondents. The random sampling was conducted using ballot papers marked "Yes" and "No," with those marked "Yes" included in the analysis.

For data collection, a structured questionnaire and a test were administered to gather information on the impact of large class sizes on the English language performance of students in the selected colleges. The researcher personally supervised the administration of the questionnaire to ensure accurate data collection. These methods were considered effective as they allowed data to be gathered from natural settings.

The data collected were analyzed using computations of frequency, mean, and percentage to determine the distribution of responses for each item on the structured questionnaire. The findings were presented using tables for better illustration and understanding.

Results

Presentation of Results

Table 1: Students' Enrolment for Two years College of Education Bama and College of Education Waka-Biu, Borno State.

Name of College	Year	Students Population
COEB	2023	2,024
COEB	2024	2,215
COEWB	2023	4,105
COEWB	2024	4,120
Total		**12, 464**

Source: Exams and record office COEB 2024. Academic Secretary Office COEWB 2024

Abbreviations	Definitions
COEB	College of Education Bama
COE WB	College of Education Waka-Biu
NCE	Nigeria Certificate in Education

As Table 1 indicates students' population created problems for both teachers and students in General English because the attention given to students is very narrow and the availability of materials could not cope with the number of students. This showed the enrolment of students for years in each of the colleges. As can be seen from the table there is a rapid increase in the student population except for 2024 which showed a slight increase in population. The slight increase might be attributed to the insecurity problems in the state which probably stopped some candidates from neighboring states like Adamawa, Gombe, Taraba and Yobe, from seeking admission from the college.

Table 2: Age Distribution of Respondents

COEWB			COEB	
Parameter	Frequency	%	Frequency	%
18-21	120	56	123	57
22-25	61	28	58	27
26-29	11	5	12	6
30-33	08	4	09	4
34 and above	15	7	13	6
Total	215	100	215	100

Source: field Data 2024

The result of Table 2 showed that 120 students which represent 56% are with the average age of 18-21 years. This could be because those students who graduate from secondary and automatically enrol on colleges while between the age of 22-25 likely have one problem or the other, possibly, maybe re-writing of their papers. Those between the ages of 26-20 may likely be those who have taught for a long with grade 11 and may likely further their academic studies. The age of 30-33 may likely be those who also taught for long and decided to further their studies. Those within the age of 34 and above are likely teachers in the institutions. The age distribution may also affect students' performance in English language lessons particularly those above the age of 25-33 and if the class is large it may deprive them of paying attention to teachers.

Table 3: Sex Distribution of Respondents

COEWB			COEB	
Parameter	Frequency	%	Frequency	%
Male	95	44	87	40
Female	120	56	128	60
Total	**215**	**100**	**215**	**100**

Source: field Data 2024

Table 3 above shows the result of sex distribution that the majority of the respondents are female, 120 (56) in the college of Education, Waka-Biu while 128 female (60) at of College of Education Bama.

Table 4: Large Class Size has Negative Impact on English language performance of students

COEWB			COEB	
Parameter	Frequency	%	Frequency	%
Strongly Agreed	126	56.2	110	51
Agreed	74	34.4	70	33

Disagreed	10	4.6	15	7
Strongly Disagreed	5	2.3	6	3
Undecided	5	2.3	11	5
Total	**215**	**100**	**215**	**100**

Source: field Data 2024

The result of Table 4 showed that large class size hurt the English language performance of Students as indicated by 56.2 and 51% in the study areas as against those who opposed by strongly disagreed represented by 2.3 and 3% respectively This fact was supported by Hancock (1996) and Siegfried (1997) who state that there is a significant relationship between class size and students performance. The larger the class, the lower the performance and the smaller the class size, the higher the performance. This is because of a small class size, the teacher gives more attention to Students and can attend to them.

Table 5: Monitoring of students' attendance can be reduced in large classes of general English lesson

COEWB			COEB	
Parameter	Frequency	%	Frequency	%
Strongly Agreed	111	52	96	45
Agreed	89	4.1	84	39
Disagreed	3	1.3	12	6
Strongly Disagreed	7	3.2	15	7
Undecided	5	2.3	5	3
Total	215	100	215	100

Source: field Data 2024

Table 5 revealed students' attendance and quality of feedback in large classes. The result showed that there is a significant difference in the two selected colleges with 111 (52%) and 96 (45%) strongly agreeing. While 89 (41%) and 84(39%) agreed in the areas under study in response to the statement. That teacher's physical approach and personality in class is one aspect of classroom management as pointed out by Harmer (2006). The approach and personality of the teacher could contribute to students' attention and feedback.

Table 6: Lack of interest on the part of learner and learning environment affects students' performance in general English lesson

COEWB		**COEB**	

Parameter	Frequency	%	Frequency	%
Strongly Agreed	102	47	101	47

Agreed		92
43	96	
45		
Disagreed		8
4	9	
4		
Strongly Disagreed		3
1	5	
2		
Undecided		10
5	4	
2		
Total		**215**
100	**215**	
100		

Source: field Data 2024

Table 6: showed that the majority of the respondents strongly agreed with the statement that lack of interest on the part of learners and the learning environment affect students' performance in General English lessons due to the size of the class. It affects the performance of English language students with 47% and 47% from both the study areas with the negligible percentage that strongly disagreed of 1% and 2% respectively. This showed that interest and learning environment duly affect students' performance in large class sizes, particularly General English classes.

Key

<	=	Greater than 2.5 Accepted
>	=	Less than 2.5 Rejected
(X)	=	Mean
Frequency	=	number of respondents

Conclusion

The following conclusions were made based on Objectives:

1. **Examining the Phenomenon of Large Class Size:** The study identified that large class sizes are prevalent in both the College of Education Waka-Biu and the College of Education Bama. Overcrowded classrooms often limit individual attention to students and reduce overall instructional quality.

2. **Determining the Impacts of Large Class Size on English Language Performance:** Large class sizes negatively affect students' performance in English language courses by reducing opportunities for active participation, individualized feedback, and effective engagement with course materials. Students in larger classes tend to have lower comprehension and writing proficiency compared to those in smaller classes.

3. **Examining Problems and Prospects of Teaching English in Large Classes:** Teachers face significant challenges in managing large classes, including difficulty in maintaining discipline, assessing students comprehensively, and employing interactive teaching methods. However, with proper training, innovative teaching strategies, and technological interventions (e.g., digital tools for assignments and assessments), it is possible to mitigate the adverse effects and enhance English language teaching in large classes.

Recommendations

Based on the results of the study, the following recommendations are made;

1. **Addressing Large Class Sizes:** Introduce policies to regulate student enrolment in English language courses, ensuring manageable class sizes. Where this is not immediately feasible, implement class-splitting or staggered lesson schedules to reduce overcrowding.

2. **Improving Students' English Language Performance:** Adopt pragmatic teaching methods such as group discussions, peer evaluations, and the use of technology-assisted learning tools (e.g., language apps)

to foster student engagement and improve individual performance in large classes.

3. **Enhancing Teaching in Large Classes:** Provide teachers with specialized training on classroom management strategies and innovative methods tailored for large classes. Additionally, equip classrooms with technological aids, such as projectors and microphones, to improve the delivery and accessibility of lessons in large settings.

Acknowledgement

References

Adenike Aderogba Onojah, A. Onojah, Doctor Jayeosimi (2023). Encouragement of Class Magnitude on Student Triumph in Erudition of English Language. International Journal of Language and Literature

Alexander K. Kofinas, Crystal Han-Huei Tsay (2021). In Favor of Large Classes: A Social Networks Perspective on Experiential Learning.

Babalola Joseph Olurotimi, Awe Olasunbon Nike (2021). Effects of Class Size on Students' Attitude And Academic Performance in English Language Among Secondary School Students in Ado Local Government, Ekiti State. LLT Journal: A Journal on Language and Language Teaching

Iipinge., S. M., (2018). Challenges of large class teaching at the university. The Namibia CPD Journal for Educators

Kelly Osariemen Okpamen, Adamu Awwal Salman (2024). Psychological Implication of Large Class Size on Academic Staff and Students Performance in Nigeria Tertiary Institutions. International Journal of Finance and Business Management

Lenny Marzulina , Dian Erlina , Muhammad Holandyah , Kasinyo Harto , Deta Desvitasari , And Dessi Angreini (2021). English Teachers' Strategies in Managing Large Classes: A Case Study. Indonesian Research Journal in Education |IRJE|

Marcus, S., (2017). Large Class Size: Strategies for Success

Ndethiu, S., Joanna O. Masingila, M. Miheso-O'Connor, D. Khatete, Katie Heath (2017). Kenyan Secondary Teachers' and Principals' Perspectives and Strategies on Teaching and Learning with Large Classes

Safura, S., Cut Mawar Helmanda, Afra Ninda (2023). English Teachers' Strategies in Managing Large Classes. Foremost Journal

Saravana Kumar (2020). Rack 'em, pack 'em and stack 'em: challenges and opportunities in teaching large classes in higher education. F1000Research

Satender Choudhary, Priyanka Batwal (2024). Identify the Most Common Challenges and Coping Strategies that Teachers Encounter in Managing Large Class Teaching. Journal of Research in Vocational Education.

Shamim, F. Kuchah Kuchah (2016). Teaching large classes in difficult circumstances

Shehu, H., Tafida, A. G., (2016). Creative Strategies for Effective English Language Teaching in Large Classes

Wahyu Indah Pertiwi, Niken Reti Indriastuti (2020). Teacher Difficulties and Strategies in Managing A Large Class in Teaching and Learning English.

PERCEPTIONS OF FEMALE SCHOOL-AGE STREET HAWKERS AND THEIR PARENTS ON ACQUISITION OF EDUCATION IN BIU AND KWAYA KUSAR LOCAL GOVERNMENT AREAS OF BORNO STATE, NIGERIA

Saleh Nathan Mshelia

College of Education,
Waka-Biu, Borno State
08034185052
salehnathanmshelia@gmail.com

This article reports a study in Biu and Kwaya Kusar L.G.A, Borno State, it analyzed the perceptions of female-aged street hawkers and their parents regarding formal education and hawking. The study found that Galdimare had the highest number of respondents, disagreeing that hawking alone would lead to success. In Kwaya-Kusar, the opposite was true, with many hawkers viewing formal education as a time waste. The study also revealed significant barriers to education and employment, perpetuating poverty. The study recommends the government address these issues by fostering economic and social empowerment for female school-aged hawkers in Biu and Kwaya Kusar L.G.A.

Introduction

Street hawking is a growing but disturbing activity, especially among school-age children who are either school dropouts or have never been to school. This unhealthy development among girls has been a common thing in most parts of developing countries (Mike 2017). It's a phenomenon of, especially school-age children hawking goods on the streets that became noticeable in the 1980s and is now a common feature of the urban and rural landscape of Nigeria.

Children of school age between 6 to 17 years are compelled by parents, who often advance poverty as a reason to hawk goods on the streets. These children are sometimes withdrawn from school to fully engage in the hawking from dawn to dusk daily. According to Okeke (2015), child street hawking is a common practice in Nigerian streets. Children sell products such as boiled groundnut, sachet water, fruits etc. they carry on a tray balanced on their heads. Okeke (2015)

noted that the practice is on the rise. Ebigbo and Abaga, (2003) pointed out that in Nigeria, the rate of child hawking has assumed a worrisome and alarming proportion. It is a daily occurrence to see children below 14 years old hawking wares and other products along the roadsides in most Nigerian towns and even rural communities.

There is a wide range of Child Rights efforts at both the global and national levels. For example one of the basic principles of the International Convention on the Rights of the Child is that every child must be protected against all forms of exploitation, indecent or degrading treatment, including child labour, abduction and sale (UNICEF 2000). There is also the Child Rights Bill that was signed by President Olusegun Obasanjo in July 2013 which seeks to check child hawking by prescribing penalties for the parents and guardians who allow children onto the streets. In 2017 Nasiru El Rufa'I, Governor of the Kaduna State threatened through a tweet that "Any child of school age hawking in

Kaduna will be asked to show us the parents – who will then be arrested". There are also constitutional provisions. Section 30(2C) of Part III of the Child Rights Act (2003) states that: "A child shall not be used for hawking goods or services on main streets, brothels or highways". Subsection 3 of it further states that "A person who contravenes the provisions of subsection 2 of this Act commits an offence and is liable on conviction to imprisonment for a term of 10 years without an option of fine. In 2008, the Lagos State government banned Child Street Hawking during school hours to reduce the practice. What is baffling is that these practices are on the increase. Ogunubi (2016) noted that despite legislative measures put in place, child street hawking and other child labour practices remain a major source of concern in Nigeria.

The street hawking among school-aged children cuts across the region of Nigeria but according to Mathias (2015. 3) "Northern State of Nigeria has remained unable to address the challenge of street begging and hawking. The region is worse hit first and foremost because of poverty, added to ignorance, cultural and religious trappings that see child labour as a norm, whereas it has for long been defined as abusive and exploitative".

It is noticeable that the most involved in this practice is the girl child. For example, in the Northern part of Nigeria, they are the most likely to be withdrawn from school or not enrolled completely. This made the girl child the most involved in street hawking. Okeke (2015) noted that this has made the young girls involved vulnerable to molestation and other risks.

Biu Local Government Area of Borno State is not immune from hawking by school-age children. It is common to find them across Biu town and its surrounding settlements hawking one thing or the other. Some are completely out of school (dropouts), some have temporarily left school and some are combining school with hawking. There is a prevalence of female street hawkers, selling fruits, groundnuts, food items etc.

The categories of school-age street hawkers (dropouts, temporarily in school and a combination of school and street hawking) hold opinions about hawking and about school or acquiring education. It is common sense that the opinion one holds drives one's activities or disposition to an activity. "When children participate in the decision-making process on issues affecting their lives, they will be more creative, positive and energetic, offering ideas devoid of prejudices and stereotypes, she said". (Vanguard, 2017 paragraph 25). The perception of a child helps the child develop a positive or negative attitude towards a thing. One would then ask, what is the perception of school-age female street hawkers in Biu, about acquiring education.

Therefore this study will examine the perception of acquiring education among female school-age street hawkers in Biu & Kwaya Kusar, Borno State.

There are several works on street hawking; the dramatic increase in child labour and street hawking in Nigeria may be attributed to several factors. These factors include the rapid population growth of many less-developed countries. High rates of unemployment, inflation low wages and deplorable working conditions have propelled children to engage in street hawking to help support their families (Charles and Charles, 2004, Deth, 2007). This study would fill this gap by examining the perception of acquiring education among female school-age street hawkers in Biu & Kwaya Kusar, Borno State, Nigeria.

Methodology

The research adopted a survey as a method.

The population of the research is some street hawkers in Biu & Kwaya Kusar Local Government Areas.

The study used a sample size of 300 females, and their parents' street hawkers in Biu & Kwaya Kusar LGA.

The research used questionnaires that the research assistants and the researcher provided guides for the respondent to fill or assist the respondent entering their responses where they were incapable of filling one.

The study adopted the quantitative and qualitative interpretation and use of percentages, and tables for presentation and explanation.

The hawkers' perception of whether they would succeed in life without formal education is given in Table. In all the three wards (villages) sampled, on the frequencies, percentages and cumulative, it shows that Galdimare had the highest number of respondents, followed by Zarawuyaku then Dugja. They strongly disagreed that only hawking would not allow them to succeed in life without formal Education. While an insignificant number of the respondents were undecided.

The parents' perceptions on Hawking vs formal education are given in Table 2 in all the three wards sampled, on the frequencies, percentages and cumulative it shows that Galdimare had the highest respondents followed by Dugja wards who strongly believed that schooling is better. Very few respondents say Hawking is better.

The hawkers' perception of whether they would succeed in life without formal education is given in Table 3. In all the three wards sampled on the frequencies, percentages and cumulative, it shows that Peta had the highest number of respondents, followed by Bila then Gusi. They strongly agreed that Hawking would like then succeed in life without formal education; while few of the respondents were undecided that is, the level of acceptance of education is low.

The parents' perception of hawking vs formal education Table 4 in all three wards sampled, on the frequencies, percentages and cumulative, shows that Peta had the highest number of respondents, followed by Gusi then Bila. They said Hawking is better than formal education while few individuals were undecided.

Findings and Discussion

At Biu, it was observed that hawkers strongly disagreed that only hawking would not allow them to succeed in life without formal education. This agreed with the finding of Paul E, 2020, who stated that once, you are not given formal education in a society you are oppressed. It is believed that in all wards, they prefer to be trained through formal education to have something in the future i.e. economic empowerment through employment.

Table 1. Hawkers perception on whether they would succeed in life without Formal Education (Case study of Biu L.G.A)

Respondents	Zarawuyaku	Per.	Cum.	Dugja	%	Cum.	Galdimare	%	Cum.
Strongly Agreed	60	20	20	80	26.7	26.7	60	20	20
Agreed	20	6.7	26.7	20	6.7	33.4	10	3.3	23.3
Disagreed	08	2.7	29.4	07	2.3	35.7	05	1.7	25.0
Strongly Disagreed	210	70	99.4	190	63.3	99	220	73.3	98.3
Undecided	02	0.6	100	03	01	100	05	1.7	100
Total	**300**	**100**	**100**	**300**	**100**	**100**	**300**	**100**	**100**

Table 2. The parents' perceptions on Hawking vs Formal Education in Biu LGA.

Respondents	Zarawuyaku	Per.	Cum.	Dugja	%	Cum.	Galdimare	%	Cum.
Hawking is better	107	35.7	35.7	102	34.0	34.0	92	30.7	30.7
Schooling is better	187	62.3	98.0	192	64.0	98.0	201	67.0	97.7
Undecided	06	02	100	06	02	100	07	2.3	100
Total	**300**	**100**	**100**	**300**	**100**	**100**	**300**	**100**	**100**

At Kwaya Kusar, it was revealed that both parents and the hawkers strongly agreed that hawking is the only way to succeed in their lives, they believed that formal education is a time wastage. This was contrary to the finding of Paul, 2020, who stated that a person without formal education in society would be oppressed, but was in accordance with the finding of Christina (2013) who stated that engaging in hawking allows female hawkers to perceive hawking as a way to gain independence and personal agency, taking initiatives in their financial support and decision makings.

Table 3. Hawkers perception on whether they would succeed in life without Formal Education (Case study of Kwaya Kusar L.G.A)

Respondents	Bila	Per.	Cum.	Gusi	%	Cum.	Peta	%	Cum.
Strongly Agreed	180	60	60	170	56.7	56.7	193	64.4	64.4
Agreed	20	6.7	66.7	22	7.3	64.0	30	10.0	74.4
Disagreed	50	16.7	83.4	38	12.7	76.7	10	3.3	77.7
Strongly disagreed	42	14.0	97.4	52	17.3	94.0	57	19.0	96.7
Undecided	08	2.6	100	18	6	100	10	3.3	100
Total	**300**	**100**	**100**	**300**	**100**	**100**	**300**	**100**	**100**

Table 4. The parents' perceptions on Hawking vs formal Education in Kwaya Kusar L.G.A.

Respondents	Bila	Per.	Cum.	Gusi	%	Cum.	Peta	%	Cum.
Hawking is better	186	62.0	62.0	190	63.3	63.3	192	64.0	64.0
Schooling is better	106	35.3	97.3	101	33.7	97.0	97	32.3	96.3
Undecided	08	2.7	100	09	3.0	100	11	3.7	100
Total	**300**	**100**	**100**	**300**	**100**	**100**	**300**	**100**	**100**

Conclusion

This study aimed to investigate the socioeconomic profiles, challenges, education and opportunities of street hawkers and their parents. The findings revealed that:

The majority of hawkers are from low-income families: Many hawkers struggle to

make ends meet, highlighting the need for support and resources.

Limited access to education and job opportunities: Hawkers and their parents face significant barriers to education and employment.

Resilience and adaptability: Despite facing numerous challenges, hawkers demonstrate remarkable resilience and adaptability in their daily lives.

Recommendations

1. Government support and resources: Provide access to education, job training and microfinance programs to help hawkers improve their socio-economic status.
2. Community engagement and empowerment: Foster community involvement and empowerment to promote hawkers' rights and interests.
3. The government should strictly adhere to children's right to education.

Acknowledgement

References

Adewole, A. (1989) – Ethics and the Education Community Jos Fab Anieh (Nigeria) Limited

Charles, O. C. & Charles, A. O. (2004). Family of child labour: A study of child hawkers in Calabar. *Journal of Social Development in Africa, 4 (I), 12 - 21*

Christiana M.AG Heblis et al 2013 Child labour, street vending and Education.

Ebigbo & Abaja, S. (2003) Sexual experiences of street trading girls in the city of Enugu. *A Paper presented at the 8th International Congress on Child Abuse and Neglect by IPSCAN, Hamburg, Germany.*

Education is the bedrock of development in any society., *Education is the driving force of any economic, political and social development of any country* (Cholin 2005 & Mehta and Kalra, 2006)

Education is the strategic heart of determining and shaping the vision of positive social change in any nation.

Education is the Systematic training and Instruction designed to transmit knowledge and develop skills in individuals.

Fafunwa, A. B. (2000) History of Education in Nigeria London: Macmillan

Mathias, T. (Sep 29 2015) Street hawking by school-age children as abuse. *Daily Trust,* Retrieved from https://www.dailytrust.com.ng/news/opinion/street- hawking-by-school- age-children-as-abuse/112967.

Mike, U. (2017) Child Street Hawking: Causes, Effects and Solutions. Retrieved 1 *July 17, 2018.* https://hubpages.com/family/Child-Street-Hawking-Causes-Effects-and- Solutions

Ogunnubi B.B (2016). Street hawking and child education – Lagos State Government https://lagosstate.gov.ng/blog/2016/07/22/street-hawking-and-child-education

Okeke, N. (October 27, 2015) Poverty is driving a rise in the number of Nigerian Child hawkers: *The Conversation*

S.F.K U dell (2013)

Subramanian, S. (2005) Gender and Education. *A review of issues for social policy*. UN Research Institute for Social Development (SPD-P), 70.

UNICEF (2001), Children's woman's Rights in Nigeria A wake-up call. Abuja, National Planning Commission

UNICEF, 2000. Nigeria and the convention on the rights of the child. Lagos: UNICEF Country office.

Vanguard (July 31, 2017) Stakeholders condemn child-hawking after school hours. *Retrieved July 13, 2018.*

https://www.vanguardngr.com/2017/07/takeholders-conderm-child-hawking-school-hours/

Women, Human Rights and Education (2008), www.phhre.org/right/women-and-education-international.

ZARIA JOURNAL OF EDUCATIONAL STUDIES 24(S)2024

EFFECTS OF FREQUENT DOMESTIC CONFLICT, VIOLENCE ON SOCIAL BEHAVIOURS, AND COGNITIVE DEVELOPMENT OF SCHOOL CHILDREN IN NORTH EASTERN, NIGERIA

Saratu Jonathan Dibal

Home Economics Department,
School of Vocational Education,
College of Education Waka-Biu
saratujdibal@gmail.com

The study assesses the effects of frequent domestic conflict, violence on social behaviours and cognitive development of school children in North Eastern Nigeria. It is generally observed by the researcher that young children between the ages of one to ten years fall victim of circumstances that happen among family members. Three objectives and three research questions were formulated which guided the study. A survey research design was used for the study, The population for the study was 8676 both children of nursery and primary schools in all the colleges of Education in the North East Geo-political zone of Nigeria. A sample of 367 nursery and primary school children were selected through a purposive sampling technique from 3 Colleges of Education in the area of study. Instruments for data collection were Family Violence Questionnaire (FVQ) for interview, observation and continuous assessment records were used to assess their social behaviour and cognitive development. Simple Percentages, Means and standard deviations were used to answer all the research questions. The finding revealed that among others there was 63% prevalence of frequent domestic conflict and violence in the study area and there was the effect of these tendencies on the social and cognitive development of school-age children in the North Eastern state of Nigeria. It was concluded that frequent domestic conflicts and violence in homes in the North Eastern State of Nigeria have influenced a lot of children and stirred up violence in them right from their childhood. It was recommended that Parents and grown-up members of the family should be enlightened on the effect of frequent domestic conflicts and violence to minimize the rate of negative effects on the children's social behaviour and cognitive development.

Introduction

The family is made up of a group of persons; young and old and it is the basic unit of social life, it forms the link between the individual and the society. Amagon and Wakjissa (2011) opined that the family is the basic unit of social institutions; it is a system of accepted norms and a procedure for getting jobs done. They further explained that family is a type of kinship grouping which provides for the rearing of children and meeting certain human needs. The family could be nuclear, polygamous or extended, which may include uncles, cousins, grandparents, wives of sons and their children as members of one family having to do their domestic activities together. Anyakoha and Eluwa (2012) stated that members of the extended family may live in towns or cities, but when they return to the villages they come together as one family. They further stated that conflicts could be a common feature in some extended families or even within the nuclear family. The North–East -geopolitical zone is not an exception to this type of family setting.

Domestic conflict is the misunderstanding that may occur in homes among family members as they interact with one another during their day-to-day activities (Anyakoha and Eluwa 2012). These may occur because of natural individual differences among people, it may be a conflict of ideas, actions and values. Gyuse (2015) stated that frequent conflict does not necessarily mean that something is wrong; rather the way conflict is dealt with is the real problem. Espino (2010) defined domestic violence as the intentional use of physical abuse by one's spouse or partner that causes pain or injury. Gilchrest and Graham (2014) defined domestic violence as any intentional abuse of family members. The family members could be children, spouses or any member of the family subsystems.

Laura (2011) stated that in many homes where domestic violence occurs, the parents are under the misconception that their children are unaware of the violence even if it has taken place close to the children. They may not witness the actual violence but they do hear the fighting, hear the screams and see the injuries. They are also traumatized by the parent's emotional pain and suffering after the violence has taken place and this directly or indirectly has devastating effects on their cognitive growth. Witnessing domestic violence can lead children to develop an array of age-dependent and negative effects (Cumming, 2012). Children who witness violence in the home and children who are abused may display many similar psychological effects (Jaffe, Wolfe, Wilson and Zak, 2011) these children are at greater risk for internalized behaviours such as anxiety and depression, and for externalized behaviours such as fighting, bullying, lying or cheating. They are also more disobedient at home and school and are more likely to have social competence problems such as poor school performance and difficulty in relationships with others. Melissa (2012), stated that nursery as well

as primary school children who witness intimate violence may develop a range of problems, including psychosomatic complaints such as headaches, abdominal pain e.t.c. Five to nine-year-old children who witness frequent domestic conflict and violence display inappropriate attitudes about the use of violence as a means of resolving conflict and indicate a greater willingness to use violence themselves.

The United Nations Children's Fund UNICEF (2006) and United Nations Secretary General's study on violence against children reported that infants and small children who are exposed to violence in the home experience so much added emotional stress that can harm the development of their brains and impair cognitive and sensory growth behaviour. Changes can include excessive irregularities, sleep, problems with toilet training and language development. As they grow, children who are exposed to violence may continue to show signs of problems. Primary school-age children may have more trouble with school work and show poor concentration and focus, they tend not to do well in school. Edileson, Ellerton, Seargen, Kirchberg and Ambrose (2010) were of the view that children exposed to domestic conflicts and violence often have conflicting feelings towards their parents, for instance, distrust and affection often coexist for the abuser. The child becomes overprotective of the victim and feels sorry for them; they often show signs of anxiety, depression, aggression and hostility. Some other symptoms of domestic conflicts and violence in school-age children include isolation from friends and relatives to stay close to siblings and victimized parents. A study carried out by UNICEF (2006) further showed that forty percent of children from

violent homes had lower reading abilities than children from non-violent homes.

According to Carpenter and Stacks (2011) Personality and behaviour problems among children exposed to violence in the home can take the forms of psychosomatic illness, depression, bed-wetting and suicidal tendencies later in life. They further opined that children between the ages of one to six years old who encounter frequent domestic conflicts and violence showed clinical levels of internalizing and externalizing behaviour problems such as depression, anxiety, high levels of general distress and some symptoms such as hyperactivity, new fears and aggressions, sleep disturbances, poor concentration and significant anxiety and excessive crying when separated from their caregiver. These children are at greater risk of substance abuse, juvenile pregnancies and criminal behaviours than those raised in homes without frequent violence. Some studies suggest that social development is also damaged. Some children lose the ability to feel empathy for others. Others feel socially isolated, unable to make friends easily due to social discomfort or confusion over what is acceptable, while some children from violent homes exhibit signs of more aggressive behaviour such as bullying and are more likely to be involved in fighting.

Cummings (2013) is of the view that domestic violence includes behaviours such as throwing objects, pushing, grabbing, shoving, slapping, kicking, biting, hitting, beating, choking, and threatening with words or objects such as a knife or gun. Such violent abusive behaviour patterns are done by one partner against another in an intimate relationship which could be the spouse or parent and child relationship. He further explained that domestic conflicts can be identified through some acts of anxiety, depression isolation from people, and withdrawal of incentives others will want to stay closer for fear of staying alone, while others may keep quiet by trying to ask questions and give open-ended answers, giving rise to communication gap.

Anderson and Bushman in Reisberg (2011) observed that the ability to imitate starts very early in life and as children grow and mature the capacity for imitation grows as well and that the rate at which violence is portrayed at home and in the media affects children who watch them. Richard, (2011) opined that when parents and other grown-up members of the family are in conflict situations nursery and school-age children are seriously affected. While many people think that they are keeping the conflicts away from the children, the children notice tension in the home and it has a profound effect on their social behaviour and cognitive development. Richard further stated that some children respond to conflicts and violence by acting out, feeling sad and wanting to intervene, some become physically and verbally aggressive with their peers while some other children are portrayed by behavioural problems such as frequent illness, and isolation from parents and friends.

Kitsmann, (2012) opined that children of nursery and school age are at the stage where cognitive development is dominated, by intellectual curiosity and performance, because of this Eriskson (2012) in Snowman, Mccown, Biehier, (2010) observed that children learn to win recognition by producing things which can help them to develop a sense of industry. Therefore, if children at this stage are encouraged to make and do things well, helped to persevere, allowed to finish tasks and praised for trying; it results in industry. If their efforts are unsuccessful or if they are denied or treated as bothersome

because parents or older siblings are cut off from them due to frequent domestic conflicts and violence, an inferiority complex sets in and such children may have few friends to interact with and may never learn to enjoy intellectual work or take pride in doing at least one kind of thing very well, at worst, they may believe they will never excel at anything socially and cognitively; while some children may have trouble thinking, impaired thinking, abstract reasoning, poor problem-solving skills and their memories affected.

These explanations give a clear indication of the fact that a peaceful environment is required for the best cognitive development of children. Cognitive development theory therefore emphasizes the role of understanding language, interpersonal thoughts and actions. According to Gardner (2013) Children know that certain things are "Bad" and other things are "Good" but they are massively influenced by their experiences, including what they see and what they do. Language as a key in cognitive development according to Nygotsky, (2010) is learnt through social and cultural experiences, interaction with peers and adults could be of great help. He further emphasized that children learn the language or speech through the act of 'self–talk' which could be referred to as 'thinking out loud'. As children interact with adults socially, they develop their thinking abilities which is part of cognition as they communicate with them but when adults and peers are into frequent conflicts and violence the children do not have the right opportunity to interact and even when they have, they will only learn the unaccepted language thereby giving place to low and slow cognitive development.

Cognitive development according to Graham (2013) is the processes that people use to gain knowledge, language, thought,

reasoning and imagination which require a safe environment and take place in the brain. He further explained that cognitive development depends on the interaction between nature and nurture, often called heredity and environment, which means the two put together to bring about the effective development of the child. He further explained that infants and children who are exposed to violence in the home experience so much added emotional stress that can harm the development of their brains. Miller (2010) Opines that the right prefrontal part of a child's brain can pick up the emotional atmosphere in a millisecond, affecting them deeply, emotionally and cognitively. Therefore, exposure to frequent conflicts and domestic violence threatens their development. As they grow children who are exposed to such conditions may continue to show signs of problems and often do poorly in school.

Nicole (2017) stated that children whose parents conflict feel as though they have done something wrong to create the conflicts and as a result, they have a difficult time concentrating in school. He further explained that some of the children respond to parental conflict by acting out, that is demonstrating behaviour problems, inability to manage anger and delinquency. Some of the children may respond by 'turning inward', that is showing signs of depression and isolation from friends and activities, so they end up not being able to interact well with others, having very poor levels of skill development and low self-esteem, while some children may have trouble thinking, thinking of all the things that take place between their family members. Advances in neuropsychology have shown that when exposed to conflicts or violence our brains release stress hormones that over time can change brain functioning leading to problems in school, truancy, impaired thinking, such as abstract reasoning, poor problem-solving skills,

and the general memory affected (National Institute of Child Health and Human Development, 2013).

Statement of the Problem

Children in nursery and primary schools in the North-Eastern states develop a wide range of problems in school which include psychosomatic complaints, such as headaches or abdominal pain, as well as poor school performance as a result of frequent domestic conflicts and violence they experience at home. It was also observed by the researcher that young children between the ages of one to ten years are generally falling victim to circumstances that happen among family members. Most of their learning behaviour is through the daily practice of what they see happening around them. Children exposed to frequent domestic conflicts and violence do not have the foundations of safety and security that are normally provided by the family. As a result of that, the children experience desensitisation to aggressive behaviour, poor anger management and problem-solving skills and learn to engage in exploitative relationships. Prevalence reports show that anger-related problems such as oppositional behaviour, verbal and physical aggression, and violence are some of the more common (Hamrin, 2017). The school-age children do not understand the meaning of the abuse that comes as a result of the conflicts and violence and may believe they did something wrong. This self-blame may cause the child feelings of guilt and worry since they cannot express their feelings verbally and these emotions can cause social behavioural problems.

Objectives of the Study

The major objective of the study is to determine the effects of frequent domestic conflicts and violence on the social behaviour and cognitive development of school-age children in North-Eastern states of Nigeria. The specific objectives are to:

1. Ascertain the prevalence of frequent domestic conflicts and violence in the Northeastern states of Nigeria.
2. Identify the social behaviour of children from families with frequent domestic conflicts and violence.
3. Determine the levels of cognitive development of school-age children brought up in frequent domestic conflicts and violent homes.

Research Question

Arising from the research objectives, the following research questions guided the study:

1. What are the prevalence of frequent domestic conflicts and violence in the Northeastern states of Nigeria?
2. What are the social behaviours of children from families with frequent domestic conflicts and violence?
3. What are the levels of cognitive development of school children brought up in frequent domestic conflicts and violent homes?

Methodology

The research design for this study is a survey research design. The population for the study was 8676 of both children of nursery and primary schools in all the colleges of Education in the North East Geo-political zone of Nigeria. A sample of 367 nursery and primary school children were selected through a purposive sampling technique from 3 Colleges of Education in the area of study. The instrument used for this research was the Family Violence Questionnaire (FVQ) for interview, observation and children's continuous assessment record. The questionnaire is developed by the researcher and given to experts for content validation based on the research questions. The data collected were

analyzed using percentage, mean and standard deviation. The Percentage was used to analyze the bio-data while mean and standard deviation were used to answer research questions one to three.

Result of the Study

Research Question One: What are the prevalences of frequent domestic conflicts and violence in the North-Eastern states of Nigeria?

Table 4.1: Prevalence of frequent domestic conflicts and violence in the North Eastern states of Nigeria.

Items	Result	
	Frequency	Percentage (%)
Nursery Children	136	37
School Age Children	231	63
Total	367	100

The result reveals that 136(37%) nursery children and 231(63%) school-age children have witnessed the prevalence of frequent domestic conflicts and violence in the North Eastern State of Nigeria. On the overall analysis, it can be deduced that the prevalence of frequent domestic conflicts and violence in the North Eastern State of Nigeria is 63%. This means that 43% did not witness frequent domestic violence in the study area.

Research Question Two: What are the social behaviours of children from families with frequent domestic conflicts and violence?

Table 4.2: Showing Mean and Standard Deviation of social behaviours of children from families with frequent domestic conflicts and violence.

	Items	Result		
		Mean	Standard Deviation	Remarks
1	Bully others	2.82	0.61	Agreed
2	Disobedient	2.56	0.31	Agreed
3	Aggressive	1.34	0.17	Disagreed
4	Do not tolerate other	2.64	0.56	Agreed
5	Not generous	2.49	0.66	Agreed
6	Timid	2.55	0.65	Agreed
7	Do not help others	2.58	0.61	Agreed
8	Cooperate	2.58	0.67	Agreed

9	Friendly	2.31	0.63	Agreed
10	Not active	2.72	0.53	Agreed
11	Active	1.37	0.60	Disagreed
12	Unfriendly	1.54	0.59	Disagreed
13	Do not cooperate	2.52	0.68	Agreed
14	Help Others	3.32	1.0	Agreed
15	Not timid	1.39	0.50	Disagreed
16	Generous	2.81	1.24	Agreed
17	Tolerate others	3.18	1.34	Agreed
18	Not aggressive	3.19	1.28	Agreed
19	Obedient	2.74	1.42	Agreed
20	Do not bully others	2.96	1.33	Agreed

Table 4.2 shows that items (1, 2, 4, 5, 6, 7, 8, 9, 10, 13, 14, 16, 17, 18, 19 & 20) have a mean score of above 2.50, which means that both nursery and primary school children are aware of the social behaviours they display at school since they are from families with frequent domestic conflicts and violence, while for items (3, 11, 12 & 15) having a mean score of less than 2.50 which means that both nursery and primary school children are not aware of the social behaviours they display at school since they are from families with frequent domestic conflicts and violence.

Research Question Three: What are the levels of cognitive development of school children brought up in frequent domestic conflicts and violent homes?

Table 4.3: Showing Percentage of levels of cognitive development in school children brought up in frequent domestic conflicts and violent homes.

Group	Result		
	N	Good Performance Level	Bad Performance Level
School Age	231	85.50	145.50

Table 4.3 shows the mean score of 85.50 of school age had good performance levels in their cognitive development while 145.50 had bad performance levels. This indicates that there are differences in the cognitive development level of school-age children from frequent domestic conflicts and violent homes in the North Eastern States of Nigeria.

Discussion

The result of the study revealed that frequent domestic conflicts and violence affect the social behaviour and cognitive

development of school children in North Eastern Nigeria. The study revealed that frequent domestic conflicts and violence affected both nursery-age and school-age children. Similarly, domestic violence and abuse are not limited to obvious physical violence. It can mean endangerment, criminal coercion, kidnapping, unlawful imprisonment, trespassing, harassment and stalking (National Network to End Domestic Violence, 2011). Furthermore, it was revealed that the most prevalent forms of domestic violence reported were physical abuse and economic disempowerment of women by spouses/partners which has a lasting effect not only on survivors but also intergenerational impacts on families especially the children and broader society (Semahegn & Mengistie, 2015).

The finding is in line with Laura (2011) who states that in many homes where domestic violence occurs, the parents are under the misconception that their children are unaware of the violence even if it takes place close to the children. They may not witness the actual violence but they do hear fighting and screams and see the injuries.

These children are also traumatized by the parent's emotional pain and suffering after the violence had taken place and this directly and indirectly has devasting effects on their cognitive growth. Witnessing domestic violence can lead children to develop an array of age-dependent and negative effects. Cumming (2012) states that children who witness violence in the home and children who are abused may display many similar psychological effects.

The school-age children have significant differences in their cognitive development. This was further confirmed by Bandura in John (2010) who emphasizes that

cognitive development and social behaviour have important links with the environment. His research program focused mainly on observational learning also called imitation or modelling, which is learning that occurs through observing what others do.

According to Osakwe & Odungiweru (2020), families from all social, racial economic, educational and religious backgrounds experience domestic violence in different ways. Children and young people need to grow up in a secure and nurturing environment. Where domestic or family violence exists, the home is not safe or secure and children are scared about what might happen to them and the people they love. Children who grow up in families where there is violence may suffer a range of behavioural and emotional disturbances. Furthermore, Children and young people do not have to see the violence to be affected by it. Studies show that living with domestic violence can cause physical, cognitive and emotional harm to children and young people (Maternowska, Catherine, & Fry, 2015).

Finally, the frequent domestic conflict and violence on social and cognitive development have an effect on both nursery and school-age children in the North Eastern States of Nigeria thereby affecting their behaviours, socially and cognitively.

Conclusion

Based on the major findings of the study it was concluded that:

i. Prevalence of frequent domestic conflict and violence in homes can be displayed among nursery and school-age children in the North Eastern States of Nigeria.

ii. Most nursery and school-age children exhibit some undesirable behaviours because of their exposure to frequent

domestic conflicts and violence in the North Eastern States of Nigeria.

iii. There are differences in the cognitive development level of nursery and school-age children from families with frequent domestic conflicts and violent homes in the North Eastern States of Nigeria.

Recommendations

Based on the major findings, these recommendations were made:

i. Grown-up members of the family should be enlightened on the effect of frequent domestic conflicts and violence to minimize the rate of negative effects on the children's social behaviour and cognitive development.

ii. Parents should be enlightened on their roles as good models to their children because children learn faster at their tender ages and also believe that what their parents do is the ultimate.

iii. Teachers should be encouraged to use methods of reward and punishment to curb and ameliorate the undesirable attitudes and poor cognition of the children from frequent domestic conflict and violent homes.

References

Amagon, M &Wakjissa, C. (2011) *Home Economics key to success*. Zimek Communications Jos Nigeria.

Ambrose, A.T. (2017) *"Assessing Child Exposure to adult domestic violence"*.

Children and Youth Service Review, 29 (7) 961-971.

Anyakoha, E.U. & Eluwa, M.A. (2012). *Home management for schools and colleges*. Africana-Fep books House trust. Onitsha Nigeria.

Boney, M. &Sugarman A. (1996) in Rathus, J.H & Silver L.B (2003) *Assessment of family violence*. A handbook for researcher and practitioners: Washington D.C American Psychological Association.

Carlson, B.E. (2010). *Children Exposed to intimate partnership violence, Research findings implication for intervention Trauma violence and Abuse*vol. 1 pg. 321 – 340.

Carpenter, G.L. & Stacks, A.M. (2011). *Developmental effects of exposure to intimate partner violence in early childhood. A review of literature, children and youth service review* vol. 31, pg. 831 – 839.

Cumming E.M (2012). Inter-parental Discord and Child Adjustment: Prospective Investigation of Emotional Security as an explanatory Mechanism. Child Development 77(Jan.-Feb.) 132-152

Cumming, E.M. (2012) *Children exposed to marital conflict and violence*. Washington D.C. America psychological Association limited.

Dennis, C. (2004) Psychology and the teacher. Seventh edition. Middasprinting international ltd. China.

Espino, G. (2010). "Personality, home influence and academic achievement of girls in Kaduna State Science Secondary Schools' Unpublished thesis, Faculty of Education, A.B.U. Zaria.

Gardners, H. (2013). *Child development principles and theories*. The good heart Willcox Publishers Co. Inc.

Gilchrist, V.J. & Graham, M.S. (1994). Spouse abuse in R.B Taylor (ed) Family Medicine, principle and practice. New York. Springer. Venlag. Pg. 10 – 25.

Graham, S.A. (2014). The impact of woman abuse on children's social development. Research and theoretical perspectives. American Psychological Association, Washington D.C. retrieved 10th January, 2017.http://ww.insightpsychological.com library.

Gysuse, E.Y. (2008). Domestic conflict and the challenges of national development. The journal of family development. vol.3.no 1 p.2

Hurluck, E. B. (1991). Child development, sixth edition, macGraw Hill Kogakusha.

John, W.S. (2010). Life span development. Eleventh edition. Beth Media Publishers United States.

Kenny, E. D. (2013). Domestic violence & its impact on the social &emotional development of young children. University of Memphis publishers U.S.A.

Kitzamann, K.M. (2007). Domestic violence & its impact on the social and emotional development of young children. *http://www.child-encyclopidia.com/documents/kitzamann*A NGXP. Retrieved 18th February, 2017.

Laura, T. (2011). Living with Domestic violence is damaging on children. Journal of family psychology. 21(2):176-184. No?

Maternowska, M., Catherine, S., & Fry, D. (2015). Understanding the Drivers of Violence: A

step by step guide to conducting preliminary research around what drives violence. Florence, Italy: UNICEF Office of Research-Innocenti, October (v.1).

Mellisa, M. (2002). Witnessing domestic violence: the effect on children. Journal of medical practice. 1; 66(11):2052-2067.

Miller, D. (2010). Children's exposure to violence community violence. Domestic violence's general effects. *http//www.nccev.org/violence/domestic.htm*. retrieved 6th March, 2017.

National Institution of Child Health and Human Development Early Child Care Research Network (2013) Does quality of child care affect child outcomes. Development psychology 39(39) 451-467.

Nicole, H. (2017). *How does parental conflict affect children* http//www.earlychildhoodoutcome.htm.

Olayiwola, A.O. (2010). Producers in educational research. Hanijam publication. Kaduna.

Osakwe, E. W., & Odungiweru, P. O. (2020). Domestic Violence: Its Implication for Family

Semahegn, A., & Mengistie, B. (2015). Domestic violence against women and associated

Factors in Ethiopia; a systematic review. *Reproductive Health, 12,* 78. https://doi.org/10.1186/s12978-015-0072-1

Stability. *International Journal of Economics, Environmental Development and Society, 1*(1), 65-81.

Piaget, J. (2008). Encyclopedia Britannica. Online. Retrieved 18th February, 2017.

Reisberg, D. (2008). Psychology, sixth edition. W.W. Norton Company Inc. USA.

Richard, E. (2011) How family conflict affects children. *http:www.howfamilyconflictand-divorce-affect-children-amstrong-legal-family-low-bloghtm*.Retrieved 18th January, 2017.

Snowman, J., McCown, R and Biehler, R. (2009) Psychology. Applied to Teaching. Twelfth Edition. Carlisle Publishing Services, Canada.

UNICEF (2005). The United Nations Children's Funding and United Nations Secretary Report. Retrieved 18th May, 2017.

Wolfe, D.A. & Crooks. C.L. (2003). The Effects of Children's Exposure to Domestic Violence. Ameta – analysis and Critique. Clinical Child and Family Psychology. http://www.avertfamilyviolence.com.au/Review. 6 171 – 187.

Yalams, S.M. & Ndomi, B. M. (2000). Research project writing and supervision. A guide to supervisors and students in Education, Engineering, Sciences and Technology. First edition. Bauchi League of Researcher in Nigeria.

AN INVESTIGATION INTO CONSONANT CLUSTER PRONUNCIATION AMONG BURA SPEAKERS OF ENGLISH LANGUAGE IN BIU, BORNO STATE, NIGERIA

Adamu Aliyu

Department of English Language
College of Education Waka-Biu, Borno State
adamualiyu893@gmail.com
07034858588

This study investigates the pronunciation of English consonant clusters by Bura speakers in Biu, Borno State, Nigeria. It focuses on identifying common mispronunciations, analyzing their causes, and examining the impact on communication. The research adopts Ormrod's Behaviorist Theory of Language Transfer as its theoretical framework and utilizes a descriptive survey methodology. A sample of 30 lecturers from the College of Education Waka-Biu, who speak Bura as their first language, was selected through purposive sampling. Data collection was conducted using a structured questionnaire and analyzed using statistical tools. The findings reveal that Bura speakers frequently mispronounce English consonant clusters due to phonotactic constraints in their native language, often substituting or modifying sounds through epenthesis or deletion. For example, "school" is pronounced as "sukul," and "spoon" as "supun." These mispronunciations distort meaning, creating barriers to effective communication. The study underscores the influence of mother tongue interference and highlights the need for targeted pronunciation interventions to improve intelligibility among Bura English speakers. In conclusion, the research emphasizes the importance of addressing phonological transfer through focused language instruction, tailored teaching strategies, and the use of technology to enhance pronunciation skills. This work contributes to understanding the interplay between first language influence and second language acquisition, offering practical insights for educators and linguists.

Introduction

Literature of phonology shows that Consonant clusters are often a target of phonological modification, such as vowel epenthesis, consonant deletion, feature change, metathesis. Even though some authorities do not consider the syllable to be a relevant phonological entity such as (J. Wells 2019), These concept has gained much pounded in the field of phonology, basically because the syllable blots the end of segmental features and the beginning of the supra-segmental features (Ukam, 2015, Ukam, Uwen & Omale, 2017, Ukam 2020). Vowels epenthesis as a modification to underlying consonant clusters from joint perspectives of phonological typology and speech perception focusing on cluster-dependent asymmetries are observed in vowel epenthesis in this study. Previous studies (Suyeon Yun2016, Rungruang, 2017) primarily strong-minded on either the onset or coda clusters in an attempt to show the problems faced by L2 learners' production (Ukam & Kadiri, 2024).

It is so common that most Nigerian languages allow simple, restricted, unmarked syllable structure, or never have consonant combinations or clusters at both beginning and

end of words, others (like English), for example, allow very complex, marked or consonant clusters between three and four at the margins. Other languages may not have as many consonant clusters as English, while some languages (e.g. Slovak) have even more consonant clusters than English (Gregova, 2010 in the works of Ukam & Kadiri, 2024). However, it is crucial to mention an important feature of English syllable structure which usually creates some pronunciation problems for users as well as learners, more especially Bura speakers of English as a second language. Majority of Bura speakers of English as second language have difficulty with the production of consonant cluster which occurs in English language. In many English words there may be an initial cluster of two or three consonants. Therefore, if a Bura speaker of English language is to speak English properly so that speakers from other countries in the world understand, he must pronounce such words that begin with two or three consonant without dropping any of the consonant or inserting a vowel between clusters.

Phonotactic constraints have been shown to play a role in second language acquisition. In second language acquisition the modifications made by non-native speakers to the production of second language syllable structure has received serious attention. More limited attention has been paid to the perception and judgment of syllable in a second language. This study would described the phonotactic constraints by examining the judgment, perception and production of word-initial and word-end consonant clusters by Bura users of English as a second language. The issues to which these tasks are relevant will first be outlined. A central issue in second language speech acquisition has been the role of the first language (Leather, 1999) and

(Major, 2001). The study therefore pose questions how can Bura speaker of English language impact speak English properly in this modern age of technology? Likewise how can the effects of miscue in consonant clusters could be in isolated in English words.

Lastly, can by investigating one phenomenon in a variety of tasks, allowed people learned about the constraints on transfer from the first language to the second language. A phenomenon which has long been observed is the epenthesis of a vowel after /s/ in English by native speakers of Bura during production that uses English for communication. Thus, Bura speaker or user of English often pronounces "school */sku:l/ as /sukul/*. This well-established phenomenon served as a useful starting point in investigating what transfer is and in what L2 behavior's it may be manifested. What causes Bura speakers epenthesis in English language sound production? Are these errors typically attributed to transfer from L1? However, how has various researchers have pointed out, the term transfer been used in different ways in the L2 learning of the English language (Hammarborg, 1997) and (Jarvis, 2000), can it be pertinent therefore to make use of well-articulated sounds to attain the required standard and comprehensive communication competence by the English users despite the fact that non-native speakers of English language may not achieve 100 percent fluency compared to native speakers called a study of this nature.

Statement of the Problem

There are scholars and researchers who had written about phonology describing many challenges associated with it, in relation to different languages in the world. Relatively, Bura language is not an exception, where the Bura speakers of English language have

challenges, specifically, consonant cluster which is still being faced with numerous pronunciation challenges which need to be clarified in a comprehensive manner in order to reduce or to completely remove the misunderstanding associated with the production of consonant cluster. Many English language speakers with different linguistic backgrounds would of course face varying degrees of difficulties in proper pronunciation of English sounds. These differences between the sound systems are regarded as barriers against competence in the pronunciation of English language sounds. This research therefore would identify and analyze the challenges associated with perception and production of consonant cluster as used by the Bura speakers of English by bringing side by side words which contain consonant clusters in order to clearly show how the Bura users of English language mispronounced them.

Objectives of the Study

The aim of this research work is to study pronunciation errors of certain consonant clusters as used by the Bura speakers of English language under the following objectives:

(i) Identify some English language consonant clusters mispronounced by the Bura speakers of English language.

(ii) Examine how the mispronounced consonant clusters are affected by the Bura speakers of English language and also how it distorts meaning.

Research Questions

Following research questions were raised to answered the research objectives:

➢ What are some of the mispronounced consonant clusters by the Bura speakers of English language?

➢ Has the mispronounced consonant clusters affect the Bura speakers of English language and distorts meaning.

Review of Related Literature

Consonant clusters refer to the arrangements or blends of consonants found at the beginning or end of words and syllables while, While Crystal (1991) in Ukam, & Kadiri, (2024) professes that consonant clusters are those series of adjacent sounds occurring in restricted patterns at the beginning or end of syllable, (Phoon et al., 2015), similarly, groups consonant clusters at both inception and coda positions differently. He opined that, the initial three-consonant clusters (e.g. spring), for instance, can be classified as pre-initial (e.g. /s/), initial (e.g. /p/) and post-initial (e.g. /r/), although he argues that only /s/, which is in initial cluster, whether in two- or three-consonant clusters, can be regarded as pre-initial. The author also groups coda clusters (e.g. prompts) into four different segments: pre-final (e.g. /m/), final (e.g. /p/), and post-final 1 (e.g. /t/) and post-final 2 (e.g. /s/). Repka even goes further to explain that some English words (like 'sixths') may not have pre-final, but have post-finals 1, 2 and 3. While in the works of Language is a complex and adaptive system of symbols and signs used for human communication (Repka, 2021). The concept of mother tongue interference has been reviewed in a number of literatures. Key to this notion is the effect of an individual's native language upon proficiency in a second or foreign language. Mother tongue interference (MTI) might affect second language learners, particularly in the areas of transfer of structures of grammar, pronunciation and morphology from first to second language (Igwebuike et al, 2022). According to Kasap &Emamvirdi (2023),

'mother tongue falls into two types: positive and negative transfer' (5).

Mispronunciation and grammatical errors are the commonest type of mother tongue interference manifestations (Manrique], 2013). Hence, mispronunciation in the public domain is a crucial challenge that draws the attention of but audience and experts to the problems of effective communication (Oyewole, 2017). In this case, it is in English. English language is one of the most widely used languages in the world. It serves a key role in cross-cultural communication.

The Nigerian policy on education stipulated that each of the listed 521 indigenous languages has its own peculiar challenges in the aspect of second language learning. In this research work only Bura language in contrast to English language were investigated. Attempt was made to study some common interference between Bura and English language

Gregova (2010), associated English consonant clusters with those of Slovak, opposed that English has about 55 two-consonant clusters at onset position and 55 at coda position, making a total of 110 two-consonant clusters. The source reported that at the level of three-consonant position, the total number for onset were nine, while those of coda were 40 which usually end with the following morphemes /s, z, t, d, θ/. When combined together, three-consonant clusters acknowledged in English were 49, whereas four-consonant clusters were only seven (7). For Slovak, the source had 139 two-consonant clusters, 85 three-consonant clusters (both of which outnumbered those of English) and seven four-consonant clusters, corresponding with those of English. The study concluded that word-initial and word-final consonant clusters showed that frequency, combination and distribution possibilities of the Slovak phonemes were higher than those of English. And that English consonant clusters could be accounted for by morphology unlike Slovak, which were not morphologically motivated.

Yuliati (2014) investigated codas, without any attention paid to onsets to show how Bahasa Indonesian speakers of English constantly deleted plural, third person and past tense form morphemes in clusters. Although the author did not introduce a theoretical model to show why Indonesian-English speakers prefer one strategy to another, the study further reveals that Indonesian speakers of English did better in the production of more than two consonants in a row. Nevertheless, they usually devoiced final consonant clusters, replacing them with voiceless sounds: they replaced clusters ending with voiced consonants such as /b, g/ with their voiceless counterparts /p, k/. Also, while obstruent consonants disappear to the most devoicing ones, consonant deletion is another repair strategy employed by Indonesian speakers in their spoken English.

Ukam, & Kadiri, (2024) investigates Consonant clusters in the spoken English of Erei-English Bilinguals, where the handling of onset and coda consonant clusters in the speech of Erei-English speakers. Chest pulse and sonority theories were adopted as theoretical frameworks, while ten subjects and 17 tokens were selected for the study. The tokens were read aloud by the subjects, recorded, saved and subjected to Praat for analysis. The findings reveal that Erei-English speakers used two strategies to modify and simplify the production of English consonant clusters: consonant deletion and vowel insertion. The subjects found it difficult to produce two or more consonants in succession at both onset and coda positions. They not only

deleted any consonant in a cluster, they also inserted a vowel(s) in-between a cluster to simplify it; a rehash of their Erei mother tongue. The study concludes that strong first language influence is the major cause of Erei-English speakers' poor performance of the correct production of consonant clusters. The empirical literature are relevant to the current study in concepts and differed in methodology.

This research adopted Ormrod's (1990) Behaviourist Theory of Language Transfer as theoretical framework. He suggested that transfer of language features depends on how similar the learning and transfer tasks are, or where identical elements are concerned in the influencing and influenced language.

Methodology

The researcher use survey in descriptive foam. The descriptive survey was used so as not to manipulate any variable. Primary data in a structured questionnaires, and interview was used. Data are organized and analyzed without altering the nature of the subject under study (Oche, 2007). Descriptive statistical tools were employed to analysis the data using mean values.

The study is situated in Biu, Borno State, Nigeria, with a particular focus on The College of Education Waka-Biu, a renowned institution established in 1986 to produce highly qualified NCE teachers. Beneficiaries of this study include students and academic staff residing in the area, as well as English language educators who aim to enhance teaching methodologies tailored to the phonological challenges faced by Bura speakers.

The population for this study is made up 30 lecturers from college of education Waka-Biu of Borno State, Nigeria who speak Bura as a language. The choice of these populations is because they are rightly related to the subject matter.

The sample size for this study was selected using a purposive sampling technique, targeting individuals with specific characteristics relevant to the study, followed by random selection within the identified group.

The instrument for data collection was the **Consonant Cluster Pronunciation Questionnaire (CCPQ)**, developed by the researcher. It was meticulously designed to collect relevant information on the subject matter, ensuring that the questions were aligned with the study's objectives and effectively addressed the research problem

Method of Data Analysis

The data collected were analysed using specific statistical tools to ensure accuracy and relevance. The analysis focused on the average performance of respondents' responses, with a significance level set at 2.5. Responses with an average score greater than or equal to 2.5 were considered impactful, while those scoring below 2.5 were deemed to have less effect or were infrequently observed. This approach was chosen to quantify the data effectively and identify meaningful patterns in the responses.

Results and Discussion

Table 4.1: Are the following Some English language consonant clusters mispronounced by the Bura speakers of English language

language consonant clusters mispronounced by the Bura speakers of English language	SA	A	D	SD	Total	Mean	Decision

	English Consonants	Bura Sounds	Gloss							
1.	/bl/	/mb/ as in mbalmbala	Not straight	84	21	0	0	105	3.5	Agreed
2.	/br/	/msh/ as in mshatu	Swift	72	33	2	0	107	3.6	Agreed
3.	/sk/	/mpl/ as in mplimta	Loose	72	30	4	0	106	3.5	Agreed
.	/kr/	/nk/ as in nkamta	Knock down	56	33	6	2	97	3.2	Agreed
5	/kl/	/nkw/ as in ankwa	Hand cuff	68	33	2	2	105	3.5	Agreed
6.	/pr/	/ng/ as in ngamta	Cover	56	45	2	2	105	3.5	Agreed
7	/ink/	/gy/ as in gyale	Play	36	54	6	0	96	3.2	Agreed
8.	/stj/	/mpw/ as in mpwa	Flour	32	45	12	1	90	3.0	Agreed
9	/tj/	/pw/ as in pwaktar	Deceive	4	12	20	15	51	1.7	Disagreed
10	/bj/	/kw/ as in kwangli	Basin	47	30	13	2	92	3.1	Agreed
11	/pl/	/mp/as mpamtah	Fight off	12	4	15	22		1.8	Disagreed

Source: Researcher's computation 2024.

The table presents an analysis of English consonant clusters that are frequently mispronounced by Bura speakers of English. Each row in the table corresponds to a specific consonant cluster, its substituted Bura sound, and its contextual meaning. For example, the English consonant cluster /bl/ is substituted with /mb/ in Bura, as in *mbalmbala*, which means "not straight." Similarly, /br/ is pronounced as /msh/, as in *mshatu*, meaning "swift." The substitution patterns reflect the phonological differences between English and Bura.

it also includes columns for respondents' ratings, categorised as Strongly Agree (SA), Agree (A), Disagree (D), and Strongly Disagree (SD). These ratings indicate the extent to which respondents agreed that a particular cluster is mispronounced. The total responses for each cluster were summed, and the mean score was calculated to determine the overall agreement. A mean score of 2.5 or higher indicates consensus among respondents that the mispronunciation is common, while a mean score below 2.5 indicates disagreement.

It reveals that most of the English consonant clusters investigated were widely agreed upon as being mispronounced by Bura speakers. For example, /bl/ was substituted with /mb/, and /br/ was substituted with /msh/, both of which received mean scores of 3.5 and 3.6, respectively. Other clusters, such as /sk/ substituted with /mpl/ and /kl/ substituted with /nkw/, also showed high levels of agreement with mean scores of 3.5 each. These results highlight that certain clusters pose significant challenges for Bura speakers due to their absence or variation in the Bura phonological system.

However, a few clusters, such as /tj/ and /pl/, were not commonly mispronounced, with mean scores of 1.7 and 1.8, respectively. This indicates that these sounds may either be more similar to native Bura phonemes or less frequently encountered in English usage among the speakers.

Table 4.2: The Following are some of the Mispronounced consonant clusters as it's distorts words meaning to the Bura speakers of English language

S/N	Respondent Questions items		SA	A	D	SD	Total	Mean	Decision
	Bura Pronunciations	**English Pronunciations**							
1.	Supun	Instead of Spoon	56	45	1	3	105	3.5	Agreed
2.	Sukul	Instead of School	30	47	10	5	92	3.1	Agreed
3.	Sutobon	Instead of Stubborn	54	36	0	6	96	3.2	Agreed
4.	Sucropulos	Instead of Scrupulous	72	30	0	4	106	3.5	Agreed
5.	Sukul	Instead of Screw	33	56	2	6	97	3.2	Agreed
6.	Kuloster	Instead of Cluster	30	47	2	13	92	3.1	Agreed
7.	Kulob	Instead of Club	33	68	3	1	105	3.5	Agreed
8,	Bulok	Instead of Block	47	30	12	6	92	3.1	Agreed
9.	Kuros	Instead of Cross	70	32	4	0	106	3.5	Agreed
10.	Burok	Instead of Broke	60	51	2	2	105	3.5	Agreed
11.	Sikkistin	Instead of Siksteen	50	61	2	3	106	3.5	Agreed
12.	Purobulem	Instead of Problem	38	52	2	4	96	3.2	Agreed
13.	Puroposal	Instead of Proposal	37	40	8	7	92	3.1	Agreed
14.	Transkiraib	Instead of Transcribe	69	35	2	0	106	3.5	Agreed
15.	Konkulozon	Instead of Conclusion	26	51	13	2	92	3.1	Agreed
16.	Stoopid	Instead of Stupid	28	54	10	0	92	3.1	Agreed
17.	Ton	Instead of Tune	36	54	6	0	96	3.2	Agreed
18.	Kulob	Instead of Closed	59	30	8	0	97	3.2	Agreed
19.	Stoodents	Instead of Students	32	47	13	0	92	3.1	Agreed
20.	Gurowing	Instead of Growing	32	45	12	1	90	3.0	Agreed
21.	Aks	Instead of Ask	73	31	2	0	106	3.5	Agreed
22.	Inkuludin	Instead of Including	44	51	8	2	105	3.5	Agreed
23.	Sukop	Instead of Scope	34	55	0	6	95	3.2	Agreed
24.	Sekatare	Instead of Secretary	72	33	2	0	107	3.6	Agreed
25.	Espert	Instead of Expert	34	56	0	6	96	3.2	Agreed
26.	Contriboot	Instead of Contribute	22	54	16	0	92	3.1	Agreed
27.	Purocess	Instead of Process	74	30	2	1	107	3.6	Agreed
28.	Takus	Instead of Task	4	12	20	15	51	1.7	Disagreed
29.	Puronunciation	Instead of Pronunciation	70	34	0	2	106	3.5	Agreed

30.	Puroperly	Instead of Properly	40	56	0	0	96	3.2	Agreed
31.	Pulommber	Instead of Plumber	10	8	26	6	51	1.7	Disagreed

Source: Researcher's computation 2024.

The computed results of some of the Mispronounced consonant clusters as it's distorts words meaning to the Bura speakers of English language, on table 4.2 reveals the thirty (30) responses of the respondents as follows: all the responses from questions 1-27, 29 and 30 were of the views that yes they actually distort the meaning of words in English but only items 28 and 31 were of different views. This shows that mispronounced wordings are of greater in number that has impact to English language speakers.

Discussion of Findings

The study identifies significant phonological challenges faced by Bura speakers of English, particularly in pronouncing consonant clusters. These challenges align with previous research on language transfer, where the first language (L1) influences second language (L2) production. Bura speakers often mispronounce English consonant clusters by inserting vowels between consonants (epenthesis), a common strategy when L1 phonological rules differ from L2 rules. For instance, /bl/ is pronounced as /mb/ and /br/ as /msh/. Additionally, certain consonant sounds are substituted, such as /kr/ being pronounced as /nk/. These phonological patterns reflect the simpler syllable structure of Bura, which lacks complex consonant clusters.

The study also highlights the impact of these mispronunciations on communication, potentially causing misunderstandings. The research emphasizes the role of language transfer, with Bura speakers applying L1 phonotactic patterns to English. The findings suggest that these challenges extend across various consonant clusters, requiring targeted teaching strategies to improve pronunciation and intelligibility. Ultimately, the study contributes to understanding how phonological constraints from the first language affect second language acquisition, offering insights for more effective language instruction (Ukam & Kadiri, 2024).

Summary

The paper explores the challenges faced by Bura speakers of English as a second language, particularly concerning the pronunciation of consonant clusters in English. Consonant clusters, which involve adjacent consonants at the beginning or end of words, are common in English but often absent in many Nigerian languages, including Bura. This linguistic discrepancy creates significant pronunciation difficulties for Bura speakers, especially in words with initial or final consonant clusters. It highlights how the mispronunciation of these clusters leads to errors like vowel insertion (epenthesis), a phenomenon where Bura speakers insert vowels between consonants, which affects the clarity and comprehension of English words. For example, "school" may be pronounced as "sukul" by Bura speakers.

The study also investigates how these pronunciation issues are influenced by the first language (L1) of the speakers and the transfer of phonological features from Bura to English. It reviews existing literature on consonant clusters and language transfer, citing studies that discuss similar issues in other languages, such as Indonesian and Slovak. The research specifically focuses on Bura speakers in Nigeria and uses a descriptive survey methodology, gathering data from lecturers at the College of Education Waka-Biu. The findings reveal that Bura speakers frequently mispronounce consonant clusters, leading to distorted meanings in English communication. The study also provides statistical analysis of these errors, showing which

consonant clusters are most commonly mispronounced.

The study aims to identify the specific consonant clusters mispronounced by Bura speakers and analyze how these mispronunciations affect communication. It also investigates the role of phonotactic constraints and language transfer in the production and perception of English consonant clusters by Bura speakers. The ultimate goal is to better understand the challenges Bura speakers face in learning English pronunciation and to propose strategies for improving their language skills.

Recommendations based on the objectives

1. **Targeted Pronunciation Intervention for Mispronounced Consonant Clusters:** The findings of the study indicate that certain consonant clusters are frequently mispronounced by Bura speakers of English. It is recommended that pronunciation interventions be developed to address these specific clusters. Teachers and speech therapists should focus on these clusters through repetitive drills, phonetic exercises, and auditory discrimination tasks to improve accuracy in their production. Additionally, integrating technology such as speech recognition tools could be beneficial in providing real-time feedback for learners, thus reinforcing correct pronunciation and helping to minimize errors.

2. **Addressing Phonological Transfer from Bura to English:** The study also revealed that the mispronunciation of consonant clusters is influenced by the phonological structure of the Bura language. It is recommended that English language instruction for Bura speakers incorporate an understanding of these phonological differences. Teachers should emphasize the contrastive aspects between Bura and English phonology, particularly focusing on

consonant clusters. By raising awareness of these differences and offering strategies to overcome them, Bura speakers can better adjust their speech patterns, leading to improved communication and a reduction in the distortion of meaning caused by mispronunciations.

References

Chen, S. (2011). *Acquisition of English Onset Clusters by Chinese learners in Taiwan*. Paper presented at the Linguistics and English Language Postgraduate Conference. University of Edinburgh. http://www.lel.ed.ac.uk/~pgc/archive/2003/proc03/Szu-wei_Chen03

Gregová, R. (2010). A comparative Analysis of Consonant Clusters in English and in Slovak. *Transilvania*, *3*(52), 79-84.

Hooi San Phoon, M. Maclagan, A. C. Abdullah(2015). Acquisition of Consonant Clusters and Acceptable Variants in Chinese-Influenced Malaysian English-Speaking Children. *American Journal of Speech-Language Pathology*. https://doi.org/10.1044/2015_AJSLP-14-0037

Ibrahim, Y (2022).). Effects of Insecurity on food production in Southern Borno State. *Journal of Educational Psychology, 56*, 38 – 44.

Igwebuike, O., Abam,G., and Etan, M.O., (2022). *Mother Tongue Interference of English Language in Primary Schools among Efik Communities in Crosss River State,*

[Conference paper]: *Education for Today* at Faculty of Education University of Calabar, Cross River State, Nigeria.

Manrique, C. M. R., (2013). *Mother Tongue Interference with Foreign Language*: A Case Study about A2 Oral Production in a Columbian Public University.

Ormrod, J., (1990). *Theories of Language Transfer: Behaviourist Theory of Language Transfer.* The Hague: Mouton.

Oyewole, O., (2017). *Influence of Mother Tongue in the Teaching and Learning of English Language in Selected Secondary Schools in Ondo State, Nigeria. Journal of Education and Practice, 8*(30):55-64.

Repka Richard. (2021).The Prague school of linguistics and Halliday's systemic and functional. grammar." Philologia" 31 (1). 165–177.

Rungruang, A. (2017). Consonant Cluster Acquisition by L2 Thai Speakers. *English Language Teaching*, *10*(7), 216-231.

Ukam, E, I & Kadiri, G., C (2024). Investigates Consonant Clusters in the Spoken English of Erei English Bilinguals. *EBSU Journal of Social Sciences & Humanities 14(2),* 449-460.

Ukam, E. I. (2020). *Introductory English Phonetics and Phonology: For Second Language Learners and Teachers.* Optimist Press.

Ukam, E., I., Uwen, G., O. & Omale, C. (2017). Application of Stress, Rhythm and Intonation in the Speech of Erei-English Bilinguals. *Global Journal of Arts, Humanities and Social Sciences*, *5*(7), 27-38.

Wells, J. (2019). English Accents and their Implications for Spelling Reform

Yuliati, Y., N. (2014). Final Consonant Clusters Simplification by Indonesian Learners of

English and its Intelligibility in International Context. *International Journal of Social Science and Humanity, 4*(6), 513-517

EFFECTS OF CONCEPTUAL DIAGRAMS TECHNIQUES ON THE ACHIEVEMENT OF DISPLACED CHILDREN IN CIVIC EDUCATION IN BORNO AND YOBE STATE NIGERIA

Gambo Baranzi Mbaya
Department of Social Studies
College of Education Waka-Biu, Borno State
gambobaranzi@gmail.com

This study was conducted to examine the Effects of Conceptual Diagram Technique on Achievement of Displaced Children in Civic Education in junior secondary school. Quasi experimental research of equivalent pre-test and post-test, non The sample of schools is made up of 4 junior secondary schools, selected from 30 junior secondary schools that fall within study area. Sample size is 216 students to form four intact classes assigned for experimental and control groups. Criteria that guide choice of schools includes: Displaced students and Non-displaced students. The schools also comprise of male and female students. Randomized research was adopted. The population of the study was 4282 junior secondary school students offering Civic Education from 30 junior secondary schools in Borno state and Yobe state. Civic Education Achievement Test (SSPT) was used for the collection of data. The reliability of SSPT was established using test-retest. Mean and standard deviation were used to answer the two research questions, while hypotheses were tested with Analysis of Covariance (ANCOVA) at 0.05 level of significance. The research revealed Conceptual diagram improve students' Achievement in Civic Education while gender have no substantial impact on students' Achievement in Civic Education. The study also attempt to investigate how conceptual diagram technique can help internally displaced children adopt to a life in a new society and how the teachers need to employ teaching techniques that can help the students acquire good moral values to enable them create positive attitude toward learning. Based on the findings of this study, it is recommended that Civic Education teachers incorporate conceptual diagram technique in the teaching, to enable students interrelate concepts, and team work.

Introduction

Teaching with diagrams helps to prepare students to acquire skills that can help in adapt to new opportunities and appreciate socio-cultural complexities and internal perspectives in school and out of school. There is evidence that suggests large learning gains when instruction includes different strategies and techniques (Oti, Egan, Salami &Uzochukwu, 2020). This indicates that teaching techniques alone do not always lead to improvement in learning outcomes. Thus, they create ways to expose students to more effective ways of learning such as the conceptual diagrams technique. Innovation into teaching techniques for the purpose of internally displaced children is needed in the area of the study (Borno and Yobe state) with the aim of improving students' achievement in new school environment. Schunk, A. and Shaibu (2017) explained further that there is a need for students' active participation in the learning process making students active regulators in pursuit of learning in a deliberate manner is among the objectives of the conceptual diagram technique. Conceptual diagram techniques allow students

to ignore rote learning, and support reflective thinking, and ideas are systematically arranged. The technique requires participation among students therefore increasing team work and meaningful learning. The impact of using this technique is the development of creative thinking in students, team work and cooperation in learning which can reorient the displaced students in their new environment.

Statement of Problem

The achievement of students in Civic Education has not been consistently good and encouraging (Erinosho, 2019). The low achievement is reflected by Nigerian government educational reforms, educators, parents and students are concerned about the causes of low achievement. Mezieobi (2014) responded by emphasizing the need to use learner – dominated teaching techniques in teaching concepts. Students' low achievements in Civic Education in the Basic Education Examination for many years constitute great worries to educators in the States under study. A comprehensive look at students' achievement in Civic Eduction is discouraging. A study conducted by Universal Basic Education 2017 shows that achievement in Civic Education among students at junior secondary schools in Borno State and Yobe state is low, students' results from 2014 to 2019 indicates that the pass rate had for most part, fallen below 50 %. The abysmal achievement of students in Civic Education is worrisome, indicating that the quest to achieve national educational objectives and Civic Education objective through effective instruction may be difficult, despite emphases on the best instructional method, strategies and techniques.

Conceptual diagrams technique seems not to be given the suitable weight of importance in actual teaching process in junior secondary school Erinosho (2019). In 2014, out of the population of 23,113 that sat for the junior secondary school examination 47% failed while 53% passed. In 2015, 12,379 students sat for the examination with 44% failing and 56% passed. Also, in 2016, 24,140. In 2017, 37% failed while 63% passed. 2018 out of population of 12,832, 41% failed and 59% passed, and in 2019 46% failed while 54% passed out of population of 13,613 and 2019 64% failed while 34% passed. Analysis shows that the level of students' academic achievement in Social Studies fluctuated between 2014-2019 in Borno State.

Nigeria Government and researchers are making frantic efforts to improve students' achievement through paradigm shift from the teacher-centered technique to the student-centered pedagogical approaches in teaching. Workshops have been organized by Borno State and Yobe state governments in collaboration with the National Teachers' Institute, Kaduna on how to enhance teachers' pedagogical skils of teaching yet, students' achievement is low. If this is allowed to continue it will affect students who wish to continue with studies in the area of social science and humanities. Hence the need to employ students' centered method such as conceptual diagram techniques, and the need for the present study on Effects of Conceptual Diagram Technique on Attitude and Achievement in Junior Secondary School Civic Education in Borno State and Yobe state

Objectives of the Study

The aim of this study is to investigate the effects of conceptual diagrams technique on achievement of internally displaced children in Borno and Yobe states, Nigeria. Specifically, the objectives of the study are to

i. find out the pre-test and post-test achievement mean scores of internally

displaced children in Borno State and Yobe state.

ii. determine the post-test achievement mean scores of internally displaced children in the experimental group based on gender in the two states

Hypotheses

The following hypotheses will be tested at 0.05 level of significance.

a. There is no significant difference in the posttest achievement mean scores of students in Civic Education in the experimental and control groups in Borno and Yobe states.

b. There is no significant difference between the posttest achievement mean scores of internally displaced children in Civic Education in the experimental and control group in Borno state and Yobe state.

c. There is no significant difference between the posttest achievement mean score of students in Civic Education in the experimental group based on gender.

d. There is no significant difference between the posttest achievement mean scores of male and female students in Civic Education in the experimental group in Borno state and Yobe state.

Methodology

The researcher adopts descriptive and inferential statistics in analyzing the data for the study. The descriptive statistics mean and standard deviation analyse data for answering the research questions. While ANCOVA analyse data for testing the hypotheses formulated for the study. All hypotheses were tested at 0.05 level of significance using Statistical Package of the Social Sciences (SPSS) version 22.2 the t–test for independent samples determine any significant difference in mean score of two different groups base on the variables under investigation.

Research Design

The research adopts the quasi-experimental research design. The design use non-equivalent pretest/posttest control group design which involves two groups, the experimental and control groups. The design is selected because it allows for separate determination of the main effect and interaction effects of independent and moderating variables on students' attitudes and achievement. The quasi-experimental design allows the use of intact classes because randomization will not be possible. Moreover, true experimental design may not be acceptable to school administrators because lessons will be disrupted.

Expanding on school-friendly experiment, Ali (2013) suggests that in situation like this, quasi-experimental design should be used because it is school-friendly design that does not disrupt major classroom structure, timetable or academic events. The design use non- randomized groups because it can use the groups already organized as intact classes. The design is diagrammed thus:

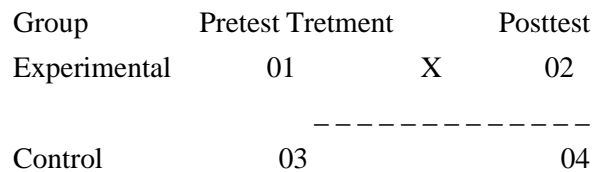| Group	Pretest	Tretment	Posttest
Experimental	01	X	02
‑ ‑ ‑ ‑ ‑ ‑ ‑ ‑ ‑ ‑ ‑ ‑			
Control	03		04

Figure – Illustration of Non-Randomized Pretest – Posttes Quasi Experimental Design

o1   pretest for the experimental group

o2   posttest of experimental group

o3   pretest for the control group

o4   posttest for the control group

X   stands for treatment (conceptual diagram technique)

_ _ _   Dotted lines stand for non-randomization of subjects

The design will have the experimental group as group 1 and control group as 2. The experimental and the control groups will be given the pre-test and the experimental group will be exposed to treatment while no treatment for control group and both groups will be given a posttest.

Population

The population of this study will consist of all the 4282 junior secondary school students offering Civic Education from 30 junior secondary schools in Borno state and Yobe state. Data source is obtained from Borno State and Yobe Ministry of Education, 2021. The population is made up of 2123 male and 2159 female. In terms of location, it consists of 1826 displaced and non-displaced students from 2456. The distribution of population is presented in Table 1.

Table 1
Population of JSSII Civic Education Students based on gender and school location

S/N	School Type	Number of Schools	Male	Female	Total
1	Displaced students	8	907	921	1828
2	Non-displaced	24	1216	1238	2456
	Total	**30**	**2123**	**2159**	**4282**

Source: Borno state and yobe state Ministry of Education, 2021.

Sample

The sample of schools is made up of 4 junior secondary schools, selected from 30 junior secondary schools that fall within study area. Sample size is 216 students to form four intact classes assigned for experimental and control groups. Criteria that guide choice of schools includes: Displaced students and Non-displaced students. The schools also comprise of male and female students.

Sampling technique

The study adapts disproportionate stratified and simple random sampling technique because it chances of selection and representation of sampled schools. A list of all the junior secondary schools in the study area was compiled. The researcher then assign numbers to each school and select four schools from selected schools under study. The selected schools by the researcher was assigned into the experimental and control group using balloting. Out of the four schools selected for study, two of these schools use conceptual diagram technieque while the other two will apply the presentation teaching technique.

Instrument for Data Collection

The researcher will use two self-designed instruments to collect data for the study. The instruments are; Civic Education Achievement Test (CEAT) and Civic Education Attitude Questionnaires (CEAQ) for junior secondary school students.

Description of the Instrument

The Civic Education Achievement Test (CEAT) for Junior Secondary School students is an instrument used to measure the Civic Education achievement of students under study. It has sections A and B. Section A contains personal data of the testees such as the name of school, school location, and gender, while section B contain 45 options multiple choice with options A-E to fill in the blank

spaces and 5 essay questions prepared based on the content of junior secondary II Civic Education syllabus.

Research Questions

The following research questions will guide the study:

a. What is the pretest and posttest attitude mean scores of Displaced and Non-displaced in Civic Eduction in experimental and control groups in Borno and Yobe States?

b. What is the posttest attitude mean scores of Displaced and Non-displaced students in Civic Education in experimental group Borno state and Yobe state?

c. What is the pretest and posttest achievement mean scores of Displaced and Non-displaced students in Civic Education in experimental and control groups in Borno State and Yobe state?

d. What is the posttest achievement mean scores of male and female JSSII students in Civic Education in Borno state and Yobe state, after exposure to conceptual diagrams instruction?

e. What are the posttest achievement mean scores of Displaced and Non-displaced students in the experimental group in Borno state and Yobe state?

Method of Data Analysis

The researcher the descriptive and inferential statistics in analyzing the data for the study. The descriptive statistics mean and standard deviation will be used to analyse data for answering the research questions. All hypotheses will be tested at 0.05 level of significance using the Statistical Package of the social sciences (SPSS) version 22.2 the t–test or independent samples will be used to determine any significant difference in the mean score of two different groups base on the variables under investigation.

TABLE 2. Pre-test and Post-test Achievement of Students towards Civic Education in the Experimental and Control Groups

Group	Test	N	$\overline{X}$	SD	Mean Gain	Mean Difference
Experimental	Pre-test	65	52.03	9.150	43.59	
	Post-test	65	95.62	14.713		33.24
Control	Pre-test	60	49.98	8.333	10.35	
	Post-test	60	60.33	10.823		

Table 2 shows the pretest and posttest achievement mean score of students in Civic education in the experimental and control group in Borno and Yobe State. Students taught Civic Education using the conceptual diagrams technique and those taught with chalk and board method had pre-test mean scores of 52.03 and 49.98 with standard deviation scores of 9.15 and 8.33, respectively. The post-test mean scores of the experimental and control groups are 95.62 and 60.33, with standard deviation scores of 14.71 and 10.35, respectively. The mean gains were 43.59 and 10.35 for two groups respectively with a mean difference of 33.24. This implies that conceptual diagrams technique does help change students' attitude positively towards Civic education.

TABLE 3. Post-test achievement Mean Scores of Male and Female Students in Civic Education in the Experimental Group

Group	Gender	Post-test			
		N	Mean	SD	$\bar{x}$- Difference
	Male	34	100.88	13.09	
Experimental					11.04
	Female	31	89.84	14.40	

Post-test achievement mean score of male and female students in Civic education in the experimental group. Male students have a mean score of 100.88 with a standard deviation of 13.09 in the post-test achievement mean score of Civic education. The female students also have a mean score of 89.84 with a standard deviation of 14.40. The findings shows that male students in the experimental group had a higher mean score (100.88) than the female students when students were taught Civic education using conceptual diagrams technique with a mean difference of 11.04. This implies that male students have a more positive attitude than female students in Civic Education after exposure to conceptual diagrams technique in the study areas.

TABLE 4. Attitude Mean Scores of Displaced and Non-Displaced Students in Civic Education

Group	Location	Post-test			
		N	Mean	SD	$\bar{x}$- Difference
	Displaced	39	95.21	15.02	
Experimental					1.02
	Non displaced students	26	96.23	14.51	

Table four indicates the post-test achievement mean scores of internally displaced and non displaced schools. Displaced students have a mean score of 95.21 with a standard deviation of 15.02. Non displaced students have a mean score of 96.23 with a standard deviation of 14.51 with a mean difference of 1.02. This implies that the attitude mean score of urban and rural school students are almost same after conceptual diagrams technique in the study areas.

TABLE 5. Pre-test and Post-test Achievement of Students in the Experimental and Control Groups

Group	Test	N	$\overline{X}$	SD	Mean Gain	Mean Difference
Experimental	Pre-test	65	27.72	10.52	36.08	
	Post-test	65	63.80	12.53		16.48
Control	Pre-test	60	24.77	9.28	19.6	
	Post-test	60	44.37	7.38		

Table five show the pretest and posttest achievement mean score of students in Civic education in the experimental and control group in Borno State and Yobe Stae. Students taught Civic Education with conceptual diagrams technique and those taught with chalk and board method had pre-test achievement mean scores of 27.72and 24.77 with standard deviation scores of 10.52 and 9.28, respectively. The post-test mean scores of the experimental and control groups are 63.80 and 44.37, with standard deviation scores of 12.53 and 7.38, respectively. The mean gains were 36.08 and 19.6 for the two groups respectively with a mean difference of 16.48. This implies that conceptual diagrams technique does help improve students' achievement in Civic education.

TABLE 6. Achievement Mean Scores of Male and Female Students in Civic Education after exposure to Conceptual Diagrams Technique

Group	Gender	Post-test			
		N	Mean	SD	$\bar{x}$- Difference
	Male	34	62.62	13.37	
Experimental					2.48
	Female	31	65.10	11.61	

Table 6 show the pretest and posttest achievement mean score of students Civic education in the experimental and control group in the study areas. Students taught Civic education using conceptual diagrams technique and those taught with Chalk and Board method had pre-test achievement mean scores of 27.72and 24.77 with standard deviation scores of 10.52 and 9.28, respectively. The post-test mean scores of the experimental and control groups are 63.80 and 44.37, with standard deviation scores of 12.53 and 7.38, respectively. The mean gains were 36.08 and 19.6 for the two groups respectively with a mean difference of 16.48. This implies that conceptual diagrams technique does help improve students' achievement in Civic Education.

TABLE 7. Achievement Mean Scores of Displaced students and Non Displaced Students in Civic Education

Group	Location	Post-test			
		N	Mean	SD	$\bar{x}$- Difference
	Urban	39	60.82	13.896	
Experimental					7.45
	Rural	26	68.27	8.586	

Table seven indicates the post-test attitude mean scores of Internally Displaced students and Non Displaced students. A mean score of 60.82 with a standard deviation of 13.90, while non displaced students have a mean score of 68.27 with a standard deviation of 8.59. The findings shows that non displaced students have a higher mean score (68.27) than the internally displaced students when taught Civic Education using conceptual diagrams technique with a mean difference of 7.45. This implies that non displaced students achieved better than displaced students in Civic Education after exposure to conceptual diagrams technique in study area.

TABLE 8. ANCOVA Result on Achievement Mean Scores of Students in Civic Education in the Experimental and Control Groups

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	11787.773a	2	5893.887	54.263	.000	.471
Intercept	46135.149	1	46135.149	424.747	.000	.777
Covariate	4.954	1	4.954	.046	.831	.000
Group	11595.291	1	11595.291	106.753	.000	.467
Error	13251.379	122	108.618			
Total	395939.000	125				
Corrected Total	25039.152	124				

a. R Squared = .471 (Adjusted R Squared = .462)

In the table 8 is Analysis of Covariance (ANCOVA) result on significant difference between the achievement mean scores of students in Civic Education in the experimental and control groups. From the result, $F(122) = 106.75$, $P< 0.05$, since the P-value of .000 is less than .05, the null hypothesis was therefore rejected, it was concluded that there is a significant difference in the post-test achievement mean scores of students in Civic Education in the experimental and control groups. The result further shows an adjusted R squared value of .462, which means that 46.2% of the variation in the dependent variable which is students' achievement is explained by variation in treatment, while the remaining is due to other factors not included in this study. This implies that conceptual diagrams technique can help improve student's achievement in Civic Education.

Hypothesis Three

There is no significant difference between the posttest achievement mean scores of male and female students in Civic Education in the experimental group in Borno State and Yobe State.

TABLE 9. ANCOVA Result on Attitude Mean Scores of Male and Female Students in Civic Education in the Experimental and Control Groups

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	150.107[a]	2	75.053	.470	.627	.015
Intercept	34302.774	1	34302.774	214.906	.000	.776
Covariate	50.446	1	50.446	.316	.576	.005
Gender	122.332	1	122.332	.766	.385	.012
Error	9896.293	62	159.618			
Total	274625.000	65				
Corrected Total	10046.400	64				

a. R Squared = .015 (Adjusted R Squared = -.017)

Analysis of Covariance (ANCOVA) was conducted to determine if there is a significant difference in the achievement mean scores of male and female students taught Civic Education with conceptual diagrams technique. In the table above, it shows that the F-value for gender is .766 with significant P-value of .385 which is greater than .05 level of significance. The null hypothesis was therefore rejected, it was concluded that there was no significant difference between the achievement mean scores of male and female students taught Civic Education using conceptual diagrams technique. The result further shows an adjusted R squared value of -.017 which means that there is no significant effect of treatment on gender. Hence, conceptual diagrams technique can help improve the achievement of both male and female students in Civic Education.

Hypothesis Four

There is no significant difference between the achievement mean scores of internally displaced students and non displaced students in the experimental group in the study area.

TABLE 10. ANCOVA Result on Achievement Mean Scores of Displaced students and Non Displaced Students in Civic Education in the Experimental and Control Groups

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	997.209[a]	2	498.605	3.416	.039	.099
Intercept	23933.803	1	23933.803	163.981	.000	.726
Covariate	131.668	1	131.668	.902	.346	.014
School Location	969.435	1	969.435	6.642	.012	.097
Error	9049.191	62	145.955			
Total	274625.000	65				
Corrected Total	10046.400	64				

a. R Squared = .099 (Adjusted R Squared = .070)

The table 10 show that the F-value for the school location(urban/rural) is 6.64 with significant P -value of .012 which is less than .05 level of significance. The null hypothesis was therefore rejected, it was concluded that there was a significant difference between the achievement mean scores of urban and rural school students taught Civic Education using conceptual diagrams technique. The result further shows an adjusted R squared value of .070 which means that 7% of the variation in the dependent variable which is students' achievement is explained by variation in school location, while the remaining is due to treatment and other factors not included in this study. This means that conceptual diagrams technique has an effect on achievement of Internally Displaced and Non Displaced students in Civic Education. This implies that conceptual diagrams technique can help improve the achievement of both Displaced and Non Displaced students in Civic Education in favour of Internally Displaced students.

Discussion of Findings

The pretest and posttest achievement mean score of students in Civic education in the experimental and control group in Biu, Borno and Yobe State. Students taught Civic Education using conceptual diagrams technique and those taught with chalk and board method had pre-test mean scores of 52.03 and 49.98 with standard deviation scores of 9.15 and 8.33, respectively. The post-test mean scores of the experimental and control groups are 95.62 and 60.33, with standard deviation scores of 14.71 and 10.35, respectively. The mean gains were 43.59 and 10.35 for the two groups respectively with a mean difference of 33.24. This implies that conceptual diagrams technique does help change students' attitude positively towards Civic education.

Post-test achievement mean score of male and female students in social studies in the experimental group. Male students have a mean score of 100.88 with a standard deviation of 13.09 in the post-test achievement mean score of Civic education. The female students also have a mean score of 89.84 with a standard deviation of 14.40. The findings shows that male students in the experimental group have a higher mean score (100.88) than the female students when students were taught Civic eduacation using conceptual diagrams technique with a mean difference of 11.04. This implies that male students have a more positive attitude than female students in Civic Education after exposure to conceptual diagrams technique in the study areas.

Conclusion

Effective use of Conceptual diagrams technique in Civic Education instruction can help improve achievement of both male and female students in.

➢ Nondisplaced students achieved better compared with displaced students in Civic Education after exposure to conceptual diagrams technique in study area.

➢ Conceptual diagrams technique does help improve students' achievement in Civic Education.

➢ Male students have a more positive attitude than female students in Civic Education after exposure to conceptual diagrams technique in the study area.

➢ Conceptual diagrams technique is found to be effective in improving students attitude to civic education in the study area.

➢ Displaced students participation in learning with conceptual diagram is found to be helpful in building confidence.

Recommendations

Based on the findings of this study, it is recommended that :

- Students should be taught Civic Education with Conceptual diagrams technique since the technique is found to improve academic achievement.
- Civic Education teachers need to employ collaborative teaching technique for students with special needs such as internally displaced for social inclusion.
- Government and Curriculum planners need to motivate teachers to use instructional technique such as Conceptual Diagram for the attainment of 21st centuary Educational goal of Learner Centerd and Teacher Passive Instruction
- Researchers in Civic Education and other related disciplines need to conduct studies in teaching techniques for effective learning in line with 21st centuary Educational goals.
- There is the need for pre-service and in-service training for teachers on instructional techniques and other related learning activities for effective learning in schools.

References

Erinosho, A. (2019) Effect of emotional Pictures on Students, Concept attainment in Primary Science. Journal of Primary and Teacher's Education Association of Nigeria. 9(2) 56-62.

Eshiwani, G. S. (2013). Factors influencing performance among primary and secondary pupils in Western Province: A Policy Study. Kenyatta: Bureau of Educational Research.

Masoume, P., Mohammad, A. &Soraya, C. (2018). The effectiveness of conceptual map training method on the achievement of social-economic skill course in male students with intellectual disability. IranianRehabilitation Journal, 11 (17), 46-52.

Mezieobi, K.A. Fubara, V.R. & Mezieobi, S.A. (2014). Social Studies in Nigeria.Teaching Methods. Instructional Materials and resources. Owerri: Academic Publishers.

NTI (2006). NCE/DLS Course Book on Social Studies Cycle 3. Kaduna: Ofoegu, T.O. (2009) Teaching and learning Resources. Curriculum theory andPractice Curriculum Organization of Nigeria.Ibadan Press.

Nyamwembe, E.O. Ondigi, S. &Kiio.M. (2013). Attitude of Students toward History and Government in Some Selected Secondary Schools in Mosocho division, Kisii Country, Kenya: Journal of Education Practice, 4(11), 17-27.

Oti, G. O., Egan, H. E., Salami, O. F., &Uzochukwu, C. P. (2020). Effectiveness of social studies curriculum in the attainment of self-reliance among undergraduate students in college of education Pankshin.International Journal of Educational Studies, 2(2), 197-209.

Schunk, A. (2017). Diagrammatic representation and inference: Therd international conference, callaway gardens, ga, usa, april 18-20, 2002: Proceedings.Berlin New York: Springer.

Shaibu, A. A. M., & Mari, J. S. (2017). Gender related differences in the understanding of science process skills among junior secondary school students in some Nigerian schools. Journal of Science Teachers Associaltion of Nigeria, 32(2),21-27.

MATHEMATICAL MODEL OF THE DYNAMICS OF CORRUPTION CONSIDERING LOSING IMMUNITY OF EX - CONVICT

Mohammed Fori

Department of Mathematics
College of Education Waka Biu
PMB 1502, Borno State, Nigeria
madufori83@gmail.com
+2348063240226

In this study, a mathematical model was developed to describe the dynamic of corruption using epidemiolocal modelling approach, considering loss immunity of Ex – Convict. The population is divided into five compartments consisting of susceptible S(t), Exposed E(t), Corrupt C(t), Jailed J(t) and Reformed R(t). The model's equilibria are identified, and the stability of these equilibria is studied in depth. At the corruption free equilibrium point (CFEP), the next generation matrix technique is used to estimate the corruption reproduction number (R_0).

The CFEP is stable when $R_0 < 1$, however, when $R_0 > 1$, then corruption would persist in society. Furthermore, the sensitivity of the model parameters was investigated, and recommendations were made. Lastly, a numerical solution was performed to confirm the analytical solutions.

Introduction

Corruption is a social problem that persists in most organizations (Corruption Index, 2018), particularly in the government where public servants are perceived with influence or power of some kind and are expected to provide some service to the citizens they service (Jederick, 2010). Transparency International adopted the definition by Eicher (2009): "corruption is the abuse of entrusted power for private gain". Corruption in public service results in revenue losses for government, degeneration of social justice, violation of human rights and exploitation of vulnerable people (Verma and Sengupta, 2015). It is a complex phenomenon with economic, social, political and cultural dimensions which cannot easily be eliminated (Hathroubi, 2017). Due to increase of public interest and concern over the universal threat to humanity, several studies have proposed mathematical models to understand and analyze the dynamics of corruption (Abdulrahman, 2014).

The epidemiological dynamics of corruption transmission model was developed and analyzed by many authors, including: Abdulrahman (2014), Legesse and Shiferaw (2018), Felix *et al.* (2017), Zerihum and Abyneh (2022), Abayneh and Zerihun (2022), Aloke (2023), Gutema *et al.* (2024), Alhassan *et al.* (2024). All the models have served the purpose for which it was developed, however, losing Immunity of ex-convict after reform was not considered.

In this paper, reunion with Ex – Convict which occur as a result of loss of immunity is considered. The objective of this work is to describe the transmission process of corruption, which can be defined generally as follows: when a reasonable number of corrupted individuals are introduced into a susceptible population, the corruption is passed to other individuals through its modes of transmission, thus, spreading in the population. Thus, in this article, the model for the spread of corruption in the sprite of epidemiology is presented which has described the dynamical

behavior of corruption, as a disease incorporating losing immunity of ex – convict.

Model formulation

The total population is divided into five non – intersecting compartments of susceptible $S(t)$, Exposed $E(t)$, Corrupt $C(t)$, Jailed $J(t)$ and Reformed $R(t)$. We assume that, susceptible individuals are innocent individuals who are not engaged in any corrupt activities, Exposed individuals are those who are exposed to a corrupted person but do not perform it, corrupt individuals are those who are engaged in corrupt activities and are capable of influencing others to become corrupt, jailed individuals comprise of those who are convicted and sentenced for corruption – related offenses, while those who undergo rehabilitation in jail, comprehending corruption's impact, are considered as reformed individuals.

Table 1: Variables and their description

Variables	Description
S	Population of susceptible individuals
E	Population of exposed individuals
C	Population of corrupted individuals
J	Population of jailed individuals
R	Population of reformed individuals

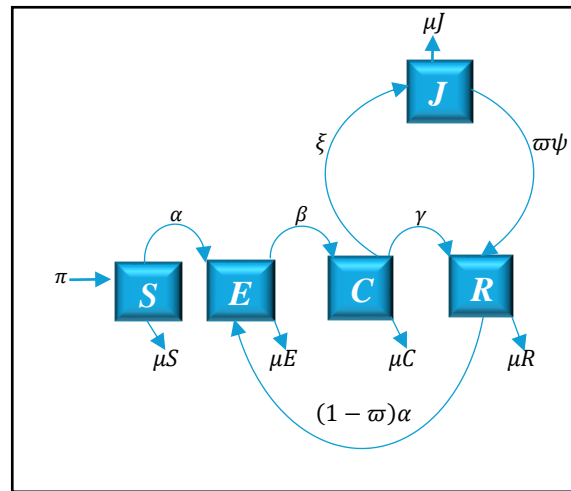*Figure 1*: schematic diagram of the model

$$\frac{dS}{dt} = \pi - \alpha SC - \mu S$$

$$\frac{dE}{dt} = \alpha SC + (1 - \varpi)\alpha CR - (\beta + \mu)E$$

$$\frac{dC}{dt} = \beta E - (\xi + \gamma + \mu)C$$

$$\frac{dJ}{dt} = \xi C - (\psi\varpi + \mu)J$$

$$\frac{dR}{dt} = \gamma C + \psi\varpi J - ((1 - \varpi)\alpha C + \mu)R$$

(1)

Subject to the initial conditions
$S(0) > 0,\ E(0) > 0,\ C(0) > 0,\ J(0) > 0,\ R(0) > 0$

Table 2: Parameters and their description

Parameter	Description
π	Recruitment rate
α	Effective corruption contact rate
μ	Death rate
β	Rate at which Exposed individual become corrupt
γ	Reformed rate of the corrupt individuals
ξ	Rate at which corrupt individual move to jail
ψ	Rate at which jailed individual are reformed
ϖ	Immunity of the reformed individual
$(1 - \varpi)\alpha$	Loss of immunity by reformed individual

Model Analysis

In this section, the solution of equation (1) is studied in the epidemiologically feasible region.

Positivity of solutions

Since the model (1) monitors human population, all the variables and the associated parameters are non – negative at all time. It is important to show that the variables of the model remain non – negative for all non – negative initial conditions. This will be established by the following theorem:

Theorem 1. The region $\mathfrak{D} = \{(S, E, C, J, R) \in \mathbb{R}^5_+\}$ is positively invariant and attracts all solutions in $\mathbb{R}^5_+$.

Proof

Assume that all the state variables are continues. Then, from the system of equation (1), one can easily obtained that

$$
\left.
\begin{aligned}
\frac{dS}{dt} &\geq -\alpha SC - \mu S \\
\frac{dE}{dt} &\geq -(\beta + \mu) E \\
\frac{dC}{dt} &\geq -(\xi + \gamma + \mu) C \\
\frac{dJ}{dt} &\geq -(\psi \varpi + \mu) J \\
\frac{dR}{dt} &\geq -((1 - \varpi)\alpha C + \mu) R
\end{aligned}
\right\} \quad (2)
$$

Solving system (2), we obtained

$$
\left.
\begin{aligned}
S(t) &\geq S_0 e^{-\mu t} \geq 0 \\
E(t) &\geq E_0 e^{-(\beta + \mu)t} \geq 0 \\
C(t) &\geq C_0 e^{-(\xi + \gamma + \mu)t} \geq 0 \\
J(t) &\geq J_0 e^{-(\psi \varpi + \mu)t} \geq 0 \\
R(t) &\geq R_0 e^{-\mu t} \geq 0
\end{aligned}
\right\} \quad (3)
$$

Thus, we can conclude that all the solutions are non – negative in $\mathbb{R}^n_+$ for all $t \geq 0$.

Invariant Region

If a solution of differential equation or system of differential equations starts on a given space, surface or curve (manifold or set) and remain within it for all time, then the manifold or set is said to be invariant (Okuonghae, 2017). Hence a positively invariant set or manifold will have solution that are positive for all time.

The dynamics of the system (1) can be studied in $\mathfrak{D}$ and it can be shown that $\mathfrak{D}$ is positively invariant and attractor of the feasible solution set of the system (1).

Theorem 2: *The initial conditions of the system (1) are contained in the region $\mathfrak{D} \in \mathbb{R}^5_+$, defined by* $\mathfrak{D} = \left\{(S, E, C, J, R) \in \mathbb{R}^5_+ : N \leq \dfrac{\pi}{\mu}\right\}$

Proof

The rate of change of the total human population is given as

$$\frac{dN}{dt} = \pi - \mu N \qquad (4)$$

Rewrite (4) in the form $\frac{dy}{dt} + Q(x) = P(x)$, we have $\frac{dN}{dt} + \mu N = \pi$

Using integrating factor method

$$N = \frac{\pi}{\mu} + Ce^{-\mu t} \qquad (5)$$

At $t = 0$, $N(0) = N_o$ which give

$$C = N_o - \frac{\pi}{\mu} \qquad (6)$$

Substitute (6) in (5)

By standard comparison theorem, it can be shown that $N(t) \le \frac{\pi}{\mu}$ if $N(0) \le \frac{\pi}{\mu}$

So that $\mathfrak{D}$ is positively invariant set. Thus, all solution enters $\mathfrak{D}$ and remain non – negative for initial conditions.

Remark 1

In the region $\mathfrak{D}$, the proposed mathematical model is mathematically well posed.

Corruption Free Equilibrium Point

Corruption – Free Equilibrium (CFE) points E_0 are steady state solutions, where there is no corruption in the society. Thus, CFE of the system (1) is attained when all the variables and parameters related to corruption are zero ($E = 0$, $C = 0$, $J = 0$, $R = 0$, $\alpha = 0$). Setting the RHS of (1) to zero, we have

$$\left. \begin{array}{l} \pi - \alpha SC - \mu S = 0 \\[1em] \alpha SC + (1 - \varpi)\alpha CR - (\beta + \mu)E = 0 \\[1em] \beta E - (\xi + \gamma + \mu)C = 0 \\[1em] \xi C - (\psi\varpi + \mu)J = 0 \\[1em] \gamma C + \psi\varpi J - \big((1 - \varpi)\alpha C + \mu\big)R = 0 \end{array} \right\} \qquad (7)$$

Substituting $E = 0$, $C = 0$, $J = 0$, $R = 0$ in (7) and solving for S, we have

$$E_0 = \left(\frac{\pi}{\mu}, 0,0,0,0\right)$$

Basic Reproduction Number

The basic reproduction number (R_0) is define as number of newly corrupters produced by a typical corrupt individual in a complete susceptible population. The next generation matrix by Dickmann, Heesterbeek and Roberts, (2009) is applied to calculate the R_0 by considering the Exposed, Corrupted and Jailed compartments of equation (1). At the free steady state, $S = R$. This means the system has three corrupting states: E, C and J

$$\frac{dE}{dt} = \alpha SC + (1 - \varpi)\alpha CR - (\beta + \mu)E$$

$$\frac{dC}{dt} = \beta E - (\xi + \gamma + \mu)C$$

$$\frac{dJ}{dt} = \xi C - (\psi\varpi + \mu)J$$

Now, we want to linearize the corrupters system, therefore let's set

$$f_1 = \alpha SC + (1 - \varpi)\alpha CR - (\beta + \mu)E$$

$$f_2 = \beta E - (\xi + \gamma + \mu)C$$

$$f_3 = \xi C - (\psi\varpi + \mu)J$$

Let matrix F represent the rate of appearance of new corrupters into the compartments and V represent the rate of transmission into (out) of compartments. Then, we have

$$F = \begin{pmatrix} \alpha SC + (1 - \varpi)\alpha CR \\ 0 \\ 0 \end{pmatrix}$$

$$V = \begin{pmatrix} (\beta + \mu)E \\ -\beta E + (\xi + \gamma + \mu)C \\ -\xi C + (\psi\varpi + \mu)J \end{pmatrix}$$

$$F = \begin{pmatrix} \dfrac{\partial f_1}{\partial E} & \dfrac{\partial f_1}{\partial C} & \dfrac{\partial f_1}{\partial J} \\[2mm] \dfrac{\partial f_2}{\partial E} & \dfrac{\partial f_2}{\partial C} & \dfrac{\partial f_2}{\partial J} \\[2mm] \dfrac{\partial f_3}{\partial E} & \dfrac{\partial f_3}{\partial C} & \dfrac{\partial f_3}{\partial J} \end{pmatrix}$$

$$= \begin{pmatrix} 0 & \dfrac{\alpha\pi}{\mu} & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix} \tag{8}$$

$$V = \begin{pmatrix} \dfrac{\partial f_1}{\partial E} & \dfrac{\partial f_1}{\partial C} & \dfrac{\partial f_1}{\partial J} \\[2mm] \dfrac{\partial f_2}{\partial E} & \dfrac{\partial f_2}{\partial C} & \dfrac{\partial f_2}{\partial J} \\[2mm] \dfrac{\partial f_3}{\partial E} & \dfrac{\partial f_3}{\partial C} & \dfrac{\partial f_3}{\partial J} \end{pmatrix}$$

$$= \begin{pmatrix} \beta + \mu & 0 & 0 \\ -\alpha & \gamma + \xi + \mu & 0 \\ 0 & -\xi & \psi\varpi + \mu \end{pmatrix} \tag{9}$$

Therefore, the inverse of V is given by

$$V^{-1} = \begin{pmatrix} \dfrac{1}{\beta + \mu} & 0 & 0 \\[3mm] \dfrac{\beta}{(\beta + \mu)(\gamma + \xi + \mu)} & \dfrac{1}{(\psi\varpi + \mu)(\gamma + \xi + \mu)} & 0 \\[3mm] \dfrac{\beta\xi}{(\psi\varpi + \mu)(\beta + \mu)(\gamma + \xi + \mu)} & \dfrac{\xi}{(\psi\varpi + \mu)(\gamma + \xi + \mu)} & \dfrac{1}{(\psi\varpi + \mu)} \end{pmatrix} \tag{10}$$

$$FV^{-1} = \begin{pmatrix} 0 & \dfrac{\alpha\pi}{\mu} & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix} \begin{pmatrix} \dfrac{1}{\beta + \mu} & 0 & 0 \\[3mm] \dfrac{\beta}{(\beta + \mu)(\gamma + \xi + \mu)} & \dfrac{1}{(\psi\varpi + \mu)(\gamma + \xi + \mu)} & 0 \\[3mm] \dfrac{\beta\xi}{(\psi\varpi + \mu)(\beta + \mu)(\gamma + \xi + \mu)} & \dfrac{\xi}{(\psi\varpi + \mu)(\gamma + \xi + \mu)} & \dfrac{1}{(\psi\varpi + \mu)} \end{pmatrix} \tag{11}$$

$$FV^{-1} = \begin{pmatrix} \dfrac{\alpha\beta\pi}{\mu(\beta+\mu)(\gamma+\xi+\mu)} & \dfrac{\alpha\pi}{(\psi\varpi+\mu)(\gamma+\xi+\mu)} & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix} \tag{12}$$

The dominant eigenvalue of (12) is equal to R_0, therefore, we evaluate the characteristic equation $|FV^{-1} - \lambda I| = 0$

$$\left| \begin{pmatrix} 0 & \frac{\alpha\pi}{\mu} & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix} \begin{pmatrix} \frac{1}{\beta+\mu} & 0 & 0 \\ \frac{\beta}{(\beta+\mu)(\gamma+\xi+\mu)} & \frac{1}{(\psi\varpi+\mu)(\gamma+\xi+\mu)} & 0 \\ \frac{\beta\xi}{(\psi\varpi+\mu)(\beta+\mu)(\gamma+\xi+\mu)} & \frac{\xi}{(\psi\varpi+\mu)(\gamma+\xi+\mu)} & \frac{1}{(\psi\varpi+\mu)} \end{pmatrix} - \lambda \begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix} \right| = 0 \tag{13}$$

Solving (13) above, we have

$\lambda_1 = \lambda_2 = 0$ and $\lambda_3 = \dfrac{\alpha\beta\pi}{\mu(\beta+\mu)(\gamma+\xi+\mu)}$

Hence , $R_0 = \dfrac{\alpha\beta\pi}{\mu(\beta+\mu)(\gamma+\xi+\mu)}$

Remark 2

The implication of the basic reproduction number is of two folds:

    i.   If $R_0 > 1$, then single corrupted person will influence more than one person to indulge in corruption activities, hence corruption will persist in the population

    ii.   If $R_0 < 1$, then corruption will be controlled

Local stability Analysis of the corruption

   – free equilibrium point

Theorem 3: *The corruption – free equilibrium point E_0, is locally asymptotically stable if $R_0 < 1$ and unstable if $R_0 > 1$.*

Proof

To prove local stability of corruption free equilibrium, we obtained the Jacobian matrix of the system (1) at corrupt free equilibrium E_0

Let

$$\left. \begin{aligned} f_1 &= \pi - \alpha SC - \mu S \\[6pt] f_2 &= \alpha SC + (1-\varpi)\alpha CR - (\beta+\mu)E \\[6pt] f_3 &= \beta E - (\xi+\gamma+\mu)C \\[6pt] f_4 &= \xi C - (\psi\varpi+\mu)J \\[6pt] f_5 &= \gamma C + \psi\varpi J - \big((1-\varpi)\alpha C + \mu\big)R \end{aligned} \right\} \tag{14}$$

Thus, the Jocobian matrix for the system (14) is given by the following:

$$J = \begin{pmatrix} \dfrac{\partial f_1}{\partial S} & \dfrac{\partial f_1}{\partial E} & \dfrac{\partial f_1}{\partial C} & \dfrac{\partial f_1}{\partial J} & \dfrac{\partial f_1}{\partial R} \\[2mm] \dfrac{\partial f_2}{\partial S} & \dfrac{\partial f_2}{\partial E} & \dfrac{\partial f_2}{\partial C} & \dfrac{\partial f_2}{\partial J} & \dfrac{\partial f_2}{\partial R} \\[2mm] \dfrac{\partial f_3}{\partial S} & \dfrac{\partial f_3}{\partial E} & \dfrac{\partial f_3}{\partial C} & \dfrac{\partial f_3}{\partial J} & \dfrac{\partial f_3}{\partial R} \\[2mm] \dfrac{\partial f_4}{\partial S} & \dfrac{\partial f_4}{\partial E} & \dfrac{\partial f_4}{\partial C} & \dfrac{\partial f_4}{\partial J} & \dfrac{\partial f_4}{\partial R} \\[2mm] \dfrac{\partial f_5}{\partial S} & \dfrac{\partial f_5}{\partial E} & \dfrac{\partial f_5}{\partial C} & \dfrac{\partial f_5}{\partial J} & \dfrac{\partial f_5}{\partial R} \end{pmatrix}$$

$$J = \begin{pmatrix} -\mu & 0 & -\alpha S & 0 & 0 \\ 0 & -(\beta+\mu) & \alpha S & 0 & 0 \\ 0 & \beta & -(\gamma+\xi+\mu) & 0 & 0 \\ 0 & 0 & \xi & -(\psi\varpi+\mu) & 0 \\ 0 & 0 & \gamma & \psi\varpi & -\mu \end{pmatrix}$$

(15)

Evaluating (7) at CFE

$$J(E_0) = \begin{pmatrix} -\mu & 0 & -\dfrac{\alpha\pi}{\mu} & 0 & 0 \\[2mm] 0 & -(\beta+\mu) & \dfrac{\alpha\pi}{\mu} & 0 & 0 \\[2mm] 0 & \beta & -(\gamma+\xi+\mu) & 0 & 0 \\[2mm] 0 & 0 & \xi & -(\psi\varpi+\mu) & 0 \\[2mm] 0 & 0 & \gamma & \psi\varpi & -\mu \end{pmatrix}$$

(16)

The characteristic equation of (16) is given as

$$(\lambda+\mu)^2(\lambda+\psi\varpi+\mu)\big(\mu(\lambda+\beta+\mu)(\lambda+\gamma+\xi)-\pi\alpha\beta\big)=0$$
(17)

Solving equation (17) for λ, we have
$$\lambda_1 = \lambda_2 = -\mu, \lambda_3 = -(\psi\varpi+\mu),$$ the remaining two eigenvalues are

$$\mu\lambda^2 + \mu(\xi+\gamma+2\mu+\beta)\lambda + \mu(\beta+\mu)(\gamma+\xi+\mu)-\pi\alpha\beta = 0$$
(18)

When (18) is substituted in R_0, we have,

$$\mu\lambda^2 + \mu(\xi+\gamma+2\mu+\beta)\lambda + \mu(\beta+\mu)(\gamma+\xi+\mu)(1-R_0)=0$$
(19)

Rewriting equation (19) in form of
$$ax^2 + bx + c = 0$$

where,

$$a = \mu$$

$$b = \mu(\xi+\gamma+2\mu+\beta)$$

$$c = \mu(\beta+\mu)(\gamma+\xi+\mu)(1-R_0)$$

Using Routh - Hurwitz criteria, the eigenvalues of the matrix all have negative real parts, and so the system of equation (19) is locally asymptotically stable.

Endemic Equilibrium Point

The endemic equilibrium point represents persistence of corruption in the population. the endemic equilibrium point is computed in terms of the force of corruption using the model system equation (1).

From the first equation of (1), we have

$$S^* = \frac{\pi}{\alpha C^* + \mu}$$

From the third equation of (1), we got

$$E^* = \frac{(\xi+\gamma+\mu)C}{\beta}$$

From the fourth equation, we obtained

$$J^* = \frac{\xi C}{\psi\varpi+\mu}$$

From the fifth equation of (1), we have

$$R^* = \frac{\gamma(\psi\varpi+\mu)C + \psi\varpi\xi C}{(\psi\varpi+\mu)\big(\alpha C(\psi\varpi+\mu)+\mu\big)}$$

From the second equation, we have

$$C^* = C$$

Hence the endemic equilibrium point E_1 is giving by

$$E_1 = \left(S^*, E^*, C^*, J^*, R^*\right) = \left(\frac{\pi}{\alpha C+\mu}, \frac{(\xi+\gamma+\mu)C}{\beta}, C, \frac{\xi C}{\psi\varpi+\mu}, \frac{\gamma(\psi\varpi+\mu)C+\psi\varpi\xi C}{(\psi\varpi+\mu)\big(\alpha C(\psi\varpi+\mu)+\mu\big)}\right)$$

Global stability Analysis of corruption Endemic Equilibrium Point

Theorem 4: *The endemic equilibrium points E_1 of the model is globally asymptotically stable if $R_0 < 1$*

Proof

Consider the Lyapunov function about E_1

$$V\left(S^*, E^*, C^*, J^*, R^*\right) =$$
$$\left(S - S^* - 1n\frac{S^*}{S}\right) + \left(E - E^* - 1n\frac{E^*}{E}\right) + \left(C - C^* - 1n\frac{C^*}{C}\right) + \left(J - J^* - 1n\frac{J^*}{J}\right) + \left(R - R^* - 1n\frac{R^*}{R}\right)$$

(20)

Differentiating (12) with respect to t, we have

$$\frac{dV}{dt} = \frac{S - S^*}{S}\frac{dS}{dt} + \frac{E - E^*}{E}\frac{dE}{dt} + \frac{C - C^*}{C}\frac{dC}{dt} + \frac{J - J^*}{J}\frac{dJ}{dt} + \frac{R - R^*}{R}\frac{dR}{dt}$$

(21)

Substituting and simplifying $\frac{dS}{dt}, \frac{dE}{dt}, \frac{dC}{dt}, \frac{dJ}{dt}, \frac{dR}{dt}$ in (21), we obtained $\frac{dV}{dt} = \chi_1 - \chi_2$ where,

$$\chi_1 = \pi + S^*\alpha C + S^*\mu + E^*\left(\beta + \mu\right) + C^*\left(\xi + \gamma + \mu\right) + J^*\left(\psi\varpi + \mu\right) + R^*\left((1-\varpi)\alpha C + \mu\right)$$

$$\chi_2 = \frac{S^*}{S}\pi + \mu S + \mu E + \frac{E^*}{E}\alpha SC + \frac{E^*}{E}(1-\varpi)\alpha CR + \mu C + \frac{C^*}{C}\beta E + \mu J + \frac{J^*}{J}\xi C + \mu R + \frac{R^*}{R}\gamma C + \frac{R^*}{R}\psi\varpi J$$

$\frac{dV}{dt} \le 0$ if $\chi_1 < \chi_2$

$\frac{dV}{dt} = 0$ if and only if

$S = S^*, \quad E = E^*, \quad C = C^*, \quad J = J^*, \quad R = R^*$

Observe that, the largest invariant impact invariant set in $\{S^*, E^*, C^*, J^*, R^*\} \in \mathfrak{D} : \frac{dV}{dt} = 0$ is a singleton set. Furthermore, by Lassalle's invariant principle, it implies that E_1 is globally asymptotically stable in $\mathfrak{D}$ if $\chi_1 < \chi_2$.

Sensitivity Analysis

The sensitivity indices of the corruption reproduction number are calculated in order to determine how important each parameter is in the initiation of corruption: that is in the control of corruption, the parameters that have the greatest influence on the corruption reproduction, and the parameters that have the greatest influence on the corruption reproduction number. We adopted the local sensitivity analysis based on the normalized forward sensitivity index R_0.

Table 3: Parameter value

Parameter	Value	Source
α	0.00009	Assumed
β	3.9	Assumed
γ	1.8	Musa & Fori
ξ	20.9	Assumed
π	0.80	Alhassan
μ	0.31	Abdulrahman
ξ	20.9	Assumed
ϖ	0.035	Zerihun
ψ	1.20	Alhassan

Table 4: Sensitivity index for the parameters with respect to R_0

Parameter	Value	$\Lambda_l^{R_0}$	Sensitivity Index
α	0.3	1	$1.0000 > 0$
β	0.8	$\dfrac{\mu}{\beta + \mu}$	$0.0326 > 0$
γ	0.5	$-\dfrac{\gamma}{\xi + \gamma + \mu}$	$-0.4673 < 0$
ξ	0.3	$-\dfrac{\xi}{\xi + \gamma + \mu}$	$-0.3628 < 0$
π	85.5	1	$1.0000 > 0$
μ	0.0234	$-\dfrac{3\mu^2 + 2\mu(\beta + \gamma + \xi) + \beta(\gamma + \xi)}{\mu(\beta + \mu)(\gamma + \xi + \mu)}$	$-10.94 < 0$

Interpretation of Sensitivity Indices

The sensitivity indices of parameters are presented in Table 4. Parameters that have positive indices $(\alpha, \beta \text{ and } \pi)$ have great impact on expanding the corruption in the community when their values increase. Parameters with negative indices $(\gamma, \mu \text{ and } \xi)$ minimize the burden of corruption in the community as their values increase. Therefore, the model sensitivity analysis demonstrated that anti – corruption agencies are supposed to decrease positive index parameters and increase the negative index parameters to combat corruption in a population.

Numerical Simulation

In this section, numerical simulations of the model (1) are performed. MATLAB 2015RB software is used to validate the analytical solution in section 3.
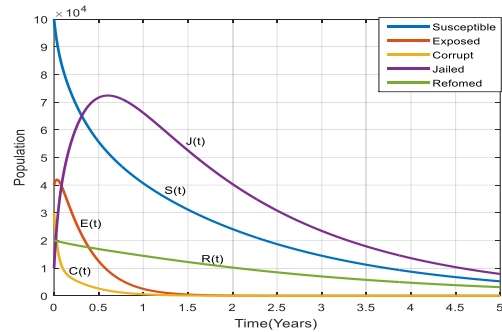

Figure 2: Time evolution of $S(t), \ E(t), \ C(t), \ J(t), \ R(t)$ with $\gamma = 1.8$ and $\varpi = 0.030$
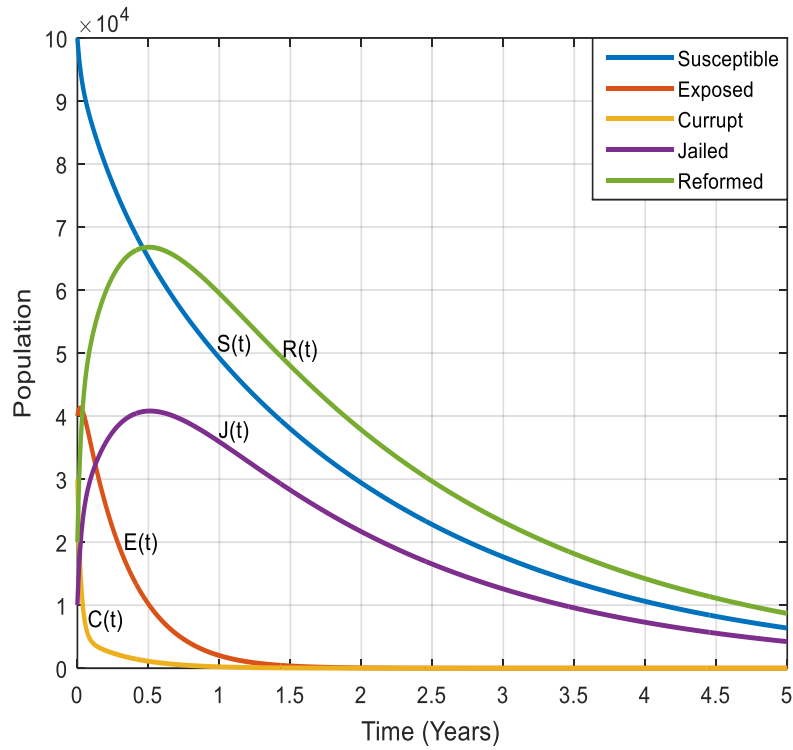
Figure 3: Time evolution of $S(t),\ E(t),\ C(t),\ J(t),\ R(t)$ with $\gamma = 35.8$ and $\varpi = 0.030$
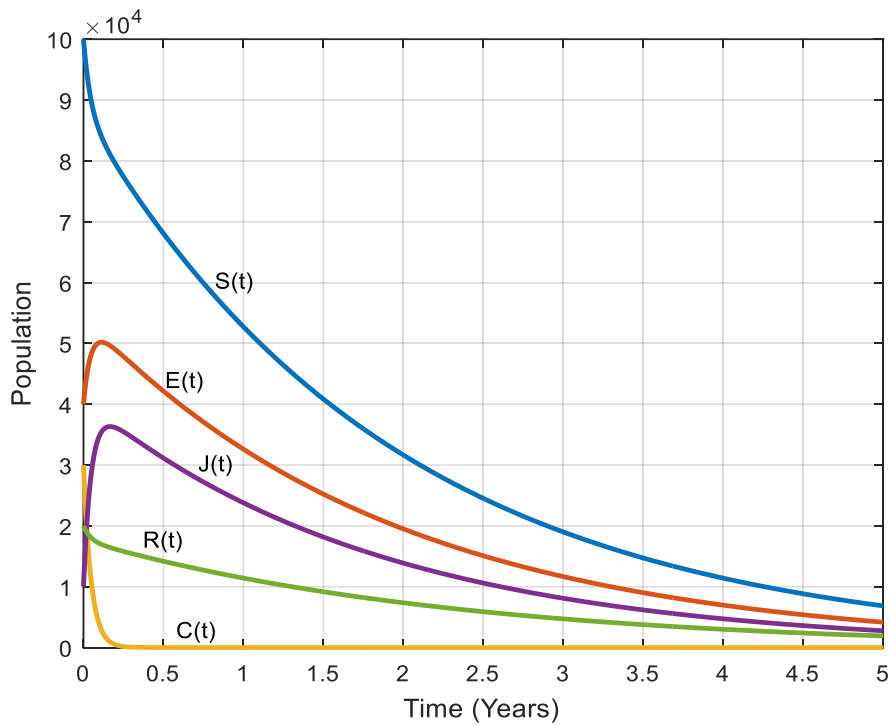

Figure 4: Time evolution of $S(t),\ E(t),\ C(t),\ J(t),\ R(t)$ with $\gamma = 0.0008$ and $\omega = 0.030$

Discussions

The simulation result indicates that an increase in the jail population directly correlates with rise in the number of exposed individuals. Furthermore, the population of the exposed individuals declines as the rate of jailing corrupt individuals ξ increases (Figure 1 & 2). The analysis also reveals that decreasing interactions between susceptible and corrupt individuals reduces the exposed group's size, while higher reformation and jailing mitigate the spread of the corruption (Figure 3). However, when a reformed individual lose immunity, the number of reformed individuals decrease leading to rise in the exposed compartment again.

Conclusions

In this paper, a mathematical model for the dynamics of corruption in population was formulated. The basic reproduction number R_0 was computed, and the stability of the equilibrium point was investigated. Using Lyapunov's function theory, the corruption - free equilibrium point is globally asymptotically stable whenever $R_0 < 1$. Using the definition of normalized forward sensitivity, the sensitivity parameters were determined. It has been shown parameters that have positive indices have great impact on expanding the corruption in the community when their values increase, and parameters with negative indices minimize the burden of corruption in the community as their values increase.

Recommendations

A loss of immunity among reformed individuals leads to an increase in the exposed population. To mitigate this, a two – integrated strategy is recommended:

i. Significantly reduce contact rates between susceptible and corrupt populations.

ii. Increase reform and jail rates to curb corruption. Furthermore, consider all recommendations suggested by Binuyo and Akinsola, 2020.

Sources of Data

Data for this research was obtained from secondary sources and have been dully cited, whereas others has been assumed.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this study.

References

Abayneh K. F & Zerihun K. B. (2022), *Mathematical model and analysis of corruption dynamics with optimal control. Hindawi, journal of applied mathematics, volume 2022, article ID 8073877, PP 1-16.*

Abdulrahman S., *stability analysis of transmission dynamics and control of corruption*, pacific journal of Science and Technology, vol. 15, no. 1, pp. 99 – 113, 2014.

Alhassan A., Momoh A.A, Abdullahi S.A. & Abdullahi M. (2024), Mathematical model on the dynamics of corruption menace with control strategies. *Internationals Journal of science for Global Sustainability*. IJSGS FUGUSAU, vol. 10(1), Pp 142 -152, DOI: https://doi.org/10.57233/ijsgS. v/oi/. 604.ISSNp:2488 – 9229; ISSNe:3027 - 1118

Aloke, S. N. (2023). Analyzing Corruption Dynamics and Control Measures in Nigeria: A Mathematical Model. *Asian Journal of Pure and Applied Mathematics*, 5(1), 493–511. Retrieved from https://globalpresshub. com/index.php/AJPAM/article/view/1896

Corruption Perception Index-Results. 2018.(Available:http://www.transparency. org/cpi2018/results)

Binuyo, A. Y. & Akinsola, V. O. (2020). Stability Analysis of the Corruption Free Equilibrium of the Mathematical Model of Corruption in Nigeria. Mathematical Journal of Interdisciplinary Sciences, 8(2), 61–9 Corruption Perception Index – Results. 2 018. (Available: http://www. transparency. org/cpi2018/results)

Diekmann, O., Heesterbeek, J., & Roberts, M. (2009). The construction of next – generation matrices for compartmental epidemic models. The royal society interface, 7,873 – 885.

Eicher, S. (2009. Corruption in International Business: The Challenge of Culture and Lega Diversity. *Gower Publishing, Ltd*.: Farnham, UK. Pp 238 (ISBN: 9780754671374).

Felix Y., Festus O., Timothy A (2016), "Understanding the Dynamics of Corruption Using Mathematical Engineering & Technology, Vol. 4 Issue 8, August 2017. ISSN (online) 2348 – 7968| Impact Factor – 5. 264.

Gutema TW, Wedajo AG and Koya PR (2024). A mathematical analysis of the corruption dynamics model with optimal control strategy. *Front. Appl.Math. Stat.*10: 1387147.doi:10.3389/ fams.2024.13871 7.

Hathroubi S., Epidemic Corruption: a bioeconomic homology, Econstor, 2013, available at http://hdl.handle.net/10419/73558.

Okuonghae, D. Mathematical Analysis of Epidemiological Models for Infectious Diseases: An introduction. Material prepared specially for the 2nd international workshop on mathematical modelling and simulations (IWMMAS) 2017, Department of mathematics, University of Nigeria, Nsukka, Nigeria, 17th September to 24th September, 2017.

Jederick P. P (2010), Modelling corruption as a contagious disease, institute of computer science, University of the Philippines Los Banos.

Leggesse L. & Shiferaw F. (2018), "Modelling Corruption Dynamics and its Analysis, Ethiopian Journal of Sciences and Sustainable Development, vol. 5, no. 2, pp. 13 – 27.

Musa S. & Fori M., (2019). Mathematical Model of the Dynamics of Rumour Propagation. *Journal of applied Mathematics and Physics, 7, 1289 –1303. https://doi.org10.4236/Jamp.2019.76088*.

Tessema, H. A. (2020). Mathematical Modelling, Analysis, and Optimal Control of Corruption Dynamics, *Hindawi, journal of Applied Mathematics, vol. 2020, Article ID 5109841, 13 pages, https//doi.org/10.1155/2020/5109841*.

Verma P. & Sengupta S., (2015). Bribe and Punishment: An evolutionary game –theoretic analysis of bribery. PLOSONE (7): doi:10.1371/journal. pone.0133441.

Zerihun K.B and Abayneh K.F, *Modelling and Analysis of Corruption Dynamics Incorporating Media Coverage.* Commun. Math. Biol. Neurosis. 2022, 2022:94.https://doi.org/10.28919/cmbn/7651. ISSN: 2052 - 254