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**JOURNAL OF SCIENCE,
EDUCATION AND HUMANITIES
[JOSEH]**

**A Publication of
DIRECTORATE OF RESEARCH AND TRAINING,
AKWA IBOM STATE COLLEGE OF EDUCATION,
AFAHA NSIT**

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Journal of Science Education and Humanities (JOSEH) is a peer-reviewed scholarly Open Access International Journal, sponsored by Tertiary Education Trust Fund (TETFund), anchored by the Directorate of Research and Training, College of Education, Afaha Nsit, Nigeria. The Journal contains articles written by researchers, professors and other experts on the basis of its originality.

As a multidisciplinary journal, it is devoted to explaining and sharing research ideas, findings and innovations as well as providing information and understanding on issues bordering on Science, education and humanities.

The Journal contains articles that dwell on socioeconomic development, Science education-related studies, entrepreneurship, vocational education, counseling, curriculum studies, information and communication technology.

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Journal of Science, Education and Humanities (JOSEH) is an international, peer-reviewed, scholarly Open Access publication sponsored by the Tertiary Education Trust Fund (TETFund) and managed by the Directorate of Research and Training, College of Education, Afaha Nsit, Nigeria. The Journal publishes articles authored by academic staff, researchers, professionals, and subject-matter experts, based on the originality and scholarly merit of their research. As a multidisciplinary journal, JOSEH accepts submissions from a wide range of academic fields, particularly in science, education, and the humanities.

This current volume comprises twenty-five (25) articles spanning the sciences, education, humanities, social sciences, entrepreneurship and vocational education, counselling, curriculum studies, and Information and Communication Technology (ICT). We are delighted to present this edition to the scholarly community and the general public, with the expectation that it will serve as an important and valuable academic resource for teaching, learning, and further research.

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In conclusion, we express our profound gratitude to the Tertiary Education Trust Fund (TETFund) for its continued financial support for the *Journal of Science, Education and Humanities (JOSEH)* at the Akwa Ibom State College of Education, Afaha Nsit, Nigeria. This support has been instrumental in sustaining high-quality academic publishing and in promoting a robust research culture within and beyond the institution.

Prof. Daniel George Udo
Editor-in-Chief

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Assessment of Radiological Emission Risks and Safety in Residential and Occupational Areas of Akwa Ibom State, Nigeria

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Abstract

This study assessed radiological emission risks in residential and occupational environments in Akwa Ibom State, Nigeria. Gamma radiation and radon concentration measurements were taken across urban, suburban, and rural residential areas, as well as industrial zones and oil refineries. Industrial areas, particularly Onna and Qua Iboe, recorded the highest gamma radiation levels. Radon concentrations were elevated in industrial and suburban residential areas, with Eket exceeding public exposure limits, resulting in an annual effective dose of 1.45 mSv/year. Occupational environments had higher radiation levels than residential areas but remained within regulatory limits. Mean gamma radiation levels in residential areas ranged from 0.05 to 0.15 $\mu\text{Sv/h}$, while occupational settings recorded 0.20–0.50 $\mu\text{Sv/h}$. The highest total effective dose of 6.20 mSv/year was found in Onna's industrial area, though still within occupational exposure limits. Statistical analysis confirmed significant differences between residential and occupational exposures (p-values: gamma radiation = 0.004, radon = 0.002, effective dose = 0.003). Most residential environments met safety standards, except Eket, which exceeded regulatory limits. While occupational settings complied, they required enhanced safety measures due to higher exposure levels. The study concluded that while most areas met radiological safety standards, certain suburban residential and industrial occupational settings required improved monitoring and mitigation. Recommendations included radon mitigation in high-risk areas, stricter workplace safety protocols, and increased public awareness. Continuous radiological monitoring, government intervention, and improved safety measures are essential to safeguard public and occupational health. Future research should explore long-term exposure effects and advanced radiation mitigation technologies.

Keywords: Radiological Emission, Occupational Exposure, Residential Environments, Ionizing Radiation, Radiological Hazard Index, Natural Radioactivity

INTRODUCTION

Radiological emissions from both natural and human-made sources continue to be a global concern due to their potential effects on public health and the environment. Ionizing radiation, which includes alpha, beta, and gamma rays, can pose serious health risks

when individuals are exposed to high levels over extended periods. The consequences of such exposure can range from acute radiation sickness to long-term effects such as cancer and genetic mutations.

In many developing regions, including

Nigeria, there is limited data on radiological emission levels in residential and occupational environments. This lack of information is particularly concerning as industrial activities, urbanization, and the use of radioactive materials in sectors like healthcare, oil exploration, and manufacturing continue to rise. Akwa Ibom State, located in southern Nigeria, has substantial industrial activity, particularly in oil and gas production. These activities have raised concerns about the potential radiological hazards they may introduce into the environment.

The International Atomic Energy Agency (IAEA, 2021) emphasizes the need for regular monitoring and assessment of radiological emissions in residential and occupational settings to ensure public safety. Research has shown that even low levels of radiation, if exposure is prolonged, can have cumulative effects, highlighting the importance of effective radiation risk management. Additionally, the International Commission on Radiological Protection (ICRP, 2007) recommends stringent measures for monitoring radiation exposure, particularly in occupational settings, to prevent adverse health outcomes.

Radiological emissions refer to the release of radiation, such as alpha, beta, gamma rays, and neutrons, from natural or artificial sources. Natural sources include cosmic rays, terrestrial radiation from radioactive materials like uranium, thorium, and radon in the Earth's crust, while artificial sources include medical procedures (e.g., X-rays, radiotherapy), industrial activities, and nuclear power generation (UNSCEAR, 2008).

In Nigeria, the National Nuclear Regulatory Authority (NNRA) is responsible for controlling and monitoring radiological emissions to protect public health. Studies have identified major radiation exposure sources in Nigeria, including oil and gas exploration activities, medical radiography, and the use of fertilizers containing naturally occurring radioactive materials (NORMs)

(Agbalagba, 2017). In oil-producing areas like Akwa Ibom State, the risk of radiation exposure from NORMs in oil waste is a concern (Ojo, 2012).

Measuring radiation in the environment is crucial for assessing exposure risks. Commonly used instruments include Geiger-Müller counters for detecting beta and gamma radiation, scintillation detectors for gamma spectroscopy, and radon detectors for measuring indoor radon levels (Knoll, 2010). Dosimeters are also employed in occupational settings to monitor cumulative radiation exposure over time (IAEA, 2014).

In Nigeria, studies have used these instruments to measure environmental radiation levels. For example, Agbalagba (2017) conducted research in the Niger Delta region using Geiger-Müller counters and scintillation detectors to measure radiation levels in soil and water samples, finding elevated radiation levels in some areas, likely due to oil and gas activities.

Exposure to high radiation levels can lead to serious health effects, including acute radiation syndrome, cancer, and genetic mutations (UNSCEAR, 2000). Even low levels of radiation, especially over long periods, can increase the risk of cancer and other health issues (ICRP, 2007). The World Health Organization (WHO) has emphasized the need for regular monitoring of radiation levels, especially in regions with potential exposure risks, to protect public health (WHO, 2016). In Nigeria, research has shown that workers in industries such as oil and gas may face increased radiation exposure risks, highlighting the need for stricter safety protocols and regular health monitoring (Arogunjo *et al.*, 2005).

Internationally, the ICRP sets guidelines on radiation protection, including recommended dose limits for both occupational and public exposure. The ICRP suggests a limit of 1 mSv per year for the general public and 20 mSv per year for occupational exposure, averaged over five

years (ICRP, 2007).

In Nigeria, the NNRA has adopted these international guidelines and implemented regulations to control radiological exposure in various environments (NNRA, 2019). Compliance with these standards is crucial for ensuring the safety of residents and workers, especially in high-risk areas like Akwa Ibom State.

Radiological safety measures include reducing exposure to harmful radiation levels. In residential areas, this may involve mitigating radon exposure by improving ventilation (Field *et al.*, 2006). In occupational environments, especially in industries with radiation sources, safety protocols such as shielding, continuous monitoring, and the use of personal protective equipment (PPE) are vital (IAEA, 2014). Research in Nigeria has stressed the need for enhanced radiological safety practices, particularly in the oil and gas industry, where handling of NORMs is common (Ojo, 2012). Ensuring that both residential and occupational environments meet safety standards is essential to protect public health in Akwa Ibom State and similar regions.

Objectives of the Study

This study examines the potential of radiological emissions and safety in residential and occupational environments within Akwa Ibom State, Nigeria. Its specific objectives are:

- (i) To measure the levels of radiological emissions in selected residential and occupational environments in Akwa Ibom State;
- (ii) To identify the primary sources of radiological emissions in these environments;
- (iii) To compare the measured radiation levels with international safety standards, such as those recommended by the International Atomic Energy Agency (IAEA);
- (iv) To evaluate the potential health

impacts of these radiological emissions on the local population and workforce;

- (v) To propose effective mitigation strategies for reducing radiological exposure in the studied environments.

Statement of the Problem

The health risks associated with radiological emissions in residential and occupational environments are becoming an increasingly pressing concern, especially in areas with high industrial activity like Akwa Ibom State. While the dangers of prolonged exposure to ionizing radiation are well-established, there is a significant lack of detailed data and systematic studies on these risks in the region. This knowledge gap hinders the development of effective strategies for risk mitigation and the establishment of necessary regulatory frameworks to protect both the public and workers. This study, therefore, aims to assess the potential of radiological emissions and safety in both residential and occupational settings in Akwa Ibom State, with the goal of filling the existing research void and offering data-driven recommendations for enhancing safety protocols.

Significance of the Study

This research will provide the first comprehensive dataset on radiological emissions in Akwa Ibom State, offering essential insights into the potential health risks faced by residents and workers. By comparing the measured radiation levels with internationally recognized safety standards, the study will pinpoint areas where regulatory improvements are needed. Furthermore, the findings will assist policymakers and regulatory bodies in implementing effective safety measures. Lastly, this study will contribute to the wider field of environmental health by addressing a critical issue that directly impacts public safety and well-being.

Materials and Methods

Study Location

The seven locations selected for the study provided a representative cross-section of the diverse environmental, residential, and occupational settings in Akwa Ibom State, making them ideal for a comprehensive assessment of radiological emission potential and safety. Given the multiple study locations and the nature of the research on radiological emissions in residential and occupational environments, a cross-sectional research design was deemed most appropriate. The descriptions of each location are as follows:

1. Uyo Metropolis

Uyo, the capital city of Akwa Ibom State, is a rapidly developing urban area with a combination of residential, commercial, and industrial zones. As the administrative and economic hub of the state, Uyo has experienced considerable infrastructure growth, which could affect radiological emission levels. The urbanization of Uyo makes it an ideal site to study the impact of human activities on radiological emissions. The presence of commercial buildings, hospitals, and other facilities handling radioactive materials necessitates an evaluation of potential emissions.

2. Eket Industrial Area

Eket is one of Akwa Ibom's major industrial towns, particularly recognized for its oil and gas activities. The town houses several multinational oil companies and their facilities, which are potential sources of radiological emissions. The industrial activities in Eket, especially those related to the oil and gas sector, may lead to higher levels of radiological emissions. Studying this area will provide insights into the occupational exposure risks for workers and surrounding communities.

3. Ikot Abasi

Ikot Abasi is another key industrial

area in Akwa Ibom, home to the Aluminum Smelter Company of Nigeria (ALSCON). The presence of heavy industrial operations in the area raises concerns about potential radiological emissions. Given the industrial nature of Ikot Abasi, it was crucial to assess the environmental and occupational safety concerning radiological emissions. This location offered an opportunity to study the impact of industrial operations on local radiation levels.

4. Oron

Oron, a coastal town in Akwa Ibom, is known for its maritime activities and fishing industry. The town also contains residential areas with a relatively dense population. Oron's coastal and maritime activities could involve the use of radioactive materials for purposes such as navigation and communication. Evaluating this area helped determine if these activities contributed to radiological emissions in the environment.

5. Ikot Ekpene

Ikot Ekpene is a major urban area in Akwa Ibom, with a mix of residential, commercial, and minor industrial activities. It is historically significant and functions as a trade center. The varied land use in Ikot Ekpene provided a diverse environment for studying radiological emissions. It was important to assess how minor industrial activities and trade influence radiation levels in a more traditional urban setting.

6. Itu Local Government Area

Itu, a key area in Akwa Ibom, is known for its agricultural activities. It also has growing residential and commercial developments, particularly around riverine areas. Assessing radiological

emissions in Itu helped understand the impact of agricultural practices and the expansion of residential areas on local radiation levels. The proximity to natural water bodies also added a unique dimension to the study.

7. Qua Iboe Terminal

The Qua Iboe Terminal, a significant oil processing and export facility operated by ExxonMobil, is located in the coastal region of Ibeno LGA. This terminal is a crucial location for studying radiological emissions due to its involvement in crude oil processing and export. Monitoring this site provided data on potential occupational exposure and environmental contamination from oil and gas operations.

Study Design

A cross-sectional design was employed to assess radiological emissions across selected residential and occupational environments in Akwa Ibom State. This design enabled the collection of data at a single point in time, providing a comprehensive snapshot of the current radiological conditions.

Sampling Procedure

A stratified random sampling method was used to select specific sampling points within each location. The locations were stratified into residential and occupational areas, with random sampling employed within each stratum to ensure representativeness. The sample size was determined based on the population density of the locations and the expected variability in radiological emission levels. Statistical formulas were used to ensure that the sample size was adequate to detect significant differences across locations.

Radiation Detection Equipment and Instruments

- (i) Geiger-Müller Counters were used to detect and measure ionizing radiation, including alpha particles, beta particles, and gamma rays (Gilmore,

2011).

- (ii) Scintillation Detectors were employed for more precise measurements of gamma radiation and detecting specific radionuclides.
- (iii) Personal Dosimeters were worn by the research team to monitor their exposure during fieldwork.

Environmental Sampling Tools

- (i) Soil Samplers were used to collect soil samples from various depths at each location to analyze radionuclide concentrations.
- (ii) Air Sampling Pumps were used to collect airborne particles to assess radon and other radioactive gases.
- (iii) Water Sampling Bottles were used to collect water samples from local sources, especially near industrial sites, for radiological analysis.

Laboratory Equipment

- (i) Gamma Spectrometer was used in the laboratory to identify and quantify specific radionuclides in the collected samples.
- (ii) Liquid Scintillation Counter was used for analyzing low-level radioactivity in liquid samples, such as water or chemical extracts from soil.

Survey Outliers Instruments

Structured questionnaires were administered to residents and workers to gather information about their awareness of radiological hazards, perceived risks, and safety practices. Semi-structured interview guides were used for in-depth discussions with key informants, such as local health officials and environmental managers.

Data Collections Methods

Field Measurements

Radiation levels were measured directly on-site using Geiger-Müller counters and scintillation detectors. Measurements were taken at multiple points within each location,

including indoor and outdoor environments.

- (i) Soil Samples were collected from three different depths (surface, 10 cm, and 30 cm) to assess the distribution of radionuclides in the soil profile.
- (ii) Air Samples were collected using air sampling pumps to assess airborne radioactive particles, with a focus on radon concentrations in enclosed spaces.
- (iii) Water Samples were taken from wells, rivers, and other local water sources near industrial areas to assess potential radiological contamination.

Laboratory Analysis

- (i) Radionuclide Samples were analyzed in the laboratory using gamma spectrometry to identify specific radionuclides, such as cesium-137, radium-226, and thorium-232.
- (ii) The concentration of radionuclides in each sample was quantified to assess the potential radiological risk.

Survey Instruments

- (i) Questionnaires were administered to a representative sample of residents and workers in each location to collect data on their knowledge, attitudes, and practices related to radiological safety.
- (ii) Semi-structured Interviews were conducted with key stakeholders to gather qualitative insights into local radiological safety practices and challenges.

Data Analysis

Descriptive statistics were used to summarize the radiological emission levels, as well as the demographic and survey data collected from participants. T-tests were employed to obtain the statistical differences in the radiological emission levels between different locations and between residential and occupational settings. Spearman correlation coefficients were calculated to assess the relationship between proximity to industrial activities and

radiological emission levels. Thematic analysis was used to analyze interview data, identifying key themes and patterns related to radiological safety practices and perceptions.

Ethical Considerations

Participants were fully informed about the purpose of the study and their role in it. Written consent was obtained from all participants. Personal information collected during the study was kept confidential and used solely for research purposes. The research team adhered to all safety protocols to minimize radiation exposure during fieldwork. Personal dosimeters were worn, and time spent in high-radiation areas was limited.

RESULTS

Below are tables summarizing the radiological emission levels measured in different residential and occupational environments across Akwa Ibom State. The data includes gamma radiation, radon levels, and effective doses for individuals in various environments.

Table 1: Radiological emission levels in residential and occupational environments across Akwa Ibom State

Location	Environment Type	Gamma Radiation ($\mu\text{Sv/h}$)	Radon Levels (Bq/m^3)	Effective Dose (mSv/year)	Regulatory Limit (mSv/year)	Compliance Status
Urban Residential (Uyo)	Residential	0.12	50	0.88	1	Compliant
Suburban Residential (Eket)	Residential	0.15	75	1.45	1	Non-Compliant
Rural Residential (Ikot Ekpene)	Residential	0.09	40	0.70	1	Compliant
Hospital (Uyo)	Occupational	0.20	60	2.10	20	Compliant
Location	Environment Type	Gamma Radiation ($\mu\text{Sv/h}$)	Radon Levels (Bq/m^3)	Effective Dose (mSv/year)	Regulatory Limit (mSv/year)	Compliance Status
Oil Producing Terminal (Qua Iboe)	Occupational	0.35	150	4.25	20	Compliant
Industrial Area (Onna)	Occupational	0.50	180	6.20	20	Compliant
Control Area (Oron)	Residential	0.05	30	0.40	1	Compliant

- (i) Urban Residential Areas (Uyo)
- (a) Gamma Radiation: $0.12 \mu\text{Sv/h}$, effective dose: 0.88 mSv/year .
- (b) Radon levels: 50 Bq/m^3 .
- (c) Compliance: Both gamma radiation and radon levels are within safe limits, and the effective dose is below the 1 mSv/year regulatory limit, indicating compliance.
- (ii) Suburban Residential Areas (Eket)
- (a) Gamma Radiation: $0.15 \mu\text{Sv/h}$, effective dose: 1.45 mSv/year .
- (b) Radon levels: 75 Bq/m^3 .
- (c) Compliance: The effective dose exceeds the regulatory limit, indicating non-compliance. Mitigation
- (iii) Rural Residential Areas (Ikot Ekpene)
- (a) Gamma Radiation: $0.09 \mu\text{Sv/h}$, effective dose: 0.70 mSv/year .
- (b) Radon levels: 40 Bq/m^3 .
- (c) Compliance: Both gamma radiation and radon levels are within safe limits, indicating compliance.
- (iv) Hospital Environment (Uyo)
- (a) Gamma Radiation: $0.20 \mu\text{Sv/h}$, effective dose: 2.10 mSv/year .
- (b) Radon levels: 60 Bq/m^3 .
- (c) Compliance: The dose is within occupational limits (20 mSv/year), suggesting
- measures such as better ventilation and shielding may be necessary.

- compliance, but continuous monitoring is advised.
- (v) Oil Producing Environment (Qua Iboe)
- (a) Gamma Radiation: $0.35 \mu\text{Sv/h}$, effective dose: 4.25 mSv/year .
- (b) Radon levels: 150 Bq/m^3 .
- (c) Compliance: Despite elevated radiation levels, the effective dose remains within the occupational limit, indicating compliance. However, additional protective measures are recommended.
- (vi) Industrial Area (Onna)
- (a) Gamma Radiation: $0.50 \mu\text{Sv/h}$, effective dose: 6.20 mSv/year .
- (b) Radon levels: 180 Bq/m^3 .
- (c) Compliance: The effective dose remains within occupational limits, but due to high exposure, strict safety measures, including personal protective equipment (PPE), are essential.
- (vii) Control Area (Oron)
- (a) Gamma Radiation: $0.05 \mu\text{Sv/h}$,
- effective dose: 0.40 mSv/year .
- (b) Radon levels: 30 Bq/m^3 .
- (c) Compliance: Both radiation and radon levels are below regulatory limits, indicating compliance.
- (viii) Residential, Occupational, Health, and Safety Observations
- (a) Residential Areas: Most areas are compliant, but some suburban locations exceed safe radiation limits, suggesting the need for interventions.
- (b) Occupational Settings: All occupational environments are within regulatory limits, though exposure levels are higher in industrial and oil-producing areas. Continuous monitoring and strict safety protocols are crucial.
- (c) Health and Safety Recommendations: Areas exceeding safe limits require mitigation measures, such as enhanced ventilation, shielding, and regular health checks.

Table 2: Gamma Radiation Levels ($\mu\text{Sv/h}$) in Residential and Occupational Environments

Environment Type	Urban Residential (Uyo)	Residential (Eket)	Rural Residential (Ikot Ekpene)	Hospital (Uyo)	Oil Refinery (Qua Iboe)	Industrial Area (Onna)	Control Area (Oron)
Mean Gamma Radiation ($\mu\text{Sv/h}$)	0.12	0.15	0.09	0.20	0.35	0.50	0.05
Standard Deviation ($\mu\text{Sv/h}$)	0.03	0.04	0.02	0.05	0.08	0.10	0.01
Range ($\mu\text{Sv/h}$)	0.08 - 0.16	0.10 - 0.18	0.06 - 0.11	0.15 - 0.25	0.25 - 0.42	0.35 - 0.60	0.04 - 0.06

The industrial area recorded the highest mean gamma radiation at $0.50 \mu\text{Sv/h}$, while the control area had the lowest at $0.05 \mu\text{Sv/h}$.

Residential areas showed more variation in radiation levels, possibly due to proximity to industrial zones.

Table 3: Radon Concentration Levels (Bq/m³) in Various Environments

Environment Type	Indoor Radon Levels (Bq/m ³)	Outdoor Radon Levels (Bq/m ³)	Average Radon Levels (Bq/m ³)
Urban Residential (Uyo)	45	55	50
Suburban Residential (Eket)	60	90	75
Rural Residential (Ikot Ekpene)	35	45	40
Hospital (Uyo)	50	70	60
Oil Producing Terminal (Qua Iboe)	120	180	150
Industrial Area (Onna)	140	220	180
Control Area (Oron)	25	35	30

The industrial area had the highest average radon concentration (180 Bq/m³), while the control area had the lowest (30 Bq/m³). Radon levels were generally higher outdoors in industrial and oil-producing areas, likely due to soil and industrial emissions.

Table 4: Annual Effective Dose (mSv/year) Across Different Environments

Environment Type	Gamma Radiation Dose (mSv/year)	Radon Dose (mSv/year)	Total Effective Dose (mSv/year)	Regulatory Limit (mSv/year)	Compliance Status
Urban Residential (Uyo)	0.53	0.35	0.88	1	Compliant
Suburban Residential (Eket)	0.67	0.78	1.45	1	Non-Compliant
Rural Residential (Ikot Ekpene)	0.40	0.30	0.70	1	Compliant
Hospital (Uyo)	1.20	0.90	2.10	20	Compliant
Oil Producing Terminal (Qua Iboe)	2.10	2.15	4.25	20	Compliant
Control Area (Oron)	0.18	0.22	0.40	1	Compliant

The highest total effective dose was recorded in the industrial area (6.20 mSv/year), but it remains within the occupational limit. The suburban residential area exceeded the 1 mSv/year limit, indicating a need for risk mitigation measures.

Table 5: Comparison of Radiation Exposure Between Residential and Occupational Environments

Parameter	Residential Environments (Average)	Occupational Environments (Average)	P-Value
Mean Gamma Radiation ($\mu\text{Sv/h}$)	0.12	0.35	0.004
Mean Radon Levels (Bq/m^3)	49	137	0.002
Mean Effective Dose (mSv/year)	1.01	4.18	0.003

The P-values suggest statistically significant differences between residential and occupational environments. Occupational settings have notably higher radiation levels and effective doses, highlighting the importance of rigorous safety measures in workplaces.

Table 6: Compliance with Regulatory Standards Across Various Environments

Environment Type	Total Effective Dose (mSv/year)	Regulatory Limit (mSv/year)	Compliance Status	Recommended Action
Urban Residential (Uyo)	0.88	1	Compliant	Continuous Monitoring
Suburban Residential (Eket)	1.45	1	Non-Compliant	Implement Mitigation Strategies
Rural Residential (Ikot Ekpene)	0.70	1	Compliant	Continuous Monitoring
Hospital (Uyo)	2.10	20	Compliant	Maintain Current Safety Measures
Oil Producing Terminal (Qua Iboe)	4.25	20	Compliant	Strengthen Safety Protocols and Monitoring
Industrial Area (Onna)	6.20	20	Compliant	Enhance Personal Protection and Health Checks
Control Area (Oron)	0.40	1	Compliant	Continuous Monitoring

Most residential environments comply with regulatory standards, with the exception of Eket. For non-compliant areas, interventions such as enhanced ventilation and health assessments are advised.

DISCUSSION

This study underscores the significance of ongoing radiological monitoring in both residential and occupational settings. While the majority of Akwa Ibom State complies with

established regulatory standards, specific suburban and occupational areas exhibit higher radiation levels, suggesting the need for additional research and intervention. These findings are consistent with previous studies that highlight the necessity of continuous risk assessments and the implementation of protective measures to ensure the health and safety of the public and workers.

Radiation levels across different environments in Akwa Ibom State varied considerably, with industrial zones (Onna) and oil production sites (Qua Iboe) registering the highest levels. This supports the observations made by Oni *et al.* (2012) and Tait & Webster (2019), who found elevated gamma radiation in industrial areas due to the concentration of radionuclides in raw materials and waste products. Similarly, Ede and Edet (2018) observed that urban areas tend to have higher radiation levels due to increased human activity and construction materials, which often contain trace amounts of naturally occurring radioactive materials (NORMs).

In contrast, radiation levels in residential areas, particularly in suburban (Eket) and rural (Ikot Ekpene) regions, were within safe limits, though slightly higher compared to the control area (Oron). This suggests that while these areas are not industrial centers, factors such as local geology and construction materials may influence background radiation levels, as noted by (UNSCEAR (2000).

Radon concentrations in industrial areas and oil terminals were significantly higher than in residential zones. The average radon level in the industrial area (180 Bq/m^3) exceeded the global average of 40 Bq/m^3 as reported by WHO (2009), likely due to the presence of radium-226 in industrial waste and materials. Meghdad *et al.* (2015) corroborated this by observing similar radon levels in industrial regions.

Radon levels in residential areas were variable, with suburban regions like Eket exhibiting higher concentrations, possibly due

to geological factors and the types of building materials used. Cothorn and Smith (1987) noted that radon levels in homes are strongly influenced by the underlying soil's uranium content, which may explain the observed variations.

The effective dose calculations show that while all occupational settings remain within regulatory limits, workers are exposed to significantly higher levels of radiation compared to residential areas. This is consistent with the findings of ICRP (2007), which established an occupational dose limit of 20 mSv/year for radiation workers. The higher doses in industrial and oil-producing zones highlight the need for stringent safety measures and continuous health monitoring of workers, as recommended by Radiation Protection Authorities.

In residential areas, effective doses in suburban regions exceeded the recommended public exposure limit of 1 mSv/year , posing potential health risks. Eket, in particular, showed an annual dose of 1.45 mSv/year due to the combined effects of gamma radiation and radon levels. EPA (2020) emphasizes the need to keep public exposure as low as reasonably achievable (ALARA), suggesting the need for mitigation strategies in such areas.

The significant differences in radiation exposure between residential and occupational environments reflect varying levels of risk. Workers in industrial and oil refinery sectors experience higher radiation exposure, a trend reported by Aliyu *et al.* (2015) in other industrial regions. The P-values suggest that the differences in gamma radiation, radon levels, and effective doses are statistically significant, supporting the hypothesis that occupational environments pose higher radiological risks. This calls for the implementation of safety protocols, including personal protective equipment (PPE) and regular health checks, as recommended by ICRP (2007).

The compliance analysis reveals that most environments adhere to the standards set

by international organizations like the ICRP and WHO. However, non-compliance in suburban areas like Eket indicates the need for intervention, which could involve radon mitigation strategies such as improving ventilation or adopting radon-resistant construction techniques, as suggested by Field *et al.* (2000).

In occupational settings, although compliance is observed, the high exposure levels in oil terminals and industrial areas indicate the need for continuous monitoring and enhanced safety measures to protect workers from long-term health risks, as advised by OSHA (2020).

Value Added to Knowledge

This research contributes the following insights:

- (i) It provides baseline data on radiation levels in residential and occupational environments in Akwa Ibom State, serving as a foundation for future studies, comparisons, and ongoing radiological safety monitoring in the region and similar Nigerian contexts.
- (ii) By comparing radiation exposure levels in residential and occupational settings, it identifies the elevated radiation levels in industrial zones and emphasizes the need for specific safety protocols in high-risk work environments.
- (iii) The study provides insights into the potential health risks associated with prolonged radiation exposure in everyday environments, which can inform public health policies and guide authorities in setting and enforcing radiation safety standards.
- (iv) It supports policy recommendations for radiation regulation and safety, encouraging protective measures, particularly in occupational settings, to minimize radiological health risks, and provides a foundation for developing region-specific regulatory frameworks.
- (v) The study demonstrates a systematic approach to radiation measurement, offering a methodological model for similar studies in other regions. The use of portable radiation meters and radiation risk indices interpretation can serve as a reference for assessing radiation exposure in different environmental contexts.
- (vi) The research raises awareness among policymakers, industry stakeholders, and the public about the importance of radiation monitoring, which can drive greater engagement with safety practices and prompt industries to adopt safer practices to limit exposure.
- (vii) It highlights areas for future studies, such as investigating sources of elevated radiation in industrial zones and assessing long-term health effects on workers in high-exposure environments. The research also lays the groundwork for exploring radiation mitigation strategies in both residential and occupational settings.

Overall, the study enhances the understanding of radiological safety in Akwa Ibom State and provides actionable insights for influencing policy, public health, and workplace safety in Nigeria and similar regions.

Conclusion

The study on "Radiological Emission Potential and Safety Assessment of Residential and Occupational Environments in Akwa Ibom State" provides valuable insights into gamma radiation and radon levels in various environments and their associated health risks. While most environments in Akwa Ibom State fall within safety limits, areas like suburban residential settings and certain occupational zones, including oil refineries and industrial

areas, exhibit elevated radiation levels that could pose health risks.

The suburban area of Eket showed radon levels and effective doses exceeding public exposure limits, underscoring the need for mitigation efforts. Although occupational environments comply with regulatory standards, they demonstrate significantly higher radiation levels compared to residential areas, emphasizing the need for continuous safety measures and health monitoring.

This study stresses the importance of ongoing monitoring, public awareness, and adherence to safety regulations to mitigate health risks from radiation exposure in both residential and occupational environments.

Recommendations

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

- (i) Enhanced Monitoring and Regulation:
 - (a) Continuous radiological emission monitoring, particularly in high-risk zones such as industrial areas and suburban regions near industrial activities.
 - (b) Regulatory bodies should enforce stricter compliance with radiation safety standards, especially in residential areas where exposure exceeds recommended limits.
- (ii) Mitigation Strategies for High-Risk Areas:
 - (a) In areas like Eket, where radon levels are high, building designs should include radon-resistant features, and existing buildings should be retrofitted to improve ventilation.
 - (b) Industrial and oil refinery facilities should introduce additional protective measures

to reduce radiation exposure, such as PPE and regular health check-ups.

- (iii) Public Awareness and Education:
 - (a) Public education programs should inform communities about radon risks and the importance of regular testing in homes.
 - (b) Workers in high-radiation occupational environments should receive ongoing training on radiation safety and protective measures.
- (iv) Government and Policy Interventions:
 - (a) Government agencies should implement policies that mandate regular radiation assessments in residential and occupational environments.
 - (b) Subsidies and incentives should be provided to homeowners and industries that take steps to reduce radiation exposure, such as installing radon mitigation systems or adopting safer industrial practices.

Suggestions for Future Research

Future studies should focus on the following:

- (i) Longitudinal studies to track radiation levels over time and understand temporal variations and their health impacts.
- (ii) Comparative studies across different regions in Nigeria to assess radiological risks in various environmental and industrial contexts.
- (iii) Epidemiological studies to investigate the health effects of chronic radiation exposure in both residential and occupational settings.
- (iv) Research on innovative technologies

for radiation detection and mitigation, particularly in residential areas and small-scale industries.

- (v) Investigating the economic and social impacts of radiation exposure and the effectiveness of mitigation measures, to help policymakers make informed decisions.
- (vi) These future research directions will provide a deeper, more actionable understanding of radiological safety in Akwa Ibom State and similar regions, ultimately contributing to improved public health and safety standards.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationship that could have appeared to influence the work reported in this paper.

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REFERENCES

- Agbalagba, E. O. (2017). Assessment of natural radioactivity levels in surface soil in oil and gas production areas of Delta State, Nigeria. *Journal of Radiation Research and Applied Sciences*, 10(4), 311-317.
- Aliyu, A.S., Ramli, A.T., Garba, N.N., *et al.* (2015). Assessment of gamma dose rates in the indoor environment of buildings in Nigeria. *Applied Radiation and Isotopes*, 103, 1-6.
- Cothorn, C.R., & Smith, J.E. (1987). *Environmental Radon*. U.S. Geological Survey Bulletin 1971, 1-40.
- Ede, P.N., & Edet, E.E. (2018). Assessment of radiation exposure levels within a major industrial area in Southern Nigeria. *Journal of Environmental Radioactivity*, 192, 1-9.
- EPA. (2020). Radiation sources and doses. *United States Environmental Protection Agency*.
- Field, R. W., Krewski, D., Lubin, J. H., *et al.* (2006). An overview of the North American and European residential radon case-control studies. *Journal of Toxicology and Environmental Health, Part A*, 69 (7-8), 599-631.
- Field, R.W., Steck, D.J., Smith, B.J., *et al.* (2000). The Iowa radon lung cancer study—phase I: Residential radon gas exposure and lung cancer. *American Journal of Epidemiology*, 151(11), 1091-1102.
- Gilmore, G. (2011). *Practical Gamma-ray Spectrometry* (2nd ed.). Wiley.
- ICRP, International Commission on Radiological Protection. (2007). *The 2007 Recommendations of the International Commission on Radiological Protection*. ICRP Publication 103. Ann. ICRP 37(2-4).
- International Atomic Energy Agency (IAEA). (2014). *Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards*. IAEA Safety Standards Series No. GSR Part 3. Vienna: IAEA.
- International Atomic Energy Agency (IAEA). (2021). *Radiological Protection of People and the Environment*. IAEA Safety Standards Series.
- International Commission on Radiological Protection (ICRP). (2007). *The 2007 Recommendations of the International Commission on Radiological Protection*. ICRP Publication 103. Annals of the ICRP, 37(2-4).
- Knoll, G. F. (2010). *Radiation Detection and*

- Measurement*. John Wiley & Sons.
- Martin, A., & Harbison, S. (2013). *Introduction to Radiation Protection* (6th ed.). CRC Press.
- Meghdad, H., Mahmoud, S., & Mahdi, K. (2015). Environmental gamma radiation and radon concentrations in the buildings of an industrial complex in Iran. *Radiation Protection Dosimetry*, 164(1-2), 241-247.
- National Nuclear Regulatory Authority (NNRA). (2019). *Radiation Safety Regulations*. NNRA, Nigeria.
- Ojo, J. S. (2012). Environmental radiological impact of oil and gas exploration activities in selected oil fields of the Niger Delta, Nigeria. *Journal of Environmental Radioactivity*, 109, 64-70.
- Oni, O.M., Isinkaye, M.O., & Awodugba, A.O. (2012). Natural radionuclide concentrations and radiological assessment of clay soils from a kaolin deposit in Ifonyintedo, Nigeria. *Radiation Protection Dosimetry*, 148(3), 381-389.
- OSHA. (2020). Ionizing radiation standards. *Occupational Safety and Health Administration*.
- Tait, D. M., & Webster, S. P. (2019). Gamma Spectroscopy for Environmental Monitoring. *Radiation Protection Dosimetry*, 183(2), 133-141.
- United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR). (2000). *Sources and Effects of Ionizing Radiation*. UNSCEAR 2000 Report to the General Assembly, with Scientific Annexes. United Nations, New York.
- United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR). (2008). *Sources and Effects of Ionizing Radiation*. UNSCEAR 2008 Report to the General Assembly, with Scientific Annexes. United Nations, New York.
- United Nations Scientific Committee on the Effects of Atomic Radiation. (2020). *Sources, effects and risks of ionizing radiation: UNSCEAR 2019 report*.
- United States Nuclear Regulatory Commission (NRC). (2016). *Radiation Protection and Emergency Response*. NRC Regulatory Guide 8.29.
- UNSCEAR. (2000). Sources and effects of ionizing radiation. *United Nations Scientific Committee on the Effects of Atomic Radiation, UNSCEAR 2000 Report to the General Assembly, with scientific annexes*.
- US Environmental Protection Agency (EPA). (2022). *Radon*. Retrieved from
- WHO. (2009). WHO handbook on indoor radon: A public health perspective. *World Health Organization*.
- World Health Organization (WHO). (2016). *Ionizing Radiation, Health Effects and Protective Measures*.



Parental Attributes and Civic Education Performance Anxiety among Secondary School Students in Urueoffong/Oruko Local Government Area of Akwa Ibom State

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Abstract

The study examined the relationship between parental attributes and Civic Education performance anxiety among secondary school students in Urueoffong/Oruko Local Government Area. To achieve the aim of the study, two research questions were raised and the correspondent null hypotheses formulated. Three relevant theories were reviewed in the study. Co-relational research designed was used for the study. The study population consisted of all the 4,223 students in senior secondary 2 in the 4 public secondary schools in Urueoffong/Oruko Local Government Area. 253 Senior Secondary 2 students representing six percent (6%) of the study population were selected for the study using Simple Random Sampling Technique. Two sets of instruments were used for data collection, these include: Parental Attributes Questionnaires (PAQ) for students and the Civic Education performance anxiety Questionnaire (CEPQ). The instruments were validated by one expert in measurement and evaluation and two experts in curriculum studies. The reliability of the instrument was determined using internal constituency method for: The instrument was subjected to Cronbach Alpha Analysis and the reliability index of 0.89 for the PAQ and Pearson's Product Moment Correlation Statistics was used to analyze data. The r-coefficient of the PPMC was used to answer the research questions and to test the null hypotheses at 0.5 level of significance. Findings of the study revealed that, parental involvement and parenting styles significantly relate to Civic Education performance anxiety among secondary school students. It was concluded that there is a significant relationship between parental attributes and Civic Education performance anxiety among secondary school students in Urueoffong/Oruko Local Government. It is recommended amongst others that, parents should change their styles of parenting if it creates nervousness in their children.

Keywords: Parental Attributes, Civic Education, Performance, Secondary School.

INTRODUCTION

The parental attributes such as parental involvement, expectation, and parenting style, can significantly influence a child's academic performance including their Civic Education performance. The role of Civic Education in the lives of individuals and in the society is very crucial especially now that the world is

driving towards social change. Then, one can say that the success of an individual student and the entire society is entangled to Civic Education.

Ukadike in Laishram (2017) revealed that Civic Education is indispensable because

it has application in all other human activities including school science and technology based subjects. As such Civic Education is one of the most important subjects Nigeria needs in the present era of technology advancements and in the realization of Nigerian vision Akpan (2018). Ugama (2011) stated that Civic Education is the only language and culture that is common to all studies. It is the science of structure, order and relation that has evolved from counting, measuring and describing the shapes of objects (Nekang, 2018), As earlier stated, for a person to be able to function very well within the immediate environment, the knowledge of rudimentary Civic Education is very necessary

It was as a result of application of Civic Education in everyday life of an individual that prompted the Federal Government of Nigeria to make Civic Education a compulsory subject at primary and secondary school levels which is rebranded as Civic Education for both junior and senior secondary level. The importance accorded to Civic Education in the school curriculum from the primary school to the secondary school level and even in the first two years of tertiary education reflects accurately the vital role played by the subject in contemporary society (Anibueze 2017), Oledede (2014).

The poor academic achievement of students has been seen as being a result of many factors. Some researchers have attributed student's poor achievements to parental factors such as family stress and financial problems among many other reasons. According to Joshua (2010) students who had problems in school were often preoccupied with concerns outside the schools setting. He further stressed that many lived in socially and economically disadvantage home situation which significantly impede their emotional, social and economic growth and developments. Poverty denies the student the opportunity of possessing such school materials as books that encourages high academic achievement. The student's lack of

the necessary time to read effectively, good food that enhance good mental development, proper dressing to boost their ego like other students are due to family stress which could be aggravated by poverty. Some students who come from such poor and stress-laden families feel out of place and odd among their fellow students. They develop low self-esteem and feel depressed. Usually, achievement in school becomes a negative venture (Akpan. 2018).

Anxiety is a natural response to stress or a perceived threat. It's a feeling of fear, apprehension, or unease. Symptoms can include restlessness, rapid heartbeat, and difficulty concentrating and muscle tension.

Anxiety can significantly impact students in Civic Education by impairing their performance and overall experience. When anxious, students may have difficulty concentrating, experience a blank mind and struggle with problem-solving. The fear of making mistakes can lead to avoidance of math-related tasks, hindering learning and skill development.

Moreover, anxiety may affect memory recall, making it challenging for students to remember and apply mathematical concepts. Seeking support from teaching, peers or professionals can be beneficial for managing Civic Education performance anxiety and improving overall performance.

Civic Education performance anxiety is the negative emotional response individuals may experience when faced with Civic Education tasks. It can manifest as feelings of tension, apprehension and fear related to Civic Education (Anibueze, 2017).

During the annual releases of senior secondary school certificate examination (SSCE) results conducted by West African Examination Council (WAEC), justified the problematic nature and generalization of the poor secondary school subjects information from WAEC showed that, out of the 1,369,142

candidates who wrote the examination in May/June 2018, only 178,962 representing 14.2 percent got the necessary requirements of five credits including English and Government. Out of 1,672,004 students, representing 24.80 percent, passed with five credits including English and Government which is the mandatory prerequisite for university and other tertiary institutions for Law and political science admissions. This poor result implies that 74.01 percent of the students failed. Also, in 2020, WAEC results showed that only 441,237 students representing 33.24 percent, passed English while 560,974 representing 41.5 percent, passed Civic Education. However, statistic showed that only 23 percent passed whereas 77 percent admission requirements.

Furthermore, Uwadiae (2021), while releasing the 2021 West African examination Council's May/June result, maintained that the students recorded mass failure again as only 472,096 candidates, representing 3 percent, passed with five credits in Civic Education out of 1,540,250 candidates that wrote the examination nationwide. Available statistics from WAEC in 2018 also showed that students even recorded poorer results in other science subjects which successes in this area depend on the good knowledge attributed to Civic Education. For instance, Chief examiner's Report (2018) indicates that out of 314,982 students that wrote the November/December Examination in biology, only 114,784, representing 36.44 percent passed at the credit level while 161,200 students representing 51.17 percent failed.

The 2023, November/December WAEC result is even worse, since out of the 320,962 students who sat for biology, only 122,872, representing 38.28 percent, had credit and above while 166,24 students who represent about 61.72 percent failed. The analysis of type above shows that invariably, the academic achievement that was adjudged by the examiner and some other significant

examination body(s) falling below an expected standard. On the other hand, Barake (2014) perceived poor academic achievement as any achievement that falls below a desired standard. In the context of this study, poor academic achievement is the inability of the adolescent students to attain the desired standard set up by the examiner in the achievement of their academic excellence.

Concept of Parental Involvement

quite a number of studies have however recommended that the multi-dimensionality of parental involvement should be taken into consideration in order to establish some uniformity among parental involvement researches and reduce the inconsistencies of results that have most often prevailed in most parental involvement studies (Grolnick and Slowiaczek, 2014).

Parental involvement in recent times has received tremendous attention and recommendations from schools administrators, educators and policy makers. Basically, this is because several researches such as (Simon (2011), (Trusty (2016), and Schunk and Zimjerman, (2016) have linked parental involvement to quite a number of positive students' behavioral and academic outcomes such as improved school behavior, school attitude, increased school participation, fewer school dropouts and better academic achievement and performance. According to Perna and Titus (2015) Parental involvement has been found to be a significant predictor of students' career choices in Civic education as well as college Civic education courses enrollment. Also, authors such as (Henderson and Berla, (2014); and Christenson (2012) have noted that parental involvement has a direct positive relationship on students' academic performance and school success. Nevertheless, there are a few inconsistencies in researches regarding the impact of parental involvement on students' anxiety. For example, El Nokali *et al* (2010) and Chowa,

Ansong and Osei-Akoto (2012) found no significant relationship between parental involvement and students' anxiety. Also, Fan (2001) discovered a negative association between some parental involvement dimension such as contact with school and students' academic performances. In addition, among the research reporting a positive relationship between parental involvement and academic performance, some have shown that parental involvement is more effective only among pre-school and elementary school students. One well-known Parental Involvement model that captures a multi dimensionality of the construct is the Epstein's (1995) model. It identifies six different ways that parents can be involved in their children's education. These are parenting, communicating, volunteering, learning at home, decision-making and community collaboration. These involvement activities may include attending school meetings or conferences, communicating with teachers and involvement in school projects, assisting child with homework, monitoring academic progress, providing opportunities for stimulating learning through experiences (Fan, 2011).

The Concept of Parenting Styles

For most people, a child's parents are the most influential person in their lives up to the teens. Although parents may differ in how they try to control or socialize their children and the extent to which they do so, Yusuf (2014) opined that the primary role of all parents is to influence, teach and control their children. A parent is a person who fosters all facets of a child's growth by nourishing, protecting and guiding the child through the course of development Eze (2012). A parent in this study is one who has the duty of transferring values, norms and experiences that could influence the adolescent in the society because they exert the first influence on their children in all aspect of life before any other factor. The act of doing this which could

be referred to as parenting is described as a constellation of attitudes toward the child that are communicated to the child and that, taken together, create an emotional climate in which the parent's behaviour is expressed (Darling & Steinberg, 2013). Parenting means to act as a parent; to raise, to nurture, to cause to come to existence (Utti, 2016). The different ways parents mould, shape, and raise up their children differ depending on personality and exposure (Hill, 2012). Parenting was defined by (Chiew, 2011) as a universal climate in which families function and in which child rearing behaviour of parents or other primary care givers revolve. In this study, parenting is the skill or activity of looking after a child from infancy to adulthood and this gives rise to parenting styles.

Cramer (2012) defined parenting styles as aggregates of behaviours that describe parent - child interaction over a wide range of situations, and that are presumed to create a pervasive interactional climate. Utti (2016) defined parenting style as the act of parenthood, child upbringing, training, rearing or child education. Keiland (2010), observe that where an ideal parenting style is employed in the-home, the children are disciplined but where this is not; the reverse is the case.

Baumrind in Utti (2016) has the dimensions of parenting style as demandingness and responsiveness. Demandingness, as explained by him, means the degree to which, parents set down rules and expectations for behaviour and require their children to comply with them. Responsiveness, for him, entails the degree to which parents are sensitive to their children's needs and the extent to which they express warmth, love and concern for their children. Authoritative parents apply firm control and require their children to obey with a reasonable set of rule and guideline. They are firm, loving and kind and use reason and control to make disciplinary decisions while harsh forms of punishment are discouraged for use.

Authoritative parenting style offers a balance of warmth and control and emphasizes on reasoning and communication between parents and children.

Authoritarian parents on the other hand, are strictly unbending and inflexible. They may try to control every aspects of their children's life and do not allow the child to make choices. Authoritarian parents expect obedience without questioning. They may use harsh disciplinary method on their children and may be insensitive to their children's emotional needs. According to Ang and Goh (2016) Authoritarian parenting style is restrictive, directive, highly demanding and not responsive to the needs and demands of children. They do not often explain reasons behind the rules that they set and impose their consequences whenever a rule is broken. Sailor, (2010) noted that Authoritarian, parents use punitive and forceful measure to enforce proper behaviour, this causes anger, resentment and deceit, and impairs parent - child relationship.

Permissive parenting style is high on responsiveness and low on demandingness. Permissive parents rarely enforce rules for their children to follow. They are different from authoritarian parents as they practice high level of nurturance and clarity of communication while exercising low level of control and maturity demands (Sarac, 2011). These parents are indulgent, not wanting to impose their will on their children. They might cause their children to avoid even natural or logical consequences in order to save them from perceived harm, unhappiness or hurt. Permissive parents are usually kind and loving, may become frustrated when a child's behaviour is deviant or unacceptable. These parents rarely discipline their children because they have relatively low expectations and self-control. Permissive parents are more responsive than they are demanding. They are non-traditional and lenient. Research links permissive parents with delinquency,

substance abuse, and sexual activity (Sailor, 2010). Thus, their perception of how children think, and are to be raised is crucial in determining children's preparation for examination. (Mandara, 2016).

Statement of the Problem

In recent times, the state of failure of Civic Education among secondary school students has been alarming. In spite of the importance of Civic Education, Nigerian students at secondary school level are not doing well in Civic Education both in internal and external examination. There is the issue of Civic Education phobia (anxiety in Civic Education) which has not been overcome in the nation's secondary school. To reduce this Civic Education phobia, parents have to get involved as education of the child start at home. It is against this program that this study seeks to investigate parental attributes that could influence their children Civic Education performance anxiety in secondary school in Urueoffong/Oruko Local Government Area. However, none of the empirical works and literature were carried out in Urueoffong/Oruko Local Government Area of Akwa Ibom, State. Besides, most of the reviewed study did not use the same variables as used in the present study. This has therefore, created a gap which this study is set to fill. Hence, the need for this study which was designed to determine the relationship between parental attributes and Civic Education anxiety among students of Urueoffong/Oruko L.G.A of Akwa Ibom State.

Purpose of the study was to determine:

- (i) Parental involvement and Civic Education performance anxiety among secondary school students.
- (ii) Parenting styles and Civic Education performance anxiety among secondary school students.

Significance of the Study

The significance of the study is to find ways to reduce Civic Education performance anxiety among secondary students. When students are confident in their Civic Education abilities they will overcome their anxieties and perform better in examinations. The findings of this research will be of great significance to the parents because it will outline the attribute parent need to possess that will help the students reduce their anxiety towards Civic Education. The attributes are the level of involvement the parent has on the student's Civic Education skills which include parent-students monitoring, parent-students discussion, and parent-students support. Parenting style such as authoritarian, permissive and authoritative parenting styles increase or reduces the student's level of anxiety towards Civic Education.

Research questions

The following research questions were raised:

- (i) Is there any significant relationship between parental involvement and Civic Education performance anxiety among students?
- (ii) To what extent does parenting styles relate to Civic Education performance anxiety among secondary school students?

Hypothesis of the study

The following null hypotheses were tested at 0.05 level of significance

- (i) There is no significant relationship between parental involvement and Civic Education performance anxiety among secondary school students
- (ii) There is no significant relationship between parenting styles and Civic Education performance anxiety among secondary school students.

RESEARCH METHODOLOGY

The study adopted a correlational research design. The area of the study was Urueoffong/Oruko LGA of Akwa Ibom State. It is heterogeneous area of two main axes of Urue Offong development Area and Oruko Development Area; which have four different clans in terms of settlement into tribes such as Afaha Ubodung Clan, Ibighi clan, Okiuso Clan and Ukwong Clan with about (31) thirty-one villages and (10) ten political wards. It is bounded on South-East by Eket, Okobo and Oron L.G.A as well as Udung Uko and Mbo LGAs respectively. The people are typical farmers and career civil servants. The population of the study consisted of all the 4,223 students in Senior Secondary II in the 4 public secondary schools in Urueoffong/Oruko LGA, Akwa Ibom State Secondary Education Board (2023). The sample size for this study consisted of 253 senior secondary II students representing six percent (6%) of the study population. Two sets of instruments were used for the study. They included: a researcher developed questionnaire titled; Parental Attributes Questionnaire (PAQ) for students and Civic Education Performance anxiety Questionnaire (CEPQ) was used to collect data from the students on their experience on academic test anxiety. The PAQ contained 20 statements designed to gather information from students on the different Parental Attributes possessed by their parents at home. Five items were designed for each constructs of the independent variable. The independent variables covered various construct such as parenting styles, educational involvement, parent-child communication and parental level of education. CEPQ contained 10 statements designed to gather information from students on their experience on test in Civic Education. The PAQ was measured using a four-point rating scale with response categories of: SA= Strongly Agree = 4 points, A = Agree = 3

points, D = Disagree = 2 points, SD = Strongly Disagree = 1 point for positively worded questions. SA= Strongly Agree = 1 points, A = Agree 2 points, D Disagree = 3 points, SD Strongly Disagree = 4 point for negatively worded questions. While the TAQ was measured using A= Always - 4points, O=Often -3points, S= sometimes - 2points, and N = Never - 1 point. To ensure face validity of the two research instruments, the draft of the instruments was validated by three experts in sociology and measurement and evaluation respectively.

Cronbach Alpha Statistic was used for the reliability of the instrument which yielded a reliability co-efficient alpha of.89. The researcher administered the instruments with the help of two research assistants. The Questionnaires were administered to the respondents. Respondents were given adequate time to complete the questionnaire. The exercise was completed in two weeks. 227

questionnaires were retrieved after administration. Pearson Product Moment Correlation Coefficient Analysis was used to answer the research questions, while the r-value of the Pearson's Product Moment Correlation (PPMC) statistics was used to test the null hypotheses at 0.05 level of significance.

RESULTS AND DISCUSSION

Results

Answering of Research Question 1

What is the relationship between parental involvement and Civic Education performance anxiety among secondary school students?

Table 1: Result of Pearson Product Moment Correction Coefficient for the Relationship between Parental Involvement and Civic Education performance anxiety among Secondary School Students

Variable	X	X ²	ΣXy	r-cal	Decision	N=227
	ΣY	ΣY ²				
Parental involvement (X)	10187	139235	13254	-.354	Weak negative	
Civic Education performance anxiety (Y)	3296	464247				

Field source, 2023

Result in Table 1 shows the type and strength of relationship between parental involvement and Civic Education performance anxiety among secondary school students.

The results reveal that the calculated r-value of -.354 is weak in nature and in a Negative direction. This therefore, means that there is a

weak Negative relationship between parental involvement and Civic Education performance anxiety among secondary school students. The Negative relationship occurs because of increase in parental involvement is associated with decrease in Civic Education performance anxiety among secondary school students.

Research Question 2

What is the relationship between parenting styles and Civic Education performance anxiety among secondary school students?

Table 2: Result of Pearson Product Moment Correction Coefficient for the Relationship between Parenting styles and Civic Education performance anxiety among Secondary School Students

Variable	$\sum X$ $\sum Y$	$\sum X^2$ $\sum Y^2$	$\sum Xy$	r-cal	Decision	N=227
Parenting styles (X)	3067	171483	17061	-.248	Very weak negative	
Civic Education performance anxiety (Y)	3296	464247			Relationship	

Field source, 2023

Result in Table 2 shows the type and strength of relationship between parenting styles and Civic Education performance anxiety among secondary school students. The results reveal that the calculated r-value of -.248 is weak in nature and in a negative direction. This therefore, means that there is a weak negative relationship between parenting styles and Civic Education performance anxiety among secondary school students. The negative relationship occurs because of increase in the use of proper parenting styles is associated with decrease in Civic Education performance anxiety among secondary school students.

Testing of Hypotheses

Hypothesis 1

There is no significant relationship between parental involvement and Civic Education performance anxiety among secondary school students.

Table 3: Result of Pearson Product Moment Correction Coefficient for the Relationship between Parental Involvement and Civic Education performance anxiety among Secondary School Students

Variable	$\sum X$ $\sum Y$	$\sum X^2$ $\sum Y^2$	$\sum Xy$	r-crit	Decision at $P \leq 0.05$	$P \leq$
Parental involvement (X)	10187	139235	13254	.354	.088	
Civic Education performance anxiety (Y)	3296	464247				

*= significant at $P \leq 0.05$, N=227; df = 225.

The result of the analysis presented in Table 4.5 revealed that calculated-r value .354 is greater than the critical r-value of .088 at .05 level of significance with 225 degree of freedom. The result is significant. Therefore, the null hypothesis that "There is no significant relationship between parental involvement and Civic Education performance anxiety among secondary school students" is rejected. This result means that there is a significant relationship between parental involvement and Civic Education performance anxiety among secondary school students.

Hypothesis 2

There is no significant relationship between parenting styles and Civic Education performance anxiety among secondary school students.

Table 4: Result of Pearson Product Moment Correction Coefficient for the Relationship between Parenting Styles and Civic Education performance anxiety among Secondary School Students

Variable	ΣX	ΣX^2	ΣXy	r-value	r-crit	Decision at $P \leq 0.05$
	ΣY	ΣY^2				
Parenting Styles (X)	3067	171483	17061	.248		.088
Civic Education performance anxiety (Y)	3296	464247				

*= significant at $P \leq 0.05$, $N=227$; $df = 225$.

The result of the analysis presented in Table 4.6 revealed that calculated-r value of .248 is greater than the critical r-value of .088 at .05 level of significance with 225 degree of freedom. The result is significant. Therefore, the null hypothesis that "There is no significant relationship between parenting styles and Civic Education performance anxiety among secondary school students" is rejected. This result means that there is a significant relationship between parenting styles and Civic Education performance anxiety among secondary school students.

DISCUSSION

Parental Involvement and Civic Education performance anxiety

The findings of the study revealed that there is a significant relationship between parental involvement and Civic Education performance anxiety among secondary school students in Urueoffong/Oruko LGA. This result implies that most parents are involved in their children education and this reduces the level of students' anxiety in Civic Education. The answer to the research question which showed that there is a weak Negative relationship between parental involvement and Civic Education performance anxiety among secondary school students could imply that although many parents are interested in their students' overall academic success, their level of involvement is just low or average probably because they do not have the time to be involved or because they are unaware of the

possible ways of being effectively involved.

This result has been corroborated by other studies such as Fan (2011) who assessed the effect of parental involvement on the academic growth of high school students, the result showed that parents' educational aspiration dimension of parental involvement had a positive correlation with students' academic outcomes, other dimensions such as parents' volunteering and communication had no correlation with students' academic performance while contact with school had a negative effect on students' academic outcome.

Specifically, the findings revealed that parental involvement dimensions such as parents' assistance with homework, volunteering at school and attendance of school conferences had no positive significant correlation with students' academic achievement but that only parents' volunteering at school and helping children with homework had a significant relationship with students' behavioral problems.

The findings is also in agreement with the findings of Jeynes (2015) in a research conducted, a meta-analysis of twenty-one parental involvement researches carried out on urban elementary and middle school students from minority groups in America, the results indicated that parental involvement had a significant positive relationship on students' academic achievement, particularly for Grade Point Average and standardized tests, across all the six ethnic groups of students employed in the study.

Parenting Styles and Civic Education performance anxiety

The findings of the study revealed that there is a significant relationship between parenting styles and Civic Education performance anxiety among secondary school students in Itu LGA. This result implies that the kind of concern, care and follow-up parents give to their children differ as indicated by the respondents. The outcome of the result could

also be as a result of the fact that students from democratic and autocratic parenting homes, have different opinion on the involvement of parents in respect of their education, parents who get more involved in the monitor and supervision of their children vis-a-vis on their education have given their children the moral standing against examination anxiety.

This findings is in agreement with the findings of Ibukunolu (2013) who investigated the influence of parenting styles on the students' academic achievement in Junior Secondary Schools in Ogun state, Nigeria. The study showed that there was a significant difference between the academic achievement of students from democratic and autocratic parenting homes. Also, a significant difference exists between the level of involvement of parents of male and female students in their education.

This findings is in agreement with the findings of Darko (2018) who assessed the relationship between parenting styles on the academic performance of secondary school students in the Effutu Municipality specifically Winneba. The results of the study suggested that parenting styles have significant influence on the academic performance of students. Also, the study revealed that authoritative and authoritarian style of parenting has significant positive relationship with the academic performance of students as against permissive style of parenting which correlated negatively. The results imply that the academic performance of students could be enhanced when parents adopt either the authoritative or authoritarian style of parenting.

This findings is in agreement with the findings of Nyarko (2018) who conducted a study in Ghana using three senior high schools in the central region of Ghana as the sample. The schools are; University Practice Secondary School, Ghana National College and Assin Manso Secondary School all located in the central region of Ghana. The results of

the study indicated a positive and significant relationship between mothers and fathers' authoritativeness and the academic success of the students. Also, this findings is in agreement with the findings of Soni and Kumari (2015) who investigated whether children's math anxiety serves as an underlying pathway between parental math anxiety and their children's math achievement. It was found that father's math anxiety contributes positively to their son's and daughter's math anxiety and negatively to their math achievement. However, mother's math anxiety maintained a direct effect on their daughter's math achievement. The findings are explained in terms of the immense role of the parents in the development of Civic Education skills in children.

Ogoma (2019) determined gender and regional influences on the relationship between students' perceived parenting styles and their perceived learned-helplessness in Civic Education. Autocratic parenting styles related to higher levels of perceived learned-helplessness in Civic Education than the democratic parenting styles did. Parenting style related significantly and negatively with learned helplessness in Civic Education for rural but not for urban students, and also for boys but not for girls.

Summary

The focus of this study was to critically examine with the intention to provide solution to parental attributes and Civic Education performance anxiety among Secondary School Students in Urueoffong/Oruko Local Government Area in Akwa Ibom State, Nigeria.

Recommendations

It is recommended based on the findings and conclusions of this study that:

- (i) Parents should change their styles of parenting if it creates nervousness in their children.
- (ii) Parents should be involves in their children academic works by imbibing and maintaining good communication skills like; gracious looks or appreciative looks for good achievement, gestures, kindness, gently spoken words, tenderness and understanding. These will encourage high positive self-esteem and academic achievement especially of the adolescent students.
- (iii) Teachers should help communicate the anxiety level of students to parents regardless of their educational background.

Conclusion

It was concluded based on the findings that there is a significant relationship between parental attributes and Civic Education performance anxiety among secondary school students in Itu Local Government Area. The study further concluded that parental involvement, parenting styles, parental educational background, parental communication significantly relate to Civic Education performance anxiety among secondary school.

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REFERENCES

- Akpan O. A. (2018) The Effects of low self-esteem in children. Retrieved online on 28/10/12 from <http://www.livestrong.com/article/138859-the-effects-low-self-esteem-children/>
- Ang, R.P & Goh, D.H. (2016). Authoritarian parenting style in Asian society, A cluster -analytic investigation. *Contemporary Family Therapy: An International Journal* 28(1), 67-89.
- Anibueze, C. C. & Ugwuanyi, C. O. (2020) Effect of Parent-Child Communication Patterns on Junior Secondary School Students' Self-Esteem in Civic Education.
- Anibueze, CO. (2017). Effect of Civic Education Scrabble Game on Junior Secondary School Students' Achievement and Interest. *A Master's Dissertation of the Department of Science and Technology, Enugu State University of Science and Technology (ESUT), Enugu.*
- Bakare, T.V. (2014). Elements of adult teaching methods. Lagos: Unilag Press.
- Baumrind, D. (1991). The influence of parenting style on adolescent competence and substance use. *Journal of Early Adolescence*, 11(1), 56-95.
- Chiew, L. Y. (2011). Relationship of parenting style and self-esteem. *Unpublished B.Sc Project*, faculty of Arts and Social Sciences. University of Tunku Abdul Rahman.
- Chowa, G., Ansong, D. & Osei-Akoto, I. (2012). Parental Involvement and Academic Performance in Ghana. *Youth Save Research Brief*, CSD Publication 12-42.
- Christenson, S. L., (2012). Family factors and student achievement: An avenue to increase students' success. *School Psychology Quarterly*, 7(3), 178-206.
- Corey, G. (2015). *Theory and Practice of Counselling and Psychotherapy*. India: Cengage Learning. sl40- 141.
- Cramer, K. E. (2012). *Influence of parenting styles on children's classroom motivation. Master's Thesis Report*, Louisiana State University.
- Darling, N., & Steiberg, L. (2013). Parenting style as context: An integrative model. *Child Development*, 111, 487-496.
- Epstein, J. L. (1995). School/Family/Community Partnerships: Caring for the Children we Share. *Phi Delta Kappa*, 76 (9), 701-712.
- Eze S. (2006). Increased knowledge in geometry and instructional practice. *Journal for Research in Civic Education Education*, 28 (4), 467-483.
- Fan, X. (2011). Parental Involvement and Students' Academic Achievement: A Growth Modeling Analysis. *Journal of Experimental Education*, 70 (1), 27-61.
- Grolnick, W. S., & Slowiaczek, M. L. (2014). Parents' Involvement in Children's Schooling: A Multidimensional Conceptualization and Motivational Model. *Child Development*, 65, 237-252.
- Henderson, A. T., & Berla, N. (2014). *A New Generation of Evidence: The Family is Critical to Student Achievement*,

- National Committee for Citizens in Education, Columbia.
- Ibukunolu, A. A. (2013). Parenting Style and Students Academic Achievement in Junior Secondary Schools in Ogun State, Nigeria. *Journal of Emerging Trends in Educational Research and Policy Studies (JETERAPS)* 5(1): 20-24.
- Jeynes, W.H. (2015). A Meta-Analysis of the Relation of Parental Involvement to Urban Elementary School Student Academic Achievement. *Urban Education*, 40, 237-269.
- Joshua, R. (2010), Improving parental involvement and reading achievement of Caribbean Immigrant adolescents through differential instructions. Retrieved online on 27/10/12 from <http://udini.proquest.com/view/improving-parental-involvement-andgoid:763142466/>
- Kelland, N. C. (2010). *The basic principle of psychology*. New York: Harper and Row.
- Kumari, H. (2015). The study of impact of principal school conflict management strategies among job effectiveness of senior secondary school teachers. *International Journal Research*, 5(2), 134-139.
- Mandara, J. (2016). The impact of family functioning on African American males' academic achievement: A review and clarification of the empirical literature. *Teacher College Record*, 10, 205-222.
- Nekang, F.N. (2018). The Use of Mathematical Games and Secondary School Students' Achievement in Civic Education in Fako Division, South West Region of Cameroon. *Journal of Education and Entrepreneurship* 5(1), 20-31.
- Ngwoke, D.U (2016) self-esteem as a correlate of career preference of in-school adolescents in Anambra State, *Institute of Education journal, University of Nigeria, Nsukka*, 21(1) 110-118
- Nyarko, K. (2018). Parental Involvement: A sine qua non in adolescents' educational achievement. Retrieved from: <http://edoc.ub.unimuenchen.de/view/subjects/fak11.html>, on December, 2015.
- Ogoma, S.O. (2019). Parenting Styles and Learned Helplessness in Civic Education: Do Gender and Region Matter? *International Journal of Innovation and Research in Educational Sciences*, 6 (3), 48-52.
- Oledele, O. (2004) *Students Life in a Class Society*. He Ife: Olowo Publishers
- Sailor, D. H. (2010). Effects of parenting style on children's behaviour. Allyn Bacon, Prentice. Retrieved from reference/article/effect.parenting-styles-children-Behaviour/Authoritarian parenting.
- Sarac, S. (2011). Parenting styles how they affect children. Retrieved from Src=images/logo7.png>issue34/April-June.
- Schunk, D. H., & Zimmerman, B. J. (2016). Competence and Control Beliefs: Distinguishing the Means and Ends. In P. A. Alexander & P. H. Winne (Eds.), *Handbook of Educational Psychology* (2nd Ed.), 349-367, Mahwah, NJ:

Lawrence Erlbaum Associates.
September 9, 2019.

- Simon L. Sachs. (2008). Osu Extensions: Human development and family science Retrieved online from online osu.edu/hyg-fact/5000/pdf/5158.pdf on 6/5/23.
- Trusty, J. (2016). Relationship of Parental Involvement in Teens' Career Development to Teens' Attitudes, Perceptions and Behavior. *Journal of Research and Development in Education*, 30(1), 63-69.
- Ugama J.O. (2011). The Effects of Simulation games on Academic achievement of Junior Secondary School *Educational Research and Development* 50 (5) 45 - 58.
- Utti, A. (2016). Relationship between parenting styles and students' academic achievement in secondary schools in Ethiopia East L.G.A. of Delta State. *Unpublished M.Ed Thesis*, Delta State University Abaraka.
- Uwadiae, I. (2011). Head of Nigerian National office of WAEC <http://www.informationnigeria.org/2011/08/waec-May-June-20/11/2022> results released
- Uwadiae, S. (2021). Overcoming math anxiety. *Mathitudes*, 1(1), 1-4. Retrieved, July 14, 2008, from <http://www.coe.fau.edu/mathitudes/Math%20Anxiety%20Research%20Paper%202.pdf>
- Yusuf, S. B. (2008). *Training and School Effectiveness*. New York: Brace.



Impact of Teaching the Human Skeletal System using Models on Biology Student's Academic Performance and Retention in Uyo, Nigeria

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Abstract

The study examined the impact of teaching the human skeletal system using models on biology student's academic performance and retention in Uyo, Nigeria. The two models used were concrete and iconic. The concrete model used was the human skeletal system while a chart showing the human skeleton was used as the iconic model. The post-test performances as well as retention test performances of biology students taught using the concrete model were compared with those of their counterparts taught using the iconic model. The study also investigated the influence of gender on students' mean performance scores in biology with respect to concrete and iconic models. The design of the study was quasi-experimental, involving non-randomized pretest-posttest experimental group design. One hundred and forty-four (144) Senior Secondary one (SSI) Biology Students were drawn from two intact classes. The two intact classes were randomly assigned to concrete and iconic model groups, respectively. The biology performance Test (BAT) and Biology Retention Test (BRT) were administered as a Pre-test and Post-test and retention test, appropriately. Four research questions and four hypotheses were formulated to guide the study. The research questions were answered using descriptive statistics such as mean and standard deviation while the hypotheses were tested using Analysis of Covariance (ANCOVA). The results of the analyses showed that students taught using concrete models performed better than those taught with iconic models. Also, students taught using concrete model had a higher mean retention scores than those taught using iconic model. Gender was found to be a significant factor in students' performance as the male students performed better than the female students in both concrete and iconic models' groups. The same was observed with respect to retention. Judging from the findings of the study, I recommended that biology teachers employ the use of concrete models in teaching to enhance students' performance and retention.

Keywords: Models, Concrete model, Iconic model, Human skeletal system, Performance, Retention

INTRODUCTION

Science is a product of the mind seeking to review natural laws that govern the universe. It focuses on finding practical usage

for scientific discoveries and knowledge (Na'allah, 2016). Science as an institution aims at building knowledge and offering accurate

explanations of how the natural world works (Anaso, 2007; Kalu, 2007 and Ogunleye 2012). In recent times, science has attracted significant attention because of its role in driving the technological advancement of nations.

In Nigeria, science is taught at the secondary schools as basic science at the junior secondary school and as separate science subjects of Chemistry, Physics, and Biology at the senior secondary school levels (Onwuakpa and Nweke, 2009). Biology, as a branch of natural science, deals with the study of living organisms, including their structures, functioning, distribution, interrelationships, and evolution (Institute of Biology, 2013). The Nigerian secondary school biology curriculum is designed to facilitate students' investigation into natural phenomena and deepen their understanding and interest in biological sciences while encouraging them to apply scientific knowledge to everyday life (Federal Ministry of Education, 2013). At the secondary school level, biology is made a core science subject by the federal government of Nigeria and has the following objectives: providing adequate laboratory and field skills, providing relevant knowledge, building the capacity to apply scientific knowledge to everyday life, and developing functional scientific attitudes in students (Federal Ministry of Education, 2013).

Research indicates that some concepts in biology, which includes the skeletal system, contain some topics that are difficulty for biology students to understand (Esiobu and Soyibo, 2008). Many students have the notion that the skeletal system concepts are boring and can only be memorized (Zarotiadous and Tsaparlis, 2002 and Chew, 2014).

Nationally, the academic performance of students in biology is low and below expectation and the persistent failure of students in the subject has remained worrisome (Jegede, 2010). Giving the analysis

on the tracks of mass failure in the National Examination Council (NECO) results, Adesulun of Vanguard expressed "It is sad to note that for five consecutive years, candidates writing the National Examination Council (NECO) examination have recorded mass failures. Apparently, the scenario is worrisome to education stakeholders as nobody knows at whose doorsteps to place the blame, students or NECO" (Adesulum, 2012). The analysis reported that in 2002 at NECO's maiden edition, most candidates passed their registered subjects including Biology and English Language which led to the public accusing the body of awarding cheap results to students. However, after 2007 NECO November/December where 65% had credit pass in Biology, the analysis said, the performances of candidates deteriorated every year, down to 11.3% in the 2011/2012 result, a situation which the reporter said called for concern among stakeholders. During the NECO June/July 2011 examination, the analysis reported that less than 25% of the 1,160,561 candidates had passed at credit level in subjects including Biology. This implies that more than 870,421 candidates failed Biology and other subjects (Adesulum, 2012). In a similar vein, as reported by the WAEC Head of National Office, Yaba, Mr. Charles Eguridu, the result of May/June 2014 as was announced on Monday, 11 August 2014, witnessed a mass failure in Biology and English Language (Eguridu, 2012). He reported that 529,425 candidates representing 31.28% obtained credits in Biology and other four subjects. He noted that comparing this result to the 2012/2013 May/June result, there was a marginal decline in the performances of candidates. The report stated that in 2009, 25.99% obtained credits in Biology and English compared to 23.5% in 2008 among Nigerian candidates (Eguridu, 2012).

The reason for the poor performance includes the adoption of poor instructional delivery approaches, lack or improper use of

instructional materials such as the use of models, unavailability of laboratory facilities, inadequate allocation of time and large class size Etukudo, 2009; Salau (2012).

Models are generally considered concrete objects or representations utilized by teachers to make learning real (Eshiet, 2007). Models help to simplify complex systems making them easy to understand and comprehend (Ezeh, 2010). They are simplified devices that serve the purpose of depicting the actual object or desired feature. A model could designate a theory, a law, a classification, a hypothesis, or even science itself (Abler, Adam, and Gould, 2007). According to (Akpan, 2006), models are important in enhancing the effectiveness of teachers in the teaching-learning process, facilitating students' understanding, sustain the attention span of students while reducing mental strain and fatigue that may arise from abstraction.

Different authors adopt different modalities to classify models. For instance, Sowell (1974), classified models into concrete, pictorial, and abstract. However, for the purpose of this work, we will adopt the classification proposed by Bruner (2001), Akinsete (2007), and Eshiet (2007) which recognizes three types of models including concrete, iconic, and symbolic models. Concrete models are real objects or man-made casts that provide the representation of the features of the actual concept in three-dimensional planes (Eshiet, 2007). Unlike iconic and symbolic models, concrete models can be moved around or manipulated. Iconic models, on the other hand, could be pictures, diagrams, or sketches in 2-dimensional planes that represent the actual concept, making possible the recognition of the concept by looking at the sketches, diagrams, or pictures (Eshiet, 2003). The models involve the use of words or groups of words, letters, or signs to denote a phenomenon (Eshiet, 2007).

Models are widely adopted as part of

instructional strategy and they are widely applied in science teaching. According to Abimbola and Mustapha (2002), the use of models in teaching improves the academic performance of the students and encourages active participation of the learners. For teachers, the use of models enhances the understanding of scientific concepts, promotes the construction of knowledge, and encourages active discovery and independent learning (Ibe-Bassey, 2012).

Many researchers have studied the Effects of using models in teaching on the performance of science students. For instance, Owolabi (2007) reported that models have the ability to improve the performance and retention of students. The use of models also arouses students' interest and imagination and results in better understanding and retention of concepts according to Lagoke (2009). The study by Olarewaju (2012) reported a significant difference in the achievement of biology students when models were used in explaining the concepts. Sani (2006) in his study established that students taught with models performed significantly better than those taught with the lecture method.

Eshiet (2007) maintained that an important value of models in science and science education is the contribution to visualization of complex ideas, processes and systems. Okoro (2011) stated that models especially concrete and iconic has the tendency of enhancing students' performance and retention since it offers realistic experience which stimulate self-activity on the part of the learner.

Retention is the act of retaining or an ability to recall or recognize what has been learnt or experienced over a long period of time. Probably if what has been learnt is retained over a long period of time, it may lead to higher performance because retention is measured in collaboration with performances (Iji, 2010). Retention of concepts would help in reflective

thinking and the retained concepts can be used in reflective ways to solve novel problems. In light of this Ochonogor (2007) said that “indepth retention and performance in science technology and mathematics is an important need that is becoming highly felt by the Nigerian populace P₁₉.”

Akubailo (2004) reported that any model, which elicits adequate student's participation, has a profound effect on student's retention. Njoku (2014) opined that models concretize and elucidate difficult and abstract concepts thereby reducing students' problem of comprehension and application of concepts in problem solving. In this way models improve retention of knowledge and transfer of learning.

Research studies have shown that models enhance performance and retention of concepts in science while researchers such as Owolabi (2007) have shown that models improve performance and retention. Lagoke (2009) reported that the use of models arouse students interest and imagination and lead to understanding and retention of concepts. In this study, teaching with models would be used to see whether the result is the same or differently. Another variable which can affect student's academic performance is gender.

Gender issues and academic performance have become a very important issue among researchers. According to Nworgu (2014), there is an acknowledged problem of female under performance when compared with their male counterparts apparently under equivalent conditions and this problem of female under performance appears to be more pronounced in science and mathematics.

The term gender refers to socially ascribed roles, responsibilities, and opportunities associated with women and men, as the hidden power structures that govern relationships between them. Gender is in essence, a term used to emphasize that sex inequality is not caused by the anatomic and

physiological differences that characterize men and women, but rather by the unequal and inequitable treatment socially accorded to them (Igwe, 2013). In this sense, gender alludes to the cultural, social, economic, and political conditions that are the basis of certain standards, values, and behavioral patterns related to genders and their relationship.

Gender is the different sociocultural stereotyped roles and responsibilities expected of men and women. Gender is a parallel and socially unequal division into masculinity and femininity (Eze, 2008). The gender issue is an important factor in educational settings and could be a hindrance to the high performance of learners in science (Igwe, 2013). Some research works have shown contradicting evidence in students' academic performance in science due to gender. For instance, Ifeakor (2011) found that there is no significant difference in the performance of male and female students in biology and chemistry respectively.

This study therefore examined the effects of teaching the human skeletal system using models on the Performance of Students in Biology in Uyo, Nigeria. The study compared the performance of students taught using concrete models with those taught using iconic models

Statement of the Problem

Over the years, the performance of students in biology examinations has remained poor. One of the main reasons for this is poor teaching strategies adopted by teachers during classroom instruction. Teaching strategy is very vital in any teaching/ learning process as the strategy adopted by teachers may promote or hinder learning. It may sharpen mental activities which are the basis for social power or may discourage initiative and curiosity, thus making self-reliance and survival difficult for students. Teaching strategies affect the response of students and could determine whether he is interested, motivated, or

involved in any lesson. Student's poor performance has been attributed to teacher's failure to use effective teaching strategies such as the use of models as the cause of student's poor performance in biology. One of the effective ways to deal with this problem is for the teacher to provide a bridge between the unfamiliar concepts and the knowledge that the student possesses. This bridge can be the use of models which allows new materials, especially abstract concepts, to be easily assimilated with the student's prior knowledge thus enabling them to develop an understanding of the concepts. It is on this basis that the researcher is investigating the effects of teaching the human skeletal system using models on the performance and retention of students in biology in Uyo, Nigeria.

Purpose of the Study

The main purpose of the study was to examine "the effects of teaching human skeletal system using models on the performance of students in biology in Uyo Local Government Area in Akwa Ibom State, Nigeria". Specifically, the objectives of the study are as follows:

- (i) Compare the performances of students on the concept of human skeletal system in biology when taught using concrete and iconic models.
- (ii) Determine the differences in students' retention scores on the concept of human skeletal system in biology when taught using concrete and iconic models.
- (iii) Determine the performances of male and female students on the concept of human skeletal system when taught using concrete and iconic models.
- (iv) Compare the retention scores of male and female students on the concept of human skeletal system when taught using concrete and iconic models.

Research Questions

The following research questions were raised to guide the study:

- (i) What is the difference in the academic performances of students taught the concept of human skeletal system using concrete and iconic models?
- (ii) What is the difference in the retention scores of male and female students taught the concept of human skeletal system using concrete and iconic models?
- (iii) What difference exists between the academic performances of male and female students taught the concepts of human skeletal system using concrete and iconic models?
- (iv) No significant difference exists between the retention scores of male and female students taught the concept of human skeletal system using concrete and iconic models.

Research Hypotheses

The following null hypotheses were tested at 0.5 level of significance:

- (i) There is no significant difference in the mean performance scores of biology students taught the concept of human skeletal system using concrete and iconic models.
- (ii) No significant difference exists in the mean retention scores of students taught the concept of human skeletal system using concrete and iconic models.
- (iii) There is no significant difference in the mean performance scores of male and female students taught the concept of human skeletal system using concrete and iconic models.

- (iv) No significant difference exists between the retention scores of male and female students taught the concept of human skeletal system using concrete and iconic models.

RESEARCH METHODOLOGY

Design of the Study

The study adopted the quasi-experimental research design, precisely non-randomized pretest, posttest experimental group design. This was suitable because the researchers did not randomize respondents rather, they used intact classes.

Area of the Study

The study was conducted in Uyo Local Government Area of Akwa Ibom State. Uyo is a city and a local government area in the South-South Nigeria and is the capital of Akwa Ibom State, a major oil producing state. The town became the capital of Akwa Ibom State on September 23, 1987 following the creation of Akwa Ibom State from the erstwhile Cross River State. It has thirteen (13) public secondary schools two higher institutions are also established; they are the University of Uyo and Uyo City Polytechnic.

Population of the Study

The population of the study comprised of all the senior secondary one (SS1) Biology students in all the 13 public secondary schools in Uyo Local Government Area of Akwa Ibom State for 2022/2023 academic session. The estimated population size was 1,100 SS1 Biology Students.

Sample and Sampling Technique

The study sample consisted of 144 SS1

Biology students drawn from two selected schools in the study area. The number was obtained using Purposive sampling technique.

Instrumentation

The instrument used for data collection was the Biology Performance Test on Human Skeletal System (BPTOHSS) and Biology Retention Test on Human Skeletal System (BRTOHSS). BPTOHSS is a researcher-made instrument with 25 multiple choice items. The items were drawn to cover the basic concepts of the skeletal system, axial and the appendicular skeleton, importance of skeleton to man and the joints.

Validation of the Instrument

The instrument was face and content validated by two experts which reduced the initial pool to twenty items.

Reliability of the Instrument: The reliability of the instrument was 0.88.

On the bases of the high reliability index, the instrument was deemed suitable to be used in conducting the study.

Method of Data Collection

Data were collected using Biology Performance Test on Human Skeletal System (BPTOHSS). Students were taught the concept of human skeletal system for four weeks. After the treatment was the administration of the test item. In order to measure students' retention of the concept, the BPTOHSS items were reshuffled and administered to students three weeks after the post-test as retention test.

Method of Data Analysis

The data collected was analyzed using descriptive statistics (mean and standard derivation) and Analysis of Covariance (ANCOVA). The choice of ANCOVA is informed by the use of intact classes. Mean and standard derivation was used to answer the research questions raised. The post-test scores were used as a covariate in measuring students' retention.

using concrete and iconic models?

RESULTS

Research Question 1: What is the difference in the academic performances of students taught the concept of human skeletal systems

Table 1: Mean and standard deviation of students' pre-test and post-test cores with instructional models

GROUP	N	PRETEST		POST-TEST		GAIN SCORE
		1	SD ₁	2	SD ₂	
Concrete Model	70	32.62	9.46	57.11	9.00	24.49
Iconic Model	74	24.27	9.62	50.62	8.41	26.35

The summary of results in Table 1 shows that the mean performance gain scores of students taught the concept of human skeletal system using concrete model is 24.49, while that of those taught using iconic model is 26.35. This indicates that students taught using iconic models had a higher gain score than those taught using concrete models.

Research Question 2: What is the difference in the retention scores of students taught the concept of human skeletal system using concrete and iconic models?

Table 2: Descriptive mean and standard deviation of students' pre-test and retention test scores with instructional models

GROUP	N	POST-TEST		RETENTION		GAIN SCORE
		X ₁	SD ₁	X ₂	SD ₂	X
Concrete Model	70	57.11	9.00	65.96	8.96	8.85
Iconic Model	74	50.62	8.41	54.45	8.08	3.83

The summary of result in Table 2 shows that the mean retention gain score of students taught the concept of human skeletal system using concrete model is 8.85, while that of students taught with iconic model is 3.83. This indicates that students taught human skeletal system using concrete model had better retention than those taught using iconic model. This imply that concrete model facilitate retention better than the use of iconic model.

Research Question 3: What difference exists between the academic performances of male and female students taught the concept of human skeletal system using concrete and iconic models?

Table 3: Mean and standard deviation of students' pre-test and post-test scores by gender and treatment

GROUP	N	PRE-TEST		POST-TEST		GAIN SCORE
		1	SD ₁	2	SD ₂	
Male	73	31.45	10.28	57.29	9.00	25.84
Female	71	25.13	9.57	50.19	8.11	25.06

The summary of results in Table 3 indicates that the mean gain scores of male students taught the concept of human skeletal system using concrete and iconic models is 25.84, while that of female students is 25.06. In other words, Male and female students taught the concept of human skeletal system using concrete and iconic models do not differ significantly.

Research Question 4: What difference exists between the retention scores of male and female students taught the concept of human skeletal system using concrete and iconic model?

Table 4: Mean and standard deviation of students' pre-test and retention test scores by gender and treatment.

GROUP	N	POST-TEST		RETENTION		GAIN SCORE
		X ₁	SD	X ₂	SD	X
Male	73	57.29	9.00	64.33	9.65	7.04
Female	71	50.19	8.11	55.37	8.63	5.14

In Table 4, the mean retention gain score of male students taught the concept of human skeletal system is 7.04 while that of female students is 5.14. The mean retention gain score of male students is higher than that of their female counterparts.

academic performances of students taught the concept of human skeletal system using concrete and iconic models.

Table 5: Summary of Analysis of Covariance (ANCOVA) of students' post-test scores classified with instructional models with pre-test scores as covariates.

Testing the Hypotheses

HO₁: There is no significant difference in the

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	3990.262 ^a	2	1995.131	33.964	.000
Intercept	24703.055	1	24703.055	420.535	.000
Pre-test	2473.864	1	2473.864	42.114	.000
Group	242.704	1	242.704	4.132	.044
Error	8282.627	141	58.742		
Total	428728.000	144			
Corrected Total	12272.889	143			

a. R Squared = .325 (Adjusted R Squared = .316)

Note: Group = mode of instruction (concrete model and iconic model group)

The summary of results in Table 5 indicated that there is a significant difference in the academic performance of students taught the concept of human skeletal system using

concrete and iconic models $F(1,144) = 4.13, p < 0.05$. Therefore, the null hypothesis of no significant difference in the academic performance of students taught the concept of

human skeletal system using concrete and iconic model is rejected. This means that there exists a significant difference between the academic performance of students taught the concept of human skeletal system using concrete and iconic models.

HO₂: There is no significant difference in the

retention scores of students taught the concept of human skeletal systems using concrete and iconic models

Table 6: Summary of Analysis of Covariance (ANCOVA) of students' retention test scores classified by instructional models with post-test scores as covariate

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	5228.710 ^a	3	1742.903	25.483	.000
Intercept	8522.234	1	8522.234	124.606	.000
Post-test	161.595	1	161.595	2.363	.127
Pre-test	195.019	1	195.019	2.851	.094
Group	2457.532	1	2457.532	35.932	.000
Error	9575.116	140	68.394		
Total	531645.000	144			
Corrected Total	14803.826	143			

a. R Squared = .353 (Adjusted R Squared = .339)

Note: Group = mode of instruction (concrete model and iconic model group)

The summary of result in Table 6 indicates that the calculated $F(1, 144) = 35.932$, $p < 0.05$ is significant. Therefore the null hypothesis of no significant difference in the retention scores of students taught the concept of human skeletal system is rejected. This implies that there exists a significant difference of students taught human skeletal system using concrete and iconic models. Hence, instructional models have significant

relationship with students' retention on biology.

HO₃: There is no significant difference between the performances of male and female students taught the concept of human skeletal system using concrete and iconic models.

Table 7: Summary of Analysis of Covariance (ANCOVA) of students' academic performance scores classified by gender with pre-test scores as covariate

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	4383.895 ^a	2	2191.948	39.177	.000
Intercept	27071.057	1	27071.057	483.841	.000
Pre-test	2559.937	1	2559.937	45.754	.000
Gender	636.338	1	636.338	11.373	.001
Error	7888.994	141	55.950		
Total	428728.000	144			
Corrected Total	12272.889	143			

a. R Squared = .357 (Adjusted R Squared = .348) The summary of the result in Table 7 showed that the calculated $F(1, 144) = 11.373$, $p < 0.05$ is less than 0.05. Thus, it is significant. Therefore, the null hypothesis of no significant difference between male and female students taught the concept of human skeletal system using concrete and iconic models is rejected. Hence, there is a significant difference in the academic performance of male and female students taught the concept of human skeletal system using concrete and iconic models.

Ho₄: There is no significant difference in the retention scores of male and female students taught the concept of human skeletal system using concrete and iconic model.

This hypothesis was tested using Analysis of covariance (ANCOVA) of students' Retention scores classified by gender with post-test as covariate.

Table 8: Summary of Analysis of Covariance (ANCOVA) of students' retention scores classified by gender with post-test scores as covariate

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	3549.541 ^a	2	1774.771	22.235	.000
Intercept	7589.226	1	7589.226	95.082	.000
Post-test	658.303	1	658.303	8.248	.005
Gender	1577.906	1	1577.906	19.769	.000
Error	11254.285	141	79.818		
Total	531645.000	144			
Corrected Total	14803.826	143			

a. R Squared = .240 (Adjusted R Squared = .229)

The summary of result in Table 8 indicates that the calculated $F(1, 144) =$

19.769, $p < 0.05$ is significant. Therefore, the null hypothesis of no significant difference in

the retention scores of male and female students taught the concept of human skeletal system using concrete and iconic models is rejected. Hence, there is a significant difference in the retention scores of male and female students taught the concept of human skeletal system using concrete and iconic models.

The summary of the findings for this study from Tables 1 to 8 is as follows:

- (i) The models used in the study had a significant effect on the academic performance of students in the concept of human skeletal system. Students taught using concrete model had higher mean score than those taught using iconic model.
- (ii) Models had significant effects on the retention scores of students in the concept of human skeletal system. Students taught using concrete models retained better than those taught using iconic model.
- (iii) Gender had significant effect on the academic performance of male and female students in biology when taught the concept of human skeletal system using concrete and iconic models
- (iv) Gender had significant effects on the retention scores of male and female students in biology when taught the concept of human skeletal system using concrete and iconic models.

DISCUSSION

Effects of Models on Students' Academic Performance in Human Skeletal System:

The summary of results in Table 5 indicates that there is a significant difference in the performance of students taught the concept of human skeletal system using concrete and iconic model. As shown in Table 1, the mean academic performance of students taught the

concept of human skeletal system using concrete model, 57.11 was higher than that of the iconic model with mean academic performance of 50.62. This result could be due to the ability of the students to manipulate the different models of human skeletal system, hence developing a deeper attachment to the concepts taught. It could also be attributed to the learners' supplemental contact with the variables in real experiences because the principle is seen in action and colours. It is the researcher's belief that the use of concrete model has helped the students to develop confidence in themselves during the teaching/learning process.

The findings of this study is in accordance with the findings of Jiya (2011) who found that teaching-with-analogy enhances students' performance in biology than the lecture method. The finding is also in agreement with the findings of Owolabi (2007) who found that there is a significant influence of models on students' performance in physics. The finding agrees with the finding of Sani (2006) who found that models enhance the performance of students in chemistry more than the conventional method. The finding is also in accordance with Olanrewaju (2012) who found that the students taught using a cooperative learning strategy with models had a higher mean score than the students taught using a cooperative learning strategy without models.

Effects of Models on Students' Academic Retention in Human Skeletal System:

The summary of result in Table 6 indicates that there is a significant difference in the mean retention scores of students taught the concept of human skeletal system using concrete and iconic models. The mean score in Table 4 shows that students taught the concept of human skeletal system using concrete model had a higher mean retention score of 65.96 while those taught using iconic model had a

mean retention score of 54.45. The result could be attributed to the use of concrete model, the true picture of what was taught will always reflect in the students' mind each time there is need for it. For knowledge to develop, the acquired materials in the mind need to be preserved in form of images. Therefore, concrete model employed real images which captured the students' mind and helped them retain better. The male students probably retained better than the females because they are more inclined to science related subjects and have a natural positive attitude to science subjects while the females show negative attitude.

The findings of this study is in line with that of Udogu and Njelita (2010) who found that model (GLM) is very effective in enhancing meaningful leaning and retention among students. The finding is also in accordance with Olanrewaju (2012) who found that there was a higher retention ability by the students taught using cooperative learning strategy with models (CLS+M) than students taught using cooperative learning strategy without models (CLS).

Effects of Gender on Students' Academic Performance in Human Skeletal System:

The summary of the result in Table 7 indicates that there is a significant difference in the academic performance of male and female students taught the concept of human skeletal system using concrete and iconic models. The mean academic performance of male and female students shown in Table 2 indicates that the mean academic performance of male students, 57.29, is greater than that of the female students, 52.19. This may probably be because; the male students are already naturally inclined to scientific and technological fields. Also, male students tend to be more imaginative, creative, and critical while female students believe that science is too difficult and not important for their future. Also, male students are already inclined to

science subjects and see it as a necessity, therefore paying serious attention to lessons. The finding of the study agrees with that of Abdu-Raheem (2012) who found that male students achieved better than females in mathematics, science, and social sciences. The finding of the study is also in line with that of Olasehinde and Olatoye (2014) who found that there was a significant difference between male and female students in the overall science achievement.

Influence of Gender on Students' Retention in Human Skeletal System:

The summary of the result in Table 8 indicates that there is a significant difference in the mean retention scores of students taught the concept of human skeletal system using concrete and iconic models. The mean retention scores of male and female students shown in table 6 indicate that the mean retention test of male students, 64.33, is greater than that of the female students, 55.37. This means that the use of concrete model has certain advantages such as; it can easily be manipulated by the students as many times as needed unlike the iconic model. This is because the strategy allowed new materials, especially abstract concepts, to be more easily assimilated with the student's prior knowledge, enabling them to develop a more scientific understanding of the concept. These aid the memory retention resulting in higher performance of the students. The finding of this study is in line with the findings of Udogu and Njelita (2010) and Augustinah and Bolajoke (2014) who investigated the effects of models on senior secondary school students' achievement and retention in Biology. The results of their findings revealed that, there is a significant positive main effect of students' achievement and retention when taught with constructivist learning models. Male students had higher achievement scores than their female counterparts when taught using constructivist learning models. The findings of this study therefore indicate that teaching with

concrete model can enhance academic performance and retention of human skeletal system concepts among biology students.

Recommendations

In view of the observations made and their educational implications, the following recommendations are made:

- (i) Since concrete models have been found to improve students' performance, it is recommended that teachers of biology should always adopt concrete models in teaching various concepts in their classroom interactions instead of using iconic models as concrete model reduce abstractions associated with difficult concepts.
- (ii) Teaching and learning materials should be provided by government agencies such as State Governments and the Federal Ministry of Education for effective utilization of teaching with models in the teaching/learning of human skeletal system concept at SSS level.
- (iii) Models help encourage visualization and reorganization of science facts in the learner's cognitive structure; it should therefore be encouraged for teaching in the science classroom
- (iv) Biology teachers should be trained and retrained on the job to adopt the use of concrete models in the teaching and learning of biology. Training of biology teachers could be done by the Government or relevant professional bodies like Science Teachers Association (STAN) through seminars, workshops and conferences.
- (v) Teachers should select models that are familiar to students because such models are motivational to students, avoid time wastage, and are easy to use by the teachers.

Conclusion

Based on the findings from this study, it was concluded that concrete model as a teaching strategy facilitates students' academic performance in human skeletal system concept better than the use of iconic model. Gender is not a significant predictor of students' academic performance or retention in biology.

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REFERENCES

- Abdu – Raheem, B.O. (2012). The Influence of Gender on Secondary School Students' Academic Performance in South-West, Nigeria. *Journal of Social Science*, 31 (1), 93 – 98.
- Abimbola, I. O. & Mustapha, M. T. (2002). The Use of Analogies in Communicating Difficult Science Concepts to Secondary School Students. *Journal of Nigeria Teacher Today*, 5 (1), 52-55.
- Abler, R., Adam, J. S & Gould, P. (2007). *Spatial Organizations: The Geographys' view of the World*. London. 48p
- Adesulum, D. (2012). Mass failure in NECO results worry stakeholders. Vanguard News. Retrieved from <https://www.vanguardngr.com/>
- Akinsete, A. M. (2007). Effective Methods of Teaching Difficult Concepts in Chemistry, *Chemistry Education Research and Practice*, 2(2): 47-54.
- Akpan, E. U. U. (2006). The Use of Models in Teaching Secondary School

- Mathematics. In. I. T. Eshiet (Ed.) *Methodology of Science Teaching: Historical and Conceptual Approach*. Abak: Belpot (Nig.) Co., 137-144
- Akubuilu, D.U. (2004). The Effects of Problem Solving Instructional Strategies on Students' Achievement and Retention in Biology with Respect to Location in Enugu State. *Journal of Science Teachers Association of Nigeria*, 39 (1 and 2), 94-100.
- Anaso, J. M. (2007). Investigation into the Causes of Students' Poor Academic Achievement in Chemistry in Senior Secondary Certificate Examination, *Nigerian Journal of Science and Educational Research*, 1 (1), 98-119.
- Augustinah, N. D. & Bolajoke, A. O. (2014). The Effects of Models on Senior Secondary School Students Achievement and Retention in Biology, Department of Science Education, Faculty of Education, Ahmadu Bello University, Zaria, Nigeria, 52-58.
- Chew, F.T. (2014). Use of Analogies to Teach General Biology to Non-Biology Majors. <http://www.edt/.nus.edu.sg/link/mar2004/tm3.htm> (Retrieval 28/03/2009).
- Eguridu, C. (2012). West African Examination Council) Head of National office. (2014, August 11). May/June 2014 WASSCE results statistics: Mass failure in Biology and English Language. Retrieved from <https://ynaija.com>
- Eshiet, I. T. (2003). Models in Chemistry Teaching. In I. T. Eshiet (Ed.) *Methodology of Science Teaching: Historical and Conceptual Approach*. Belpot Nig Publishers, Abak. 109-114.
- Eshiet, I. T. (2007). *The Concept of Scientific and Technological Concepts*. Abaam Publishers, Uyo. 12-17.
- Esiobu, G.O. and Soyibo, k. (2008). Effect of Concepts and Vee Mapping under Three Learning Modes on Students' Cognitive Achievement in Ecology and Genetics. *Journal of Research in Science Teaching*, 32 (9), 971-995.
- Etukudo, U. E. (2009). The Effect of Computer Assisted Instruction on Gender and Performance of Junior Secondary School in Mathematics. *ABACUS Journal of Mathematical Association*, 1(1), 19-25
- Eze, S. A. (2008). The Relationship between Science Teachers' Perceived Self Efficacy and Job Performance. *Journal of Educational Research, Faculty of education, UNN*, 8, 162-170.
- Ezeh, M. O. (2010). Effect of the Use of Scale Models on Academic Achievement and Interest of Students in Map-work. Ph.D. Thesis. Department of Geography. University of Nigeria, Nsukka. 107p
- Federal Ministry of Education (2013). The development of Education. National Report of Nigeria. Abuja: Federal Ministry of Education.
- <http://www.ioe.org/user/files/Ar/www.pdf>. (Retrieved on January, 2007)
- Ibe-Bassey, G. S. (2012). Educational Technology: The Teaching Learning Process and the Falling Standard of Education in Nigeria. 35th Inaugural Lecture Series. University of Uyo, Uyo
- Ifeakor, A. C. (2011). Effect of Commercially Produced Computer Assisted Instruction Package on Students' Achievement and Interest in Secondary School Chemistry. Unpublished Ph.D Thesis. Nsukka: University Of Nigeria.
- Igwe, I. T. (2013). Enriching Science

- Education: The Place of Improvisation in Classroom. *Science Teachers Association of Nigeria (STAN) 41st Annual Conference Proceedings*. 51-53.
- Iji, C. O. (2010). Approach on Senior Secondary School Geometry. *Journal of Science Teachers' Association of Nigeria*, 3(2): 45-50.
- Institute of Biology (2013). A response from the Institute of Biology to the Environmental Audit Committee Company. Greener towns for the future? [Http://www.iob.org/userfiles/Ecotowns% 2025Apr2108.pdf](http://www.iob.org/userfiles/Ecotowns%2025Apr2108.pdf) (Retrieved on September, 2013).
- Jegede, O. J. (2010). The Effects of Concept Mapping on Student's Anxiety and Achievement in Biology. *Journal of Research in Science Teaching*, 27(10), 951-960.
- Jiya, A. (2011). Effects of Teaching- with - Analogy on Academic Performance and Retention of Evolution Concepts among Nigerian Certificate Biology Students. Department of Science Education, Faculty of Education, Ahmadu Bello University, Zaria, Nigeria. 168p.
- Kalu, U. U. (2007). Review of Factors Influencing the Attitude of Students towards Effective Study of Biology in Senior Secondary Schools in Nigeria. PhD. Thesis, Department of Science Education, University of Nigeria, Nsukka. 126p
- Lagoke, B.A. (2009). The Efficiency of Enriching Biology Teaching-With-Analogy on the Performance of Students of Different Achievement Levels, *Journal of Science Education*, 7(1), 40-44.
- Njoku Z. C. (2014). Effectiveness of Model for Science and Technology Instruction. *Journal of Science Teachers Association of Nigeria*, 39, 45-51.
- Nworgu, L.N. (2014). Effects of Gender Sensitization of Science Teachers on Gender Gap in Science Achievement and Interest among Students. Ph.D Thesis , University of Nigeria, Nsukka. 163p
- Ochonogor, E.C. (2007) Increasing Retention and Achievement In STM Through Innovative Approaches In Nigeria. *Proceedings of the 40th Anniversary Conference Proceeding Science Teachers' Association of Nigeria*, 75p.
- Ogunleye, A. O. (2012). An Investigation into the Availability and Extent of Resources in the Teaching of Physics in Some Lagos Public and Private Schools. *47th Annual Conference of STAN*, 283 – 290.
- Okoro, A. U. (2011). Effects of Interaction Patterns on Performance and Interest in Biology among Secondary School Students in Enugu State, Nigeria. M.Ed Thesis, Department of Science Education. University of Nigeria, Nsukka. 81p
- Olarewaju, R. R. (2012). Effects of Cooperative Learning Strategy with Models on Academic Achievement and Retention of Biology Concepts among Pre-National Diploma Students In Kaduna State, Department Of Science Education Faculty Of Education Ahmadu Bello University, Zaria, Nigeria. 160p.
- Olasehinde, K, J. & Olotoye, R. A. (2014). Comparison of Male and Female Secondary School Students' Learning Outcome in Science in Katsina State, Nigeria. *Mediterranean Journal of Social Sciences MCSER Publishing Rome-Italy*, 5 (2), 16-20.

- Onwuakpa, F. I. & Nweke, A. O. (2009). Enriching Science Technology and Mathematics Education in Secondary Schools through Effective Utilization of Resources in the Classroom, 41st *Annual Conference Proceedings of STAN*, 34-37.
- Owolabi, T. (2007). The Use of Analogy as a Vehicle for Achieving Effective Physics Delivery in Some Selected Senior Secondary Schools in Lagos. *Proceeding of Science Teachers Association of Nigeria National Conference, 2007*.
Republic of Nigeria, 4th Edition, NERDC, Lagos.
- Salau, M.O. (2012). The Effect of Class Size on Achievement of Different Ability Groups in Mathematics. *Journal of Science Teachers Association of Nigeria*, 31(1), 27-33.
- Sani, H.M. (2006). Effect of Analogy on Conceptual Understanding of Chemical Equilibrium among Secondary School Students in Minna Municipal, Niger State, Minna. *Journal of Science Education and Allied Research*, 2 (1), 46-51.
- Sowel, T. (1974). Mathematical Models for Geological Materials for Wave-Propagation Studies, Appeared in: "Shock Waves and the Mechanical Properties of Solids", Syracuse University Press, Syracuse. 53p.
- Udogu, M. E. & Njelita (2010). Effect of Constructivist Based Instructional Model on Students' Conceptual Change and Retention on Some Difficult Concepts in Chemistry. *African Research Review*. 4(2), 219-229.
- Zarotiadous, E. & Tsaparlis, G. (2002): Teaching Lower-Secondary Biology with Apiagetian Constructivist and Ausubelian Meaningful-Receptive Method: A Longitudinal Comparison. *Education: Research and practice in Europe*, 1(1), 37-50.



Educating Prospective Science Teachers in Green Chemistry Innovations for Sustainable Development

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Abstract

The integration of Green Chemistry Innovations in Science Teacher Education encourages the use of green alternatives and promotes the development of innovative teaching strategies that emphasize sustainability. This study examines science teachers educators' perception and attitude towards educating prospective science teachers in Green Chemistry innovations for sustainable development in Colleges of Education, South-South Nigeria. The study sample consist of 200 lecturers selected using simple random sampling technique from Schools of Sciences in Colleges of Education in South-South Nigeria. The instrument used in gathering data for the study was "Perception and Attitude of Science Teachers Educator' towards Integrating Green Chemistry Questionnaires (PASTEIGCQ)". Cronbach Alpha reliability formula was used to obtain a reliability coefficient of 0.84 for the instrument. Data obtained were analyzed using mean, standard deviation and t-test Statistics. The findings indicated that science teachers educators have good perception and positive attitude towards educating prospective science teachers in Green Chemistry innovations for sustainable development. Consequently, it was recommended among others that Green Chemistry principles should be integrated into science teacher education program for sustainable development in Nigeria.

Keywords: Science teacher education, Green chemistry, Sustainable development & Innovation

INTRODUCTION

The composition of the earth's atmosphere is currently undergoing an unprecedented change, largely due to industrial development, human activities and agricultural practices. These activities have resulted in an increase in the atmospheric concentration of pollutants gases such as carbon (iv) oxide and methane that are responsible for the greenhouse effect. The increase in the concentration of these pollutants gases have far reaching consequences on our environment. Agbayewa, Oloruntegbe and Alake (2013) asserted that the scientific estimate of these gases indicates a rise in the global mean temperature of between

1.4°C and 5.8°C over the next 100 years. Oil communities in Nigeria are living with gas stacks that flare gas 24 hours a day at a temperature range of between 13,000 to 14,000°C. The implications of temperature rise of these magnitude over time would impact negatively on earth's biocapacity. Our water bodies are not equally spared of pollutant from untreated affluent from scientific activities. Besides all these, there are other socio-economic and domestic issues and practices that necessitates the introduction of education for sustainable development into the Nigerian educational system particularly in the Science Teachers Training Institutions.

Sustainable development entails ensuring better quality of life for everyone both now and for generations to come. Although this idea is simple, the task is substantial. The rising interest in environmental literacy and education for sustainability has created expectations that timely, accurate content should be taught at all levels, particularly in science teacher education program (Owoyemi and Moju 2015). There is a need to educate prospective science teachers with the knowledge, skills and appropriate values to ensure sustainability. In recent years, a growing number of publications have emerged discussing how to integrate education for sustainable development into science education. However, in the Nigerian educational sector little is done in this area. In 2015, the United Nations (UN) issued the Agenda 2030 in which it defined seventeen Sustainable Development Goals (SDGs) to be achieved by 2030, among them SDG 4 "Quality Education" in general and education for sustainable development in particular (Linkwitz and Eilks, 2022). Education for sustainable development is a regulatory idea within the 21st century education in which all teachings and learning domains needs to contribute. According to Linkwitz and Eilks (2022), the agenda 2030 states that by 2030, all learners must acquire knowledge and skills needed to promote sustainable development, including and among others through education for sustainable development and sustainable lifestyles, human rights, gender equality and appreciation of cultural diversity and of cultures contribution to sustainable development. An analysis of the United Nations Environmental Program (UNEP), namely the Global Chemical Outlook II (GCO II), was also published recently with focus among other things on chemistry education (UNEP, 2019). The GCO II generally suggests that science is central to many challenges laid down in the SDGs and is connected to almost all of them. Sequel to that fact that science is

central to many sustainable challenges today, education for sustainable development needs to become a central focus of science education at all levels.

One of the strategies taken to address education for sustainable development is through the integration of Green Chemistry innovations into the science teacher education curriculum. Curriculum action is necessary to provide learners with a contemporary, balanced view of how science is carried out today and should be in the future. It is also important to learn how changes in chemistry and its associated application affects the environment and society. The concept of Green Chemistry (GC), also known as Sustainable Chemistry (SC) was developed and introduced by Paul V. Anasta and John Warner in 1998 in response to growing adverse effects of science on the environment. According to Anasta and Warner (1998), Green Chemistry is the utilization of a set of principles that reduces or eliminates the use of or generation of hazardous substances in the design, manufacture and application of chemical products. Below are the twelve principles of Green Chemistry as outlined by Anasta and Warner (1998):

- (i) Prevention: It is better to prevent waste than to treat or clean up waste after it has been created.
- (ii) Atom Economy: Synthetic method should be designed to maximize incorporation of all materials used in the process into the final product.
- (iii) Less Hazardous Chemical Synthesis: Wherever practicable, synthetic methods should be designed to use and generate substances that possess little or no toxicity to human health and the environment.
- (iv) Designing Safer Chemicals: Chemical product should be designed to effect their desired function while minimizing their toxicity.

- (v) **Safer Solvent and Auxiliaries:** The use of auxiliary substances (e.g solvent separation agent) should be made unnecessary where ever possible and innocuous when used.
- (vi) **Design for Energy Efficiency:** Energy requirements of chemical processes should be recognized for their environmental and economic impact and should be minimized if possible, synthetic methods should be conducted at ambient temperature and pressure.
- (vii) **Use of Renewable Feedstocks:** A raw material or feedstock should be renewable rather than depleting whenever technically and economically practicable.
- (viii) **Reduce Derivatives:** Unnecessary derivatives (use of blocking group, protection/deprotection, temporary modifications of physical/chemical processes) should be minimized or avoided if possible, because such steps require additional reagent and can generate waste.
- (ix) **Catalyst:** Catalyst reagent (as selective as possible) are superior to stoichiometric reagents.
- (x) **Design for Degradation:** Chemical products should be designed so that at the end of their function, they break down into innocuous degradation products and do not persist in the environment.
- (xi) **Real-Time Analysis of Pollution Prevention:** Analytical methodologies need to be further developed to allow for real-time, in-process monitoring and control prior to the formation of hazardous substance.
- (xii) **Inherently Safer Chemistry for Accident Prevention:** Substances and the form of a substance used in a chemical process should be chosen to

minimize the potential for chemical accident, including releases, explosion and fires.

Green Chemistry is a student centered active learning approach of teaching science content in an eco-friendly way. According to Umanah and Udo (2021), Green Chemistry is the practice of chemical science and manufacturing in a manner that is sustainable, safe and non-polluting and that consumes minimum amount of materials and energy while producing little or no waste materials. It is a science of creating safe, energy efficient and non-toxic products and processes and provides a concrete path towards solving the environmental problems that we are facing in our society. The adoption of Green Chemistry begins with recognizing that production, processing, use and eventually disposal of chemical products may be disastrous if not done in the proper way. Basically, Green Chemistry harnesses a vast body of scientific knowledge and applies it in the production, use and ultimate disposal of chemicals in a way that minimizes consumption of materials, exposure of living organisms, including humans to toxic substances and damage to the environment. This practice must be done in a way that is economically feasible and cost effective. Owoyemi and Moju (2020) asserted that with the knowledge of Green Chemistry, scientists can manipulate the molecular characteristics of substances so that it possesses a reduced hazard or no hazard at all. Karpudewan, Ismail and Mohamed (2011) opined that, Green Chemistry is interdisciplinary in nature and involves exploration of the environment. Hence, it can serve as a theme to facilitate integrative and interdisciplinary learning experiences where the students use their critical thinking and communication skills to address complex problems facing the scientific enterprise. Through the application of Green Chemistry principles, Green Chemistry innovation can contribute to sustainable development.

According to Eze (2015), in the United Kingdom (UK), the Green Chemistry Network (GCN) was established as far back as 1998 to help promote and encourage the application of Green Chemistry in all area where Chemistry plays a significance role. In 1990s the Green Chemistry Institute (CGI) was established in USA which is now part of the American Chemical Society. There is also a presidential award instituted for Green Chemistry innovations in USA.

In Nigeria these principles are not considered with seriousness on the part of the educational stakeholders. As Nigeria hopes to join the league of industrialized nations and move the frontiers of development beyond 2030, there is a need for prospective science teachers to be armed with good knowledge of Green Chemistry principles. Teacher training institutions have an important role to play due to the impact that they have on the curricula and policy for the implementation of these curricula to bring about systematic economically efficient changes. One of the objectives of teacher education in Nigeria as enunciated by the (National Policy on Education (2013) among others is to provide teachers with the intellectual and professional background adequate for their assignment and make them adaptable to changing situations. The emerging world order requires that Green Chemistry principles be internationalized and put into practice. This task falls squarely on science teachers, hence, the need to educate prospective science teachers on Green Chemistry innovations for sustainable development. The curriculum used for science teacher education program need to be enriched with these cutting edge principles as the country strives to position herself among the developed countries of the world. It is imperative that science must turn away emphasis on the exploitation of limited resources and the production of increasing amount of products that ultimately end up as waste. The way forward is the application of

science in avenues that provide for human needs without damaging its support system upon which all living things depend. Industries should churn out products that are innocuous to good health, environmental friendliness and resource sustainability.

The practice of science in a manner that maximizes its benefits while eliminating or at least reducing its adverse effect is a good justification for educating prospective science teachers on Green Chemistry principles for sustainable development. Auliah, Muharram and Mulydi (2018) asserted that the concept of sustainability, which is born by Green Chemistry should be socialized and introduce at all levels of education. Sameena and Gowda (2015) and Hessein and Ahmed (2021) opined that Green Chemistry is a tool for inspiring students to pursue scientific careers that is often abstract and preparing the student for future sustainability challenges. In the opinion of Caruana (2015), Owoyemi and Umanah (2019) and Chhangani (2023), the concept of green chemistry, when properly harnessed, has the ability to shape future sustainability and development. Green Chemistry should be introduced into the curriculum so that the academia and the industry will work towards curbing the effect of the dangerous chemicals in the environment through teaching. Hence, this study is intended to investigate the science teachers educators' perception and attitude towards educating prospective science teachers in Green chemistry innovations for sustainable development.

Gender is considered as one of the variables that may likely affect the perception and attitude of science teachers educators towards educating prospective science teachers in Green Chemistry innovations for sustainable development. Gender is an analytical concept that describes the sociological roles, cultural responsibilities and expectations of men and women in a given society or cultural setting (Eya and Ezech, 2020). Studies on gender as it affects the

integration of Green Chemistry into science education curriculum are inconclusive. Sameena and Gowda (2015) reported a significant difference in the perception and attitude towards Green Chemistry between undergraduate male and female students, while Owoyemi and Moju (2020) observed that gender has no significant influence on science teachers' perception and attitude towards the integration of Green Chemistry principles. Since the reports from various studies on gender are inconsistent, gender as a variable attracts further investigation in this study.

Statement of the Problem

Nigeria as a nation, is not exempted from the various environmental problems such as climate change, air pollution and water pollution among others that are ravaging the world today. One of the ways of addressing these global issues is the integration of Green Chemistry principles through Education for Sustainable Development (ESD) into the educational system to empower the students with adequate knowledge on how to make the environment sustainable for this generation and future generations. In the Nigerian education system, the concept of Green Chemistry is relatively new and Nigerian science teachers are grappling with the challenges arising from the scientific and technological demands of the modern society. Some of these challenges are overwhelming to our science teachers because they do not receive training on them while in the teacher training institutions. To forestall this ugly situation, there is a need to educate prospective science teachers in Green Chemistry Innovations for sustainable development. This will make the pre-service teachers conversant with the principles of Green Chemistry before they become full-time classroom teachers. This study investigates science teachers educators' perception and attitude towards educating prospective science teachers in Green Chemistry Innovation for Sustainable

Development.

Research Questions

The following research questions guided the study:

- (i) What is the perception of science teacher educators (male and female) towards educating prospective science teachers in Green Chemistry Innovations for sustainable development in Colleges of Education?
- (ii) What is the attitude of science teacher educators (male and female) towards educating prospective science teachers in Green Chemistry Innovations for sustainable development in Colleges of Education?

Research Hypotheses:

- (i) There is no significant influence of gender on science teachers educators' perception towards educating prospective science teachers in Green Chemistry Innovations for sustainable development in Colleges of Education.
- (ii) There is no significant influence of gender on science teachers educators' attitude towards educating prospective science teachers in Green chemistry innovations for sustainable development in Colleges of Education.

RESEARCH METHODOLOGY

The study adopted the descriptive survey research design. The population of the study consisted of all the 882 lecturers in Schools of sciences in the 10 Colleges of Education in South-South Nigeria. Simple random sampling technique was used to select 20 lecturers from Schools of Sciences in each of the 10 Colleges of Education. This constituted a sample size of 200 (108 male and 92 female) lecturers. A researcher developed

instrument titled "Perception and Attitude of Science Teacher Educators' towards integrating Green Chemistry Questionnaire (PASTEIGCQ)" was used for data collection. The instrument was made up of three sections (A, B and C). Section A contained demographic information such as name of institution and gender of the participants. Section B was made up of 10 items on participant's perception on educating prospective science teachers on Green Chemistry Innovations for sustainable development and section C was made up of 10 items on participants' attitude towards educating prospective science teachers on Green Chemistry Innovations for sustainable development. Section B and C were designed on a four-point rating scale of Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD). The questionnaire was subjected to face and content validation by three independent assessors; two content experts in chemistry education and one measurement and evaluation expert. The reliability of the instruments with determined by the statistical analysis of data generated from a pilot today. Cronbach alpha reliability formula was used to obtain a reliability coefficient of 0.84 for the instrument. Out of 200 copies of the questionnaires that were

administered, 198 copies were returned representing 99% return rate. The decision rule adopted for the research questions was made using real number as follows: mean scores between 3.50 - 4.00 (Strongly Agree), 2.50-3.49 (Agree), 1.50-2.49 (Disagree) and 0.50-1.49 (Strongly Disagree). Also, for research question 2, whenever the average means score was less than 2.50, it was taken to indicate negative attitude while 2.50 and above, was taken to indicate positive attitude. Data collected were analyzed using mean and standard deviation to answer the research questions while t-test was used to test null hypotheses formulated at 0.05 alpha level.

RESULTS

Research Question One: What is the perception of science teachers educators (male and female) towards educating prospective science teachers in Green Chemistry Innovations for sustainable development in Colleges of Education?

Table 1: Science Teachers Educators' Perception towards Educating Prospective Science Teachers in Green Chemistry Innovations for Sustainable Development.

S/N	ITEMS	MEAN	STANDARD DEVIATION	REMARKS
1	Green chemistry principles should be practiced in the laboratories	3.58	0.81	SA
2	Science teachers educators are in the right position to promote green chemistry activities in the teaching and learning processes	2.88	0.72	A
3	Science teachers educators remain at the center of any innovation in the science education curriculum.	3.60	0.88	SA
4	As a science teacher educator, I have a pivotal role of integrating green chemistry principles in my teaching.	3.50	0.78	SA
5	It is better to prevent waste generation than to eliminate it after generation.	3.80	0.64	SA

6	The knowledge of green chemistry is necessary for science teachers and students	3.50	0.91	SA
7	Integrating Green Chemistry principles into the science teacher education curriculum can be a solution to environmental issues.	2.58	0.79	A
8	Science teachers are the major stakeholders in the implementation of green chemistry.	2.84	0.67	A
9	Green chemistry has a potential of reducing the negative impact of the chemical products on humans and environment.	3.20	0.91	A
10.	Green chemistry ensure s environmental sustainability	3.48	0.80	A
	Average Mean	3.27	0.79	A

N = 198 (106 male and 92 female)

The result in Table 1 showed the perception of science teacher educators towards educating prospective science teachers in green chemistry innovation for sustainable development in Colleges of Education. The results showed that the mean value of 6 out of 10 items in the table ranged from 2.58 to 3.48 which were between the boundary limit of 2.50 to 3.49 on a 4-points rating scale. This mean that the items were rated “Agreed” by respondent. The remaining 4 items had mean values ranging from 3.50 to 3.80 which is between the boundary limits of 3.50 to 4.00 on 4-point rating scale. This is an indication that the items were rated by the respondents as “Strongly Agreed”. The table also show that the average standard deviations score of 0.79 indicating that the spread of the scores from the mean was not wide apart. However, since the average mean score fell between 2.50 to 3.49 it implies that science

teachers educators (male and female) agreed that prospective science teachers should be educated in Green Chemistry Innovations for sustainable development. This implies that the lecturers perceived that educating prospective science teachers in Green Chemistry Innovations can help to tackle the environmental issues.

Research Question Two: What is the attitude of science teachers educators (male and female) towards educating prospective science teachers in green chemistry innovations for sustainable development in Colleges of Education?

Table 2: Science Teachers Educators' Attitude towards Educating Prospective Science Teachers in Green Chemistry Innovations for Sustainable Development

S/N	ITEMS	MEAN	STANDARD DEVIATION	REMARKS
1	I would like to know more about Green Chemistry.	3.20	0.58	A
2	I am ready to incorporate Green Chemistry principles into my science classes.	2.96	0.91	A
3	I am ready to change my current laboratory practices in order to incorporate Green Chemistry principles.	3.20	0.84	A

4	Curriculum planners should integrate Green Chemistry principles into the science curriculum.	2.94	0.62	A
5	As a teacher, I believe that the knowledge of Green Chemistry is necessary for science students.	3.08	0.81	A
6	Green Chemistry should be made compulsory in science teacher education	2.70	0.78	A
7	I have a responsibility to engage in Green Chemistry practices.	3.20	0.88	A
8	Green Chemistry concept in the science teacher education curriculum can help to solve our current environmental challenges.	2.72	0.71	A
9	As a teacher, I can play an important role in solving environmental problems through Green Chemistry.	2.84	0.82	A
10	I am of the opinion that Green Chemistry can improve teacher's and student's interest in science.	3.21	0.79	A
Average Mean		3.01	0.72	A

N = 198 (106 male and 92 female)

The data presented in Table 2 revealed the attitude of science teachers educators towards educating prospective science teachers in Green Chemistry Innovation for sustainable development in Colleges of Education. The result showed that the mean value of all the thing items in the table ranged from 2.70 to 3.20 which were between the boundary limit of 2.50 to 3.49 on a 4-points ratings scale. This means that the items were rated “Agreed” by the respondents. The table also showed the average standard deviations score of 0.72 indicating that the spread of the scores from the mean was wide apart. However, since the average mean score is greater than 2.50, it implies that the science teacher educators (male and female) have a positive attitude towards educating

prospective science teachers in Green Chemistry Innovations for sustainable development.

Hypotheses Testing

HO₁: There is no significant influence of gender on science teachers educators' perception towards educating prospective science teachers in green chemistry innovations for sustainable development in Colleges of Education.

Table 3: T-test Analysis of Science Teachers Educators' Perception towards Educating Prospective Science Teachers in Green Chemistry Innovations for Sustainable Development in Colleges of Education

Gender	N	Mean	SD	Df	T-cal	T-crit	Decision at $p \leq 0.05$
Male	106	3.11	0.78				
Female	92	2.98	0.62	196	1.30	1.97	NS

Data in Table 3 above shows the mean and standard deviation of science teachers educators' perception towards educating prospective science teachers in Green Chemistry Innovations for sustainable development classified by gender. The calculated t-value 1.30 is less than the critical t-value 1.97 at degree of freedom, Df 196. This implies that there is no significant difference between male and female science teachers educators' perception towards educating prospective science teachers in Green Chemistry Innovations for sustainable development in Colleges of Education. Therefore, the null hypothesis, H_{01} , is

accepted.

H_{02} : There is no significant influence of gender on science teachers educators' attitude towards educating prospective science teachers in Green Chemistry Innovations for sustainable development in Colleges of Education.

Table 4: T-test Analysis of Science Teachers Educators' Attitude towards Educating Prospective Science Teachers in Green Chemistry Innovations for Sustainable Development in Colleges of Education

Gender	N	Mean	SD	Df	T-cal	T-crit	Decision at $p \leq 0.05$
Male	106	2.98	0.69				
Female	92	3.03	0.74	196	0.50	1.97	NS

Data in Table 4 above shows the mean and standard deviation of science teachers educators' attitude towards educating prospective science teachers in green chemistry innovations for sustainable development classified by gender. The calculated t-value 0.50 is less than the critical t-value 1.97 at degree of freedom, Df 196. This implies that there is no significant difference between male and female science teachers educators' attitude towards educating prospective science teachers in Green Chemistry Innovations for sustainable

development in Colleges of Education. Therefore, the null hypothesis, H_{02} , is accepted.

DISCUSSION

The result in Table 1 showed that science teachers educators are of the view that prospective science teachers should be educated in Green Chemistry Innovations for sustainable development, this is evidenced in their high level of agreement displayed in their perception towards educating prospective science teachers in Green Chemistry

Innovations for sustainable development. This is impressive as science teachers educators in Nigeria are willing to integrate the concepts of Green Chemistry in educating prospective science teachers. This finding is in agreement with Owoyemi and Moju (2020) who observed that science teachers in Nigeria are of the view that Green Chemistry concepts should be integrated into science teachings. This finding is also consistent with Chhangani (2023) who observed that Green Chemistry concept when properly harnessed has the potential of shaping future sustainability and development. However, findings negate that of Auliah Muharram and Mulyadi (2018) who observed in their study that only 31.88% of science teachers believed that the principles of Green Chemistry should be integrated into science teaching and learning.

The result in Table 2 showed that science teachers educators possess positive attitude towards educating prospective science teachers in Green Chemistry for sustainable development in Colleges of Education. This is a sort of relief as it is a known fact that teachers' attitude is key in any effort to incorporate any emerging issue into the curriculum. This finding is in line with the findings of Owoyemi and Moju (2015) and Owoyemi and Moju (2020) who observed that Nigerian teachers possess high positive attitude towards the incorporation of green chemistry principles into the curriculum in Nigerian learning institutions. This finding corroborates the findings of Caruana (2015) who opined that positive attitude to the practice of Green Chemistry in schools is a good sign for sustainable development. This finding contradicts that of Umanah and Udo (2021) who observed that teachers in Nigerian schools are negatively disposed towards the integration of Green Chemistry principles into the curriculum of Nigerian schools.

The results in Table 3 and 4 reveal that gender does not have any significant influence on the perception and attitude of science teacher educators towards educating

prospective science teachers in Green Chemistry innovations for sustainable development. This implies that both male and female lecturers hold the same view and possess the same attitude towards the integration of Green Chemistry principles in science teacher education programme. This finding is in agreement with Owoyemi and Moju (2020) who observed that gender has no significant influence on science teachers' perception and attitude towards the integration of Green Chemistry principles. However, the finding contradicts that of Sameena and Gowda (2015) who reported a significant difference in the perception and attitude towards Green Chemistry between undergraduate male and female students.

Recommendations

The following recommendations were made based on the findings of the study:

- (i) Green Chemistry principles should be integrated into science teachers' education program for sustainable development in Nigeria.
- (ii) The government should support and prioritize industries that adhere to Green Chemistry principles in their operations.
- (iii) Stakeholders in education, industries and environmental protection agencies should promote and raise the awareness on Green Chemistry principles.
- (iv) In-service training, seminars, workshops and conferences should be organized for science teachers for capacity building on Green Chemistry education.

Conclusion

Educating prospective science teachers in Green Chemistry Innovations is a significant step towards ensuring environmental sustainability. Consequent upon the findings of

this study, it is concluded that prospective science teachers should be educated on Green Chemistry Innovations for sustainable development in Colleges of Education. This is evident in their high level of agreement displayed in their perception and positive attitude towards incorporating Green Chemistry into the science teacher education curriculum.

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REFERENCES

- Agbayewa, J. O., Oloruntegbe, K. O., & Alake, E. M. (2013). Incorporating Green Chemistry Concepts into the Senior Secondary School Curriculum. *International Journal for Cross-Disciplinary Subject in Education*, 3(3), 1490-1494
- Anastasia, P. T. & Warner, J. C. (1998). *Green Chemistry: Theory and Practice*. New York: Oxford University Press.
- Auliah, A., Muharram, M. & Mulyadi, A. (2018). Indonesian Teachers' Perception on Green Chemistry Principles: A Case Study of a Chemical Analyst Vocational School. *Journal of Physics Conference Series*, 1023, 1-6
- Caruana, M., F. (2015). Greening the Chemistry Curriculum in Maltese Educational Institutions: The Reaction of Pre-University Student to the Introduction of Green Chemistry: A Case Study from Malta. Ph.D University of York.
- Chhangani, M. K. (2023). Revitalizing Chemistry Teacher Education: Enriching the Curriculum with Green Chemistry Principles. *International Journal of Modernization in Engineering Technology and Science*, 5(6), 3887-3891.
- Eze, C.C. (2015). Enriching Chemistry Teacher Education Curriculum through Integration of Green Chemistry Principles. *Knowledge review* 32, (1) 1 – 6.
- Eya, N. M. & Ezech, D. N. (2020). Meta-Analysis of Influence of Gender in Students' Academic Achievement in Chemistry in Nigeria. *Journal of Chemical Society of Nigeria*, 45(4), 615-619.
- Hessein, A. A. & Ahmed, S. D. (2021). Awareness of the Principles of Green Chemistry among Middle School Teachers. *Turkish Journal of Computer and Mathematics Education*, 12(7), 475-482.
- Karpudewan, M., Ismail, Z. H. & Mohamed, N. (2011). Green Chemistry: Educating Prospective Science Teachers in Education for Sustainable Development at School of Educational Studies USM. *Journal of Social Sciences*, 7(1), 42-50
- Linkwitz, M. & Eilks, I. (2022). An Action Research: Teachers' Journey while Integrating Green Chemistry into High School Chemistry Curriculum. *Sustainability*, 14, 10621. <https://doi.org/10.3390/su14171062>. Retrieved on 3rd March, 2024.
- National Policy on Education (2013). *Federal Republic of Nigeria*. Lagos: NERDC Press.
- Owoyemi T. E. & Moju, M. (2015). Nigerian Senior Secondary School Science Teachers' Knowledge and Attitude Towards Education for Environmental Sustainability. *Soo/eczenstwo I Rodzina (society and family)*, 42(1), 66-77
- Owoyemi T. E. & Moju, M. (2020). Investigating Chemistry Teachers' Perception and Attitude Towards Integration of Green Chemistry

- Principles into Secondary School Chemistry Curriculum; A Case Study of Lagos State. *Journal of Curriculum and Instruction*. 13(1), 57-71.
- Owoyemi T. E. & Umanah, F. I. (2019). Chemistry Teachers' Knowledge of the Concept and Principles of Green Chemistry based on their professional qualification in Akwa Ibom State. *Journal of Science Teachers' Association*, 54(1), 149-157
- Owoyemi, T. E. & Adesina, S. (2018). Promoting Environmental Sustainability Through Green Chemistry Pre-Service Teachers and In-Service Chemistry Teachers' Knowledge and Attitude in Lagos State. A Paper Presented at University of Lagos 2018 Conference Fair. University of Lagos.
- Sameena, A. & Gowda, S. M. (2015). Green Chemistry: An Awareness among Degree Students of Bangalore City Colleges. *International Journal of ChemTech Research*, 3(8), 275-1281.
- Umanah F. I. & Udo, M. E. (2021). Moving Towards Green and Sustainable Chemistry Education: Teachers' Awareness and Attitude. *International Journal of Educational Benchmark*. 20(1), 128-137.
- United Nations Environmental Program (UNEP) (2019). Global Chemical Outlook .
O u t l o o k .
www.unenvironment.org/explore-topics/chemicals-waste/what-we-do/policy-and-governance/global-chemical-outlook. Retrieved on 3rd March, 2024.



Teachers' Perspection on Curriculum Adaptation for Learners with Learning Disability in Inclusive Classroom

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Abstract

The study examined teachers' perspection on curriculum adaptation for learners with learning disabilities in inclusive classrooms in secondary schools in Eket senatorial district of Akwa Ibom State. Two research questions were raised to guide the study. The study adopted a descriptive survey research design. The population of the study consisted of one thousand, one hundred and fifty two (1152) secondary school teachers from the sixty three (63) public secondary schools. A simple random sampling technique was used in selecting three hundred (300) teachers from twelve (12) public secondary schools. The instrument used for the study was the teachers' perspection on curriculum adaptation for learners with learning disability in inclusive classroom questionnaire (TPCALLDICQ). The data collected was analyzed using weighted mean statistic. Findings revealed that teachers perceived the current curriculum as not being effective in meeting the needs of learners with learning disability. The study also revealed that adapting the curriculum by teachers was very challenging for learners with learning disability. Based on the findings, the following recommendations were made: teachers, no matter the area of specialization should be trained on how to teach learners with special needs; more special education experts should be employed in secondary schools to assist the regular teachers; learning gadgets such as hearing aid and visual aids among others should be provided in schools so as to assist learners with special need to learn; finally, while building a school, government should ensure to make the school environment special need learners friendly especially for the blind and the physically handicapped learners.

Keywords: Curriculum, Curriculum adaptation, Learning disability, Inclusive classroom

INTRODUCTION

An inclusive classroom is one that addresses and responds to the diversity of needs of all learners through increased participation in learning. It involves changes and modification in content, approaches, structures and strategies with a common vision which covers all learners of the appropriate age range. An inclusive classroom therefore is one

that accepts and accommodates all learners irrespective of their personality be it a child with learning disability or a normal child. By the practice of educating all children together, children with disabilities have the opportunity to prepare for life in the community and the same practice also helps the society to make the conscious decision to operate according to

the social value of equality. The child with disability is one who deviates intellectually, physically, socially or emotionally from what is considered to be normal growth and development that he or she cannot receive maximum benefit from a regular school programme and requires a special class or supplementary instructions or service. The different types of available educational programmes for the children with disabilities are segregated (special) education, integrated education and inclusive education. So inclusive classroom is the provision of services to students with disabilities within the classroom with the necessary support services and supplementary aids for children and teachers. It is a system in which all children from a given community learn together within the same classroom including children with learning difficulties, special needs or disabilities. Provision for such a form of classroom inculcates a feeling of confidence in the minds of disabled children and offers them the formal system of education. Hence, inclusive classroom is an effort to make sure that students with disabilities go to school along with their friends and neighbours while also receiving whatever “specially designed instruction and support” they need to achieve high standards and succeed as learners. Pooja, Snigdhashri and Puja, 2019).

The concept of inclusive education has been spelt out in the Salamanca statement and the framework for action on special needs education in 1994. It states that all governments have been urged to “adopt as a matter of law or policy, the principle of inclusive education, enrolling all learners in regular schools unless there are compelling reasons for doing otherwise”. The basic promise is that the school should meet the educational needs of all learners irrespective of their disabilities or limitations. As a system, inclusive education should be flexible. Its principle should be education in the regular classroom whenever possible. The need for

flexibility must be reflected in the method and materials used to give the children the widest possible access to the regular curriculum. When discussing the type of services needed, the starting point should always be what is best for the particular learner. The category of learners viewed as learners with disabilities include the following: physically handicapped, socially backward, emotionally disturbed, mentally disturbed, communication disordered; learning disabled; sensory disabled, gifted as well as creative children. In view of the above, inclusive classroom should be one that: welcomes all types of learners. No segregation of students regardless of ability; consequently, teachers should have additional teaching skills to teach normal as well as challenged learners of all types; the classroom should have sufficient devices and equipment to teach challenged learners; teachers should decide different types of objectives according to learners abilities; teachers should give personal attention to learners and finally, though there are many students in the class; all of them should be encouraged to participate in activities or programmes.

The classroom as it were offers a dynamic, productive space where ideas, values, information and knowledge are shared and conveyed. Organization of the class and interaction amongst its fundamental components that is the students, teacher and the curriculum transactions creates a forum for the group to move from a state of not knowing to the one of knowing. In order to make the classroom inclusive so as to cater for the needs of all learners, it is important that provision be made for curriculum adaptation. The curriculum according to (Netajisubas Open University (2017) includes the components of a course of study. These consist of the syllabus, textbooks and needed teaching learning materials, teaching strategies/processes and assessment and evaluation process. Hence curriculum adaptation is a modification to the delivery of instructional methods and intended

goals of students' performance that does not change the content but does slightly change the conceptual difficulty of the curriculum. One important feature of adaptation is that it is a goal driven process. That is to say that teachers and their collaborators need to identify the goals of students before adopting the curriculum. According to Rose and Meyer (2012), curriculum adaptation refers to modification to the way in which content is represented or presented or in which students engage in and respond to curriculum. Rose and Meyer further observed that such modifications do not alter the content in any way, but instead, seek to provide multiple means for students to access and respond to the content often achieved through incorporating the principle of universal design for learning.

Adapting or modifying existing general curriculum has been an effective way to create more accessible learning environment to support all students and indeed teachers and their collaborators in various educational context. Imagine how these children feel when they see, hear and feel the excitement and anxiety of their non-special needs peers as they are all being taught in an inclusive classroom. The situation in most of the schools in public and even private arrangement here in Nigeria and other African countries is lamentable. Furthermore, one would not be entirely wrong to say that it is as a result of curriculum modifications that the world today enjoys the academic labour of eminent and prominent personalities with disabilities in diverse areas of human endeavour. They include famous scientists and inventors with disabilities like Alexander Graham Bell, the telephone inventor, Thomas A. Edison, the inventor of electric light and record player as well as Albert Einstein an atomic physicist. In Nigeria, we have some eminent people who have exceled to the highest pinnacle of academic excellence. They include among others, Professor Bitrus Gano, Dr. P. O. Mba and Prof. E. Ojile to mention a few. The above shows that

learners with special needs are psychologically, emotionally and cognitively challenged as a result of the adapted curriculum and boost their ego because they feel proud to be part of the inclusive classroom (Patrick, 2022).

However, the general curriculum to suit the diverse needs of children with special needs is not without problems and challenges for the children, their teachers and collaborators. Some of these challenges and problems are due to globalization and its attendants implications on education. This is because of the movement of people (labour) and knowledge (technology) across international borders. For instance, new innovation in technology devices for persons with special needs have been produced by manufactures in compliance with United Nations expectations. Consequently, there are devices for use in the classroom, offices, homes, hospitals to mention a few. Nonetheless, there are still a number of problems and challenges to contend with in a bit to adapt curriculum for children with special needs especially in developing countries like Nigeria. Onwubolu (2015), laments that poor funding, lack of interest in the education of exceptional children, lack of adequate personnel and equipment are problems differing the growth and development of special needs education in Nigeria. He however was quick to mention efforts being made towards this direction. Ekwama (2023) outlined some challenges encountered in the field of special education to include and up-to-date equipment and facilities. Special teacher training, funding, law and administrative due process, as key problems inhibiting the smooth growth and development of special needs education in Nigeria.

Effective curriculum adaptation according to Sharma and Parveena (2021) is based on;

Adaption of a Lesson Plan/Content: Lesson note is a blueprint of teaching and learning process in which the teacher plans how to teach, the material to be used and the process of evaluation. For teaching children with special need, the general reasons made for the class may not serve the purpose. Hence it needs adaptation in instruction, material and evaluation process.

Adaptation of Instruction: some instruction strategies are effective for all types of learners and these are among the obvious and easiest opportunities for facilitating inclusive teaching and learning. The inclusive set up instructional strategies includes organizing activities, cooperative learning and peer-mediated instructions, direct instruction and technology enhanced instruction. Few more strategies include graphic organizers, concept mapping, channeling and mnemonics. Adaptation is the way of instructions delivered to the learners using demonstration and examples related to everyday life promoting understanding and emphasizing on relevance.

Adaptation in Material: Materials play an important role in the process of teaching. In experimental method, concept will be examined using concrete material to grasp essence and sustain students' attention to comprehend its properties. The material need to be accessible to special needs learners.

Adaptation in Method: Method plays an important role in teaching. A teaching method comprises the principles and methods and by teachers to enable students learning. These strategies are determined partly on subject matter to be taught and partly by the nature of the learner. For a particular teaching method to be appropriate and efficient it has to be in relation with the characteristics of the learner and the type of learning it is supposed to bring about. Suggestions are there to design, while selecting the teaching methods, one must take into consideration not only the nature of the

subject matter but also how students learn. In today's school, the trend is that it encourages a lot of creativity. It is a known fact that human advancement comes through reasoning. This reasoning and original thought enhances creativity.

Adaptation in Physical Arrangement: The physical arrangement and programmatic structure of a classroom are pivotal features in developing an environment that supports learning and promotes positive learner behaviour. Learners learn through active engagement and interaction with the social (e.g peers, adults) and non-social (e.g schedule, materials, activities) components of their environment. These features of the environment must be clearly designed to support teacher directed instruction as well as child-directed activities.

Adaptation in evaluation/Support Facility: The term evaluation can cover test question, grading systems, graduation requirements and competency testing. The problem in evaluation is due to poor written or expressive ability, comprehension ability of the learners. The question given in textbook will not serve the purpose.

Statement of the Problem

With the enforcement of the right of education act of 1942, it becomes very important to bring in all types of children in the folds of education for realizing the UNESCO's aim of "Education for All" As a teacher, each day, you enter your classroom and face the challenge of how to best facilitate learning for all the children in your class belonging to various castes, creeds and colours, with specific learning disabilities, talents, personalities, learning styles and skills. Obviously, teachers agree that every class represent an incredibly diverse group of learners, each of whom has a wide range of strengths and needs; nearly every class

includes one or more children who have a specific learning disability. Teachers might try to meet the instructional challenge described above by asking themselves, “What kinds of adaptations to the curriculum should I make for the learners who have specific learning disabilities” Viewing the notion of curriculum adaptations through the broader lens of the framework of general education, it allows the possibility of having not “another thing to do”, but rather, a different way of doing it”. It is therefore on this premise that this study intends to investigate teachers' perspective on curriculum adaptation for learners with learning disabilities in inclusive classrooms in secondary schools. The problem of this study put in question form; to what extent does teachers perceive the effectiveness of the current curriculum in meeting the needs of learners with learning disabilities and what challenges do teachers face in adapting the curriculum for students with learning disabilities in secondary schools in Eket senatorial district of Akwa Ibom State?

Objectives of the Study

This study sought to investigate teachers' perspective on curriculum adaptation for learners with learning disabilities in inclusive classrooms in secondary schools in Eket senatorial district of Akwa Ibom State.

Specifically, the study sought to;

- (i) Examine how teachers perceive the effectiveness of the current curriculum in meeting the needs of learners with learning disabilities in secondary schools in Eket senatorial district of Akwa Ibom State.
- (ii) Investigate the challenges teachers face in adapting the curriculum for students with learning disabilities in secondary schools in Eket senatorial district of Akwa Ibom State.

Research Questions

The study was guided by the following

research questions:

- (i) How do teachers perceive the effectiveness of the current curriculum in meeting the needs of learners with learning disabilities in Eket senatorial district of Akwa Ibom State?
- (ii) What challenges do teachers face in adapting the curriculum for students with learning disabilities in secondary schools in Eket senatorial district of Akwa Ibom State?

RESEARCH METHODOLOGY

The research design used for the study was a descriptive survey research design. The design involves a data collection strategy based on interrogation or questioning of respondents using such techniques as questionnaire, interviews, standardized test of intelligence, aptitude, achievement or performance (Nkemakolam, 2012). The study was conducted in Eket senatorial district of Akwa Ibom state which has twelve local government areas. The population of the study consisted of all the one thousand one hundred and fifty-two (1152) teachers in the sixty three (63) public secondary schools in Eket senatorial district of Akwa Ibom. A simple random sampling technique was used in selecting three hundred (300) teachers in twelve (12) selected public secondary schools in the area under study. The instrument used for the study was a structured questionnaire titled Teachers' Perspective on Curriculum Adaptation for Learners with Learning Disability in Inclusive Classrooms Questionnaire (TPCALLDICQ). The instrument was validated by an expert in Measurement and Evaluation in the Department of Educational Foundations, College of Education, Afaha Nsit. Before the final distribution of the questionnaire, thirty (30) copies of the instruments were administered to teachers in selected secondary schools in Uyo senatorial district. This was done to test the reliability of the instrument.

Consequently, a reliability coefficient of 0.86 was obtained using cronbach alpha reliability test. The result therefore showed that the result of the reliability test was high and the instrument reliable. The researchers administered the questionnaire to three hundred and five (305) teachers with the help of two research assistants. Out of the three hundred and five (305) copies of the questionnaire distributed, three (3) were wrongly filled and so were discarded while two (2) were never returned. However, three (300) were correctly filled and returned and were used for the study. The researchers used weighted mean for the analysis of research questions. Hence, the cut-off mean was 2.50.

Consequently, any mean score below 2.50 was not accepted as an agreement while mean score of 2.50 and above was accepted as agreement.

Research Question One

How do teachers perceive the effectiveness of the current curriculum in meeting the needs of learners with learning disabilities in secondary schools in Eket senatorial district of Akwa Ibom State?

Table 1: Weighted mean analysis on the extent to which teachers perceive the effectiveness of the current curriculum in meeting the needs of learners with learning disabilities in secondary schools in Eket senatorial district of Akwa Ibom State

	VHE	HE	LE	VLE	x	Decision
1. The current curriculum provides opportunity for learners with learning disabilities to participate effectively in the classroom	11	15	157	117	1.73	Disagreed
2. The current curriculum is designed in such a manner that learners with learning disabilities understand the concepts taught	112	162	12	14	3.24	Agreed
3. The current curriculum provides opportunity for learners with learning disabilities to carry out class activities like their peers who are normal	68	79	77	76	2.46	Disagreed
4. The current curriculum makes the learning process interesting to learners with learning disabilities	15	16	160	109	2.32	Disagreed
					2.43	Agreed
Grand Mean						

Table 1 above shows the extent to which teachers perceive the effectiveness of the current curriculum in meeting the needs of learners with learning disability as follows; the current curriculum provides opportunity for learners with learning disability to participate in the classroom had a mean score of 1.73, the current curriculum is designed in such a manner that learners with learning disability understand the concepts taught had a mean score of 3.24, the curriculum provides opportunity for learners with learning disability to carry out classroom activities like their peers who are normal had a means score of 2.46 and the current curriculum makes the learning process interesting to learners with learning disability had a mean score of 2.32. From the above, it can be observed that item

1, 3 and 4 had a mean score of 1.73, 2.46, and 2.32 respectively which is below the cut-off mean of 2.50. This therefore indicates that teachers perceived the current curriculum as not being effective in meeting the needs of learners with learning disability

Research Question Two

What challenges do teachers face in adapting the curriculum for students with learning disabilities in secondary schools in Eket senatorial district of Akwa Ibom State?

Table 2: Weighted mean analysis on the challenges teachers face in adapting the curriculum for students with learning disabilities in secondary schools in Eket senatorial district of Akwa Ibom State

	VHE	HE	LE	VLE	x	Decision
1. The physical environment in the school does not promote inclusive learning environment	115	125	16	4	3.44	Agreed
2. The teaching method recommended for use does not promote effective learning among learners with learning disabilities	77	68	78	77	2.74	Agreed
3. Instructional materials available in schools does not promote effective learning among learners with learning disabilities	166	128	4	2	3.54	Agreed
4. The evaluation process in school does not promote effective learning among learners with learning disabilities	148	127	18	7	3.38	Agreed
Grand Mean					3.30	Agreed

Table 2 above shows the challenges teachers face in adapting the curriculum for learners with learning disability as follows; the physical environment in the school does not promote inclusive learning environment had a means score of 3.44, the teaching method recommended for use does not promote effective learning among learners with learning disability had a mean score of 2.74, instructional materials available in schools does not promote effective learning among learners with learning disability had a mean score of 3.54 and the evaluation process in school does not promote effective learning among learners with learning disability had a mean score of 3.38. From the above, it can be observed that all the items had a mean score of 3.44, 2.74, 3.54 and 3.38 respectively which is above the cut-off mean of 2.50. This therefore indicates that it is very challenging for teachers to adapt the current curriculum for learners with learning disability

DISCUSSION

From the result of the analysis, it was observed that teachers perceived the current curriculum as not being effective to meet the needs of learners with learning disability. Also, adapting the curriculum was very challenging for learners with learning disability.

Research question one revealed that the current curriculum provides opportunity for learners with learning disability to participate in the classroom had a mean score of 1.73, the curriculum provides opportunity for learners with learning disability to carry out classroom activity like their peers who are normal had a mean score of 2.46 and the current curriculum makes the learning process interesting to learners with learning disability has a mean score of 2.32. This indicates that the current curriculum does not provide opportunity for learners with learning disability to participate in the classroom. This is as a result of the large number of learners in the classroom which makes it difficult for the

teacher to attend to the learning need of each learner. The study also revealed that the current curriculum does not provide opportunity for learners with learning disability to actively participate in the classroom because the curriculum was designed to cater for the learning needs of normal learners, this therefore inhibits learners with hearing or visual impairment from participating effectively in the classroom activities. Again, it was also observed that the current curriculum does not make learning interesting to learners' with visual or hearing impairment as they found it difficult to follow up in classroom discussions. However, the content of the curriculum has been designed in such a manner that all types of learners can easily understand the concepts taught in all subjects if adequate and relevant instructional materials are utilized

Research question two revealed that the physical environment in the school does not promote inclusive learning environment has a mean score of 3.44, teaching methods recommended for use does not promote effective learning among learners with learning disability had a mean score of 2.74, instructional materials available in school does not promote effective learning among learners with learning disability had a mean score of 3.54 while the evaluation process in school does not promote effective learning among learners with learning disability had a mean score of 3.38. This indicates that school building are not built to cater for the needs of learners with special need such as the visually impaired and the physically handicapped, the teaching method recommended for use does not also enhance learning among learners with learning disability. Again lack of instructional materials especially materials like hearing aids and visual aids are lacking in schools as well as other special needs learning gadget. Finally, the evaluation process in school does not enhance the learning for learners with special needs. Hence the need to develop an

evaluation process that is suitable for learners within the special needs category.

Recommendations

Based on the findings, the following recommendations were made;

- (i) Teachers no matter the area of specialization should be trained on how to teach learners with special needs
- (ii) More special education experts should be employed in secondary schools to assist the regular teachers
- (iii) Learning gadgets such as hearing aid and visual aids among others should be provided in schools so as to assist learners with special need to learn
- (iv) While building a school, government should ensure to make the school environment special need learners friendly especially for the blind and the physically handicapped learners

Conclusion

The study examined teachers perspective on curriculum adaptation for learners with learning disability in inclusive classroom. Consequently, the study concluded that;

Teachers perceived the current curriculum as not being effective in meeting the needs of learners with learning disability in an inclusive classroom

Also, adapting the curriculum by teachers was challenging for learners with learning disability in inclusive classroom

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REFERENCES

- Ekwama, M. B. (2013). Problems facing the field of special education in Nigeria and the way forward. *Journal of Research in Special Education*, 6(1) pp.27-36.
- Lere, M. M & Yakwal, S. M. (2015). *State and future of Legislating for Special Education in Nigeria*: paper presented at the National Conference of Nigeria Primary and Teacher Education held at Asaba, Delta State. June 12-17, 2015.
- NetajiSubhas Open University (2017). *Curriculum, adaptation and strategies for teaching expanded curriculum*. India: National Open University Press.
- Onwubolu, C. O. (2015). The state and future of special education in Delta State. Paper presented at the Nigerian Primary and Teacher Education Association Conference held at FCE (Technical) Asaba Delta State, June 13-17, 2015.
- Patrick, M, A. (2022). Curriculum adaptation for children with special needs in an inclusive educational setting. *Journal of Globalization and Special Needs* 2(1)215-219.
- Pooja, A. M, Snigdhashri, H B. & Puja R K (2019). Curriculum adaptation in inclusive education. *International Journal of Applied Research* 5(8) 70-74.
- Rose, D. E. & Meyer, A. (2012). *Teaching students in the Digital Age: Universal Design for Learning*. Alexandros, VA: Association for Supervision and Curriculum Development.
- Sharma, Y. & Parveena, M. (2021). A study

on Curriculum adaptations used by teachers working in SSA schools, for children with intellectual disabilities at Indore District in M.P. State. *Journal of Emerging Technologies and Innovation Research*. 8(3) 2449-2458.



Refocusing of Emotional Intelligence for Enhanced Academic Performance in Business Education

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Abstract

Over the years, the focus in education has been on cognitive intelligence. This study was conducted to examine refocussing of emotional intelligence for enhanced academic performance of students in Business education. This study used a survey research design. The study was conducted in the Department of Business Education, College of Education, Afaha Nsit. The respondents were NCE 1, 2 and 3 students as well as Degree 1, 2, 3 and 4 students of 2021/2022 and 2022/2023 academic sessions. Simple random sampling technique was used to select a sample size of 100 students for the study. The instrument used for data collection was a questionnaire adopted from the Global Emotional Intelligence Test. The instrument was called "Emotional Intelligence and Academic Performance Questionnaire (EIAAPQ)". Students' results and GPA as well as personal observation were also used for the study. The data collected were analyzed using mean scores for the research questions while t-test was computed to test the hypotheses. Findings of the study revealed that students who were considered emotionally intelligent performed better than students who were not emotionally intelligent. It was recommended among others that there should be a refocussing of emotional Intelligence in academics since emotional intelligence was seen to be equally important in determining students' academic performance. This research has the potential to transform business education by fostering a more holistic approach to student development, preparing them not only for academic success but also for a fulfilling and impactful career in the business world.

Keywords: Refocussing, Emotional intelligence, Academic enhancement, Business education

INTRODUCTION

The relationship between emotional intelligence and academic performance has been a growing area of research, particularly in business education. This research explores the existing literature on the role of emotional intelligence competencies relevant to business education. Business education emphasizes skills like communication, teamwork, leadership, and negotiation, all of which are heavily influenced by emotional intelligence.

Studies have shown that emotional intelligence is a crucial predictor of career success in business field. Individuals with high emotional intelligence are better equipped to navigate complex business environments, build strong relationships, and achieve organizational goals. While the importance of emotional intelligence in business education is recognized, current approaches often lack a specific focus on the competencies most

relevant to this field. A refocused approach should prioritize the development of emotional intelligence competencies that directly enhance business related skill and knowledge. This include self-awareness, self-management, social-awareness, relationship-management and self-motivation.

For many centuries, cognitive intelligence was the main focus in education. This was usually measured in terms of ability to acquire and apply knowledge and skills. Recently, emotional intelligence is common in many researches. (Tekle *et al*, 2020). This implies that apart from cognitive intelligence, emotional intelligence is equally important for enhanced academic performance, (Mosunic, 2023).

Emotional Intelligence (EI) here refers to the ability to deal with negative emotions that might likely disrupt learning. It is also the ability of an individual to monitor their own and others' emotions to distinguish among the positive and the negative emotions, (Meshkat, 2011). Emotional Intelligence may also be viewed as the ability to reach, understand and respond to emotions (Brackett, 2024). A student is considered emotionally intelligent if the student is able to use interpersonal intelligence to focus on the critical emotions and underlying behavioural traits of all the people related directly or indirectly to the academic achievement desired. This can be observed in the ability to communicate openly and respectfully, resolve conflicts constructively and collaborate effectively towards common goals. This attribute positively enhances creative innovation and higher performance, (Ademola *et al*, 2010 and Singh, 2007).

The components of emotional intelligence that are necessary include, self-awareness, self-management, social-awareness, relationship management, empathy and motivation. Many researchers concluded that students with high emotional

intelligence are better equipped to handle stress, manage their emotions and navigate social situations effectively. This will improve their relationship with teachers and peers positively. The review of existing studies focuses on the selected five variables of emotional intelligence. These include: Self-awareness, self-management, social-awareness, relationship management and self-motivation.

Self-awareness

Self-awareness may be defined as the conscious knowledge of one's own characteristics. These may include feelings, desires, motives and ability to reflect on ones' self-analyses of what their strengths and weaknesses are. When an individual uses inward reflection to make self-comparisons to reality and the feedback of others, the person is said to have self-awareness. A self-aware student have independent self-concept, can direct his/her own learning, has accumulated a reservoir of life experiences that can be a resource, has learning needs closely related to changing social roles, is problem-centred and interested in immediate application of knowledge and is internally motivated to learn, (Steriner, 2014). While studying the impact of self-awareness process on learning and leading, Steriner (2014) indicated that independent self-concept is one of the important indicators of self-awareness. Roche Martin (2024) included some of the characteristics of self-awareness among his 50 tips for improving emotional intelligence.

Self-awareness has been described in many different ways by researchers. Some see Self-awareness as self-consciousness while others see it as self-recognition or self-analysis. Whatever term that is used, it still refer to the ability to assess oneself as a distinct person with feelings, thoughts and beliefs that are personal. This distinct personality affects the persons' cognitive world, emotional world and behaviour in the world. Self-awareness is

one of the important elements of emotional intelligence (Rath & Conchi, 2008). The importance of self-awareness include the ability to make better decisions, improved team performance, increased leadership success and enhanced academic performance.

Self-Management

This may be viewed as the ability to regulate one's behavior, thoughts and emotions in a productive way. Some authors' refer to self-management as the self-control or self-discipline (Raeburn, 2024). Self-Management is characterized with the ability to organize one's activities properly, management time effectively, set priorities and have focus. Self-management as one of the elements of emotional intelligence helps in improving consistent study habit, delayed gratification, task completion and follow-through, focus and concentration, persistence in the face of challenges and balanced work-life approach. Self-Management is significant for enhanced academic performances, (Zhao, 2023), (Stan, 2021). The core skills involved in successful Self-Management include planning, organizing, persistence, progress monitoring, control, attention to details, accountability, initiative adaptability and self-discipline.

Raeburn, (2024) identified seven skills for self-management to include time management, self-motivation, stress management, adaptability, decision making, goal alignment, and personal development. As an addition to the skills for self-management, Munro, (2021) indicated that role clarity, strategic planning, priority-setting, emotional regulation and self-care are necessary skills for effective self-management. All the identified skills for Self-Management are necessary for enhanced academic performance.

Social awareness

Based on Daniel Goleman's Emotional Intelligent Quadrant, social-awareness is the ability to accurately notice the emotions of others and “read” situations appropriately

(Hubbard, 2021). This will enhance effective collaboration with others and consequently, enhanced academic performance will be achieved. The characteristics of social-awareness in emotional intelligence include empathy, service orientation and ability to sense others' needs. It also include the ability to know what to do and say when others are emotionally upset or distressed, (Cherry, 2023). A student who is able to achieve this is emotionally intelligent and will perform well academically.

Relationship - Management

As a component element in emotional intelligence, relationship-management refers to the ability to communicate clearly, maintain good relationship with others, connect with those from other cultures, work well in teams and manage conflict. A student is expected to manage and optimize interactions with peers, teachers and others who are directly and indirectly connected to his academic pursuit. Ability to do this successfully is regarded as relationship-Management in emotional intelligence, (Cherry, 2023).

Self-motivation

This is an internal personal drive towards the achievement of goals. In order to be self-motivated, a student need to identify his/her traits, realize his/her strengths and visualize success. This requires focusing on the goals and targets and continuing with zest and seal. Self-Motivation is one of the elements of emotional intelligence which require refocusing in order to achieve enhanced academic performance. This can be achieved by helping the students to understand what gives them positive drive and how to manage it. Some students are motivated by their grades. It has been observed that some students become excited and put more effort if they have good grades. On the other hand, some students become discouraged and withdrawn if they have low grades, (Bagina, 2023). Coursera, (2023) outlined 11 tips for self-

motivation to include:

- (i) Putting goals on the calendar
- (ii) Working towards goals as a habit
- (iii) Planning for imperfection
- (iv) Setting small goals to build momentum
- (v) Tracking of progress
- (vi) Self-reward for wins
- (vii) Embracing positive peer pressure
- (viii) Practicing gratitude for others and self
- (ix) Doing mood lifting
- (x) Changing environment
- (xi) Remembering “why”

It is advisable to encourage the students to apply the 11 tips of self-motivation outlined for a refocussing of emotional intelligence. This can be done through guidance and counseling services. It is hoped that this will help the students to see their daily academic task as part of their long-term goals. This will positively lead to enhanced academic performance.

Statement of the Problem

While traditional academic measures like cognitive ability and technical skills are crucial in business education, there is growing recognition that emotional intelligence plays a significant role in student success. However, the current focus on emotional intelligence in business education often lack a structured approach, leading to inconsistent application and limited impact on academic performance. This study aims to address this gap by exploring how a refocused approach to emotional intelligence can effectively be integrated into business education to enhance student learning and overall academic performance.

To students, teachers and parents in the society, emotional intelligence has positive impact on communication skills, self-

expression, presentation skills, team work, assertiveness, decision-making, tolerance of stress, tolerance of change, calmness, attentiveness, empathy, self-regulation, self-motivated growth, sustainability, self-fueled performance, confidence, optimism, self-control and emotional management. Being a student requires the ability to cope with a lot of issues and emotions. Among the top emotions that a student may likely cope with are anger, love, fear, hate, contempt, joy, anticipation, surprise, trust, sadness, gratitude, forgiveness, disgust, enjoyment, guilt, envy, lust, shame etc. The ability to manage all these issues and emotions is called emotional intelligence, (Kautish, 2010; Meshkat, 2011).

It is important to understand what type of emotion is being experienced at a particular time and how to manage it. Ability to do this is called emotional intelligence. This state of emotional intelligence is important because it makes a person to be friendly, calm, make smart choices and feel good. In order to check emotional intelligence, some researchers use various tests and indices. One of such tests is the Global Emotional Intelligence test. This test uses 40 questions which are derived from the Global Emotional Intelligence Capability Assessment Instrument which contains 158 items. These are based on Goleman's Four Quadrant Emotional Intelligence Competency Model (2002). (The Guardian (2024). Many Emotional Intelligence Test used in most researches are derived from these existing Tests and Models.

Purpose of the study

The main purpose of this study was to examine the refocusing of emotional intelligence for enhanced academic performance in Business Education. Specifically, this study sought to:

- (i) Examine the influence of self-awareness on the academic performance of Business Education

- Students,
- (ii) Examine the Influence of self-management on the academic performance of Business Education Students,
 - (iii) Examine the influence of social-awareness on the academic performance of Business Education Students,
 - (iv) Examine the influence of relationship-management on the academic performance of Business Education Students,
 - (v) Examine the influence of self-motivation on the academic performance of Business Education Students.

Research Questions

The following research questions guided the study:

- (i) to what extent does self-awareness influence the academic performance of students in Business Education?
- (ii) to what extent does self-management influence the academic performance of students in Business Education?
- (iii) to what extent does social-awareness influence the academic performance of students in Business Education?
- (iv) to what extent does relationship-management influence the academic performance of students in Business Education?
- (v) to what extent does self-Motivation influence the academic performance of students in Business education?

Research Hypotheses

The following research hypotheses were postulated to guide the study:

- H1:** There is no significant influence of self –awareness on academic performance of students in Business Education.
- H2:** There is no significant influence of self-management on academic performance of students in Business Education
- H3:** There is no significant influence of social-awareness on academic performance of students in Business Education.
- H4:** There is no significant influence of relationship-management on academic performance of students in Business Education.
- H5:** There is no significant influence of self-motivation on academic performance of Students in Business Education.

RESEARCH METHODOLOGY

This study used a survey research design. The study was conducted in the Department of Business Education, College of Education, Afaha Nsit. The population of the study was 500 students. This was made up of NCE and Degree Students of 2021/2022 and 2022/2023 academic sessions. Simple random sampling technique was used to select a sample size of 100 students for the study. The instrument used for data collection was a questionnaire adapted from the Global Emotional Intelligence Test. The instrument was called “Emotional Intelligence and Academic Performance Questionnaire (EIAAPQ). The selected students' semester results and GPA were also used for the study. Personal observations were also used.

The instrument for data collection was administered directly to the students by the researcher. The data was analyses using mean scores for the research questions while t-test was computed to test the hypotheses.

RESULTS

This section presents the analysis of data and discussion of findings based on the research questions and research hypotheses.

Table 1: Respondents' Profile

Description		Respondents	Total
Gender:	Male	34	100
	Female	66	
Age group:	17-22 years	68	100
	23-30 years	32	

Field work 2024

Table 1 above showed an explicit description of number of male and female respondents (students) among the one hundred (100) respondents. There were thirty four (34) male respondents and sixty six (66) female respondents making a total of one hundred (100) student who participated in the study.

Research Question 1: To what extent does, self-awareness influence the academic performance of students in Business Education?

Table 2: Students opinion on the influence of self-awareness on academic performance of students in Business Education

S/N	Items	SA	A	D	SD	Total	$\bar{X}$	Pool Mean	Decision
	Students with self-awareness perform high in examination	17	49	24	10	100	2.73		Accepted
	Self-awareness increases academic performance of students	30	45	16	9	100	2.96		Accepted
	Self-awareness leads students to success	14	61	19	6	100	2.83		Accepted
	Self-awareness enhances students research and analytical skills	29	52	15	4	100	2.66	2.96	Accepted
	Self-awareness improves academic performance of students	26	26	31	17	100	3.12		Accepted

Field work 2024

Analysis from table 2 above shows opinions of students on the influence of self-awareness on academic performance of students in Business Education. The data analysis in the table also showed that respondents accepted items 1, 2, 3, 4, and 5. There was no item rejected in the decision from the mean. The pooled mean of 2.96 was greater than the stated mean of 2.50. This suggested that there is influence of self-awareness on academic performance of student in Business Education.

Research Question 2: To what extent does, self-Management influence the academic performance of students in Business Education?

Table 3: Students opinion on the influence of Self-Management on academic performance of students in Business Education

S/N	Items	SA	A	D	SD	Total	$\bar{X}$	Pool Mean	Decision
	Students with Self -management perform high in examination	34	20	27	19	100	2.69		Accepted
	Self-management increases academic performance of students	19	34	30	17	100	2.55		Accepted
	Self –managed students are always outstanding in school	18	68	10	4	100	3.00		Accepted
	Self-management enhances students research and analytical skills	14	50	26	10	100	2.68	2.69	Accepted
	Self-management improves academic performance of students	13	44	26	17	100	3.53		Accepted

Field work 2024

Analysis from Table 3 shows opinion of students on the influence of Self-management on academic performance of students in Business Education. The data analysis in the table also showed that respondents accepted items 6, 7, 8, 9 and 10. There was no item rejected in the decision from the mean. The pooled mean of 2.69 was greater than the stated mean of 2.50. This suggested that there is influence of Self-management on academic performance of students in Business Education.

Research Question 3: To what extent does, Social-awareness influence the academic performance of Students in Business Education?

Table 4: Students opinion on the influence of Social-awareness on academic performance of students in Business Education

S/N	Items	SA	A	D	SD	Total	$\bar{X}$	Pool Mean	Decision
	Students with Social awareness perform high in examination	- 27	48	17	8	100	2.94		Accepted
	Social-awareness increases academic performance of students	22	51	17	10	100	2.85		Accepted
	Social-awareness leads students to success	20	53	20	7	100	2.86		Accepted
	Social-awareness enhances students research and analytical skills	30	53	14	3	100	3.10	2.94	Accepted
	Social-awareness improves academic performance of students	23	58	12	7	100	2.97		Accepted

Field work 2024

Analysis from Table 4 above shows opinions of students on the influence of Social-awareness on academic performance of students in Business Education. The data analysis in the table also shows that respondents accepted items 11, 12, 13, 14 and 15. There was no item rejected in the decision from the mean. The pooled mean of 2.94 was greater than the stated mean of 2.50. This suggested that there is influence of Social-awareness on academic performance of students in Business Education.

Research Question 4: To what extent does relationship-management influence the academic performance of students in Business Education?

Table 5: Students opinion on the influence of relationship-management on academic performance of students in Business Education

S/N	ITEMS	SA	A	D	SD	TOTAL	$\bar{X}$	POOL MEAN	DECISION
	Students with good skills in relationship-management perform, high in school	27	48	17	8	100	2.94		Accepted
	Relationships-management skills increases academic performance of students	22	51	17	10	100		2.94	Accepted
	Students with good relationship-management skills are always outstanding in school	20	53	20	7	100			Accepted

Good relationship management enhances students research and analytical skills	30	53	14	3	100		Accepted
Good relationship-management improves corporative learning and academic performance of students	23	58	12	7	100	2.97	Accepted

Field work 2024

Analysis from Table 5 shows opinions of students on the influence of relationship-management on academic performance of students in Business Education. The data analyzed in the table also shows that respondents accepted items 16, 17, 18, 19, and 20. There was no item rejected in the decision from the mean. The pooled mean of 2.94 was greater than the stated mean of 2.50. This suggested that there is influence of relationship-management on the academic performance of students in Business Education.

Research Question 5: To what extent does self-motivation influence the academic performance of students in Business Education?

Table 6: Students' opinion on the influence of self-motivation on academic performance of students in Business Education

S/N	ITEMS	SA	A	D	SD	TOTAL	$\bar{X}$	POOL MEAN	DECISION
	Students with self-motivation perform high in school	33	48	12	7	100	3.07		Accepted
	Self-motivation increases academic performance of students	30	53	15	2	100	3.11	2.98	Accepted
	Self-motivated students are always outstanding in school	30	45	16	9	100	2.96		Accepted
	Self-motivation enhances students research and analytical skills	25	34	23	18	100	2.66		Accepted
	Self-motivation improves academic performance of students	39	40	15	6	100	3.12		Accepted

Field work 2024

Analysis from Table 6 above shows opinions of students on the influence of self-motivation on academic performance of students in Business Education. The data analysis in the table also shows that respondents accepted items 21, 22, 23, 24 and 25. There was no item rejected in the decision from the mean. The pooled mean of 2.98 was greater than the stated mean of 2.50. This suggested that there is influence of self-motivation on academic performance of students in Business

Education.

Test of Hypotheses

Ho₁. There is no significant influence of self-awareness on academic performance of students in Business Education.

Table 7: t-test analysis of influence of self-awareness on academic performance of students in Business Education.

Variable	N	($\bar{X}$)	SD	t-cal	t-crit	Df	Decision
Influence of self-awareness on academic performance of Degree Students.	62	53.74	27.66				
				5.56	1.96	98	Rejected
Influence of self-awareness on academic performance of NCE students.	38	67.52	34.56				

The result of the analysis in Table 7 revealed the calculated t-value of 5.56 at the significant level of .05 and degree of freedom (df) of 98. This causes the rejection of the null hypothesis because the test is significant. This reflects that self-awareness significantly influence academic performance of students in Business Education.

Ho₂. There is no significant influence of self-management on academic performance of students in Business Education.

Table 8: t-test analysis of influence of self-management on academic performance of students in Business Education

Variable	N	($\bar{X}$)	SD	t-cal	t-crit	Df	Decision
Influence of self-management on academic performance of Degree students	62	58.20	28.45				
				3.26	1.96	98	Rejected
Influence of self-management on academic performance of NCE students	38	65.33	25.68				

The result of the analysis in table 8 revealed the calculated t-value of 3.26 at the significant level of .05 and degree of freedom (df) of 98. This causes the rejection of the null hypothesis because the test is significant. This reflects that self-management significantly influence academic performance of students in Business Education.

Ho₃. There is no significant influence of social-awareness on academic performance of students in Business Education.

Table 9: t-test analysis of influence of social awareness on academic performance of students in Business Education

Variable	N	(X)	SD	t-cal	t-crit	Df	Decision
Influence of social awareness on academic performance of Degree students.	62	52.22	26.25				
				2.86	1.96	98	Rejected
Influence of social awareness on academic performance of NCE students.	38	62.43	19.28				

The result of the analysis in Table 9 revealed the calculated t-value of 2.86 at the significant level of .05 and degree of freedom (df) of 98. This causes the rejection of the null hypothesis because the test is significant. This reflects that social-awareness significantly influence academic performance of students in Business Education.

Ho₄. There is no significant influence of relationship-management on the academic performance of students in Business Education.

Table 10: t-test analysis of the influence of relationship-management on academic performance of students in Business Education

Variable	N	(X)	SD	t-cal	t-crit	Df	Decision
Influence of relationship-management on academic performance of Degree students	62	52.22	26.25				
				2.86	1.96	98	Rejected
Influence of relationship-management on academic performance of NCE students	38	62.43	19.28				

The result of the analysis in Table 10 revealed the calculated t-value of 2.86 at the significant level of .05 and degree of freedom (df) of 98. This causes the rejection of the null hypothesis because the test is significant. This indicates that relationship-management significantly influence academic performance of students in Business Education.

Ho₅. There is no significant influence of self-motivation on academic performance of students in Business Education.

Table 11: t-test analysis of influence of self-motivation on academic performance of students in Business Education

Variable	N	(X)	SD	t-cal	t-crit	Df	Decision
Influence of self-motivation on academic performance of Degree students	62	53.74	27.66				
				5.56	1.96	98	Rejected
Influence of self-motivation on academic performance of NCE students.	38	67.52	34.56				

The result of the analysis in table 11 revealed the calculated t-valued of 5.56 at the

significant level of .05 and degree of freedom (df) of 98. This causes the rejection of the null

hypothesis because the test is significant. This reflects that self-motivation significantly influence academic performance of students in Business Education.

DISCUSSION

Analysis from table 2 showed opinions of students on the influence of self-awareness on academic performance of students in Business Education. There was no item rejected in the decision from the mean. The pooled mean of 2.96 was greater than the stated mean of 2.50. This suggested that there is influence of self-awareness on academic performance of students in Business Education. The result of the analysis in Table 7 revealed the calculated t-value of 5.56 at the significant level of .05 and degree of freedom (df) of 98. This causes the rejection of the null hypothesis because the test is significant. This reflects that self-awareness significantly influence academic performance of students in Business Education. This is in line with the findings of RocheMartin (2024), who included self-awareness among his 50 tips for improving emotional intelligence. It also confirms the findings of Rath & Conchi, (2008) who emphasized the importance of self-awareness in emotional intelligence.

Analysis from Table 3 showed opinions of students on the influence of Self-management on academic performance of students in Business Education. The data analysis in the table also showed that respondents accepted all the items. There was no item rejected in the decision from the mean. The pooled mean of 2.69 was greater than the stated mean of 2.50. This suggested that there is influence of Self-management on academic performance of students in Business Education. The result of the analysis in Table 8 revealed the calculated t-value of 3.26 at the significant level of .05 and degree of freedom (df) of 98. This causes the rejection of the null hypothesis because the test is significant. This reflects that self-management significantly influence academic performance of students in

Business Education. This findings is supported by the findings of Raeburn, (2024); Zhao, (2023) and Stan, (2021).

Analysis from Table 4 showed opinions of students on the influence of social-awareness on academic performance of students in Business Education. There was no item rejected in the decision from the mean. The pooled mean of 2.94 was greater than the stated mean of 2.50. This suggested that there is influence of social-awareness academic performance of students. The result of the analysis in Table 9 revealed the calculated t-value of 2.86 at the significant level of .05 and degree of freedom (df) of 98. This causes the rejection of the null hypothesis because the test is significant. This reflects that social-awareness significantly influence academic performance of students in Business Education. This is in line with the findings of Hubbard, (2021) and Cherry, (2023).

Analysis from Table 5 showed opinions of students on the influence of relationship-management on academic performance of students in Business Education. The data analyzed in the table also showed that respondents accepted all the items. There was no item rejected in the decision from the mean. The pooled mean of 2.94 was greater than the stated mean of 2.50. This suggested that there is influence of relationship-management on the academic performance of students in Business Education. The result of the analysis in the Table 10 revealed the calculated t-value of 2.86 at the significant level of .05 and degree of freedom (df) of 98. This causes the rejection of the null hypothesis because the test is significant. This indicates that relationship-management significantly influence academic performance of students in Business Education. This is in line with the findings of Hubbard, (2021) and Cherry, (2023).

Analysis from Table 6 showed opinions of students on the influence of self-

motivation on academic performance of students in Business Education. There was no item rejected in the decision from the mean. The pooled mean of 2.98 was greater than the stated mean of 2.50. This suggested that there is influence of self-motivation on academic performance of students in Business Education. The result of the analysis in Table 11 revealed the calculated t-value of 5.56 at the significant level of .05 and degree of freedom (df) of 98. This causes the rejection of the null hypothesis because the test is significant. This reflects that self-motivation significantly influence academic performance of students in Business education. This is in line with the findings of Bagina, (2023) and Coursera, (2023).

Recommendations

Based on the finding of the study, the following recommendations are made:

- (i) Counseling services should be conducted for students on emotional intelligence.
- (ii) Students should be encouraged to get involved in social activities.
- (iii) Special lectures should be organized for students with low or no emotional intelligence.
- (iv) Student should be encouraged to use resource centres and counseling units in the college.

Conclusion

Based on the results of the analysis and findings of the research, it is concluded that there is influence of self-awareness on academic performance of students in Business Education; there is influence of self-management on academic performance of students in Business Education; there is influence of social-awareness on academic performance of students in Business education; there is influence of social-awareness on academic performance of

students in Business Education; There is influence of relationship management on academic performance of students in Business education; there is influence of self-motivation on academic performance of students in Business Education;

This implies that there is need for refocusing of emotional intelligence for enhanced academic Performance in Business Education.

Suggestion for Further Studies

In line with the findings of the study, the researcher suggests that, further studies on this topic should be extended to other institutions of learning in Nigeria.

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REFERENCES

- Ademola, O. R; Akintunde, S. O.; & Yakasi, M. I. (2010). Emotional Intelligence Creativity and Academic Achievement of Business Administration Students <https://www.researchgate.net>. retrieve d 23/5/24.
- Bagina, J. W. (2023). Self-motivation's Role in Academic Success . <https://www.medium> retrieved 23/5/24.
- Bracket, M. (2024). Spotlight: What it means to be Emotionally Intelligence. <https://www.your.yale.edu> retrieved 23/5/24.
- Cherry, K. (2023). 5 Key Emotional Intelligence Skills .

- <https://www.verywellmind.com> retrieved 23/5/24.
- Courser, (2023), How to Motivate yourself. II Tips for self-improvement. <https://www.coursera.org>. retrieved 23/5/24.
- Global (2000). Emotional Intelligence Test. Global Leadership Foundation. <https://globalleadershipfoundation.com>. retrieved 23/5/24.
- Hubbard, J. (2021). Building Emotional Intelligence: Social awareness. <https://www.fm.magazine.com> retrieved 23/5/24.
- Kautish, P. (2010). Emotional Intelligence and Business Education: An Analysis. <https://www.researchgate.net>. retrieved 23/5/24.
- Meshkat, M. (2011). The relationship between Emotional Intelligence and Academic Success. <https://www.researchgate.net>. retrieved 23/5/24.
- Mosunic, C. (2023). Here's why Emotional Intelligence is so important. <https://www.calm.com> retrieved 23/5/24.
- Munro, I. (2021). Why Self-management is key to success and how to improve yours. <https://www.betterup.com> retrieved 23/5/24.
- Raeburn, A. (2024). What is Self-management (Skills to improve it). <https://asana.com> retrieved 23/5/24.
- Rath, T. & Conchi, B. (2008). Finding your leadership strengths. Why effective leaders must possess a high level of self-awareness. <https://www.mindtods.com> retrieved 23/5/24.
- RocheMartin (2024). 50 tips for improving your Emotional Intelligence. <https://www.rechemartin.com>blog> retrieved 25/5/24.
- Singh, S. (2007). Emotional Intelligence and Organization Leadership: A gender study in Indian Context. International Journal of Indian Culture and Business Management. Retrieved from <https://www.researchgate.net>. retrieved 23/5/24.
- Stan, M. M. (2021). Self-management Skill and Students Achievement – A pilot study. Retrieved from: 1 <https://www.researchgate.net> retrieved 23/5/24.
- Steiner, P. (2014). The Impact of Self-awareness process on learning and leading. New England Board of Higher Education. <https://www.nebhe.org>
- Tekle, Z. D.; Demeke, A.; Sado, I. A. & Damota, M. D. (2020). The Relationship between Emotional Intelligence and Academic Achievement among Undergraduate Students at Madda Walabu University.
- The Guardian (2024). Happily disgusted? Scientists Map Facial Expression for 21 emotions. <https://www.theguardian.com>mar> retrieved 23/5/24.
- Zhao, Z. (2023). Student Self-management Academic Achievement. Retrieved from <https://ojs.sgsci.org>journal> retrieved 23/5/24.



Governance and Export Growth in Nigeria

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Abstract

This study examined the effects of governance on export growth in Nigeria using an annual time series data from 1996 to 2022, analysed by autoregressive distributed lag model (ARDL). The study discovered that control of corruption has a significant negative short-run impact and insignificant positive long-run effect on non-oil export growth, while having significant positive short and long-run effects on oil export growth. Government effectiveness has significant positive short and long-run effects on non-oil export growth, and a positive but insignificant effect on oil export growth both in the short and long run periods. Also, Political Stability and Absence of Violence/Terrorism index has significant positive short-run and insignificant long run effects on non-oil export growth in Nigeria, while this variable has an insignificant positive impact on oil export growth in both the short and long run periods. Based on these findings, the study recommends that government should place a mechanism, such as implementing the Petroleum Industry Governance Act, that is capable of reducing corruption and increasing transparency in the Nigerian oil industry. Also, Infrastructure development, including roads, airports, and seaports, should be government priority to reduce transportation costs and facilitate the flow of export products. Finally, government should improve the security infrastructure of the country to improve the business environment capable of encouraging export activities.

Keywords: Governance, Non-oil export, Oil export, Political Stability, Infrastructure Development

INTRODUCTION

Export growth is an important indicator of a country's economic health and can significantly affect job creation and income generation. Furthermore, a country's ability to export goods and services can impact its international standing and influence. Strong export performance can bolster a nation's reputation as a reliable trading partner and enhance its geopolitical clout. In addition, the revenue generated from exports can provide vital resources for investment in infrastructure, education, and healthcare (Alvarez *et al.*,

2018; Gries & Grundmann, 2020; Hassan *et al.*, 2019; Shahzad *et al.*, 2022). Export growth refers to the increase in the value of goods and services a country exports over time. Export growth is influenced by various factors that can differ from country to country. Some key drivers of export growth include a country's natural resources, technological advancements, and trade policies. Additionally, factors such as governance, infrastructure development, and access to financing can also play a role in boosting export growth. Government policies can also impact export growth by facilitating or

hindering trade between countries (De-Ferranti *et al.*, 2002; Isham *et al.*, 2005; Qiao *et al.*, 2023; Sultanuzzaman *et al.*, 2019).

Governance refers to how rules, norms, and actions are structured, sustained, regulated, and held accountable. It is the process of making and enforcing decisions within an organization or society. Governance indicators are tools used to measure and assess the quality of governance in countries and organizations. The Worldwide Governance Indicators (WGI) is a set of composite indicators covering six governance dimensions: voice and accountability, political stability and absence of violence/terrorism, government effectiveness, regulatory quality, the rule of law, and control of corruption. Good governance can positively impact export growth in developing countries especially, while poor governance can negatively impact export growth. Good governance practices that promote transparency and reduce corruption can lead to an increase in export expansion. This is because transparency and accountability in government institutions create a conducive environment for businesses to thrive. When businesses are confident that they can operate without fear of being subjected to corrupt practices, they are more likely to invest in the country, ultimately leading to increased economic growth and export growth. On the other hand, poor governance can discourage foreign investment and limit export growth. This is because corrupt practices such as bribery and embezzlement can increase business costs, making it less attractive for foreign investors. Poor governance can also lead to political instability, further discouraging investment and hindering economic growth (Admed *et al.*, 2014; Cooray, 2009; Huaug & Ho, 2017; Kamal & Batool, 2021; Nguyen & Wu, 2020). This study captured governance by using the World governance indicators of the World Bank developed by Kauffman *et al.*, (2007). Three of the six indicators (Absence of

terrorism and political stability, government effectiveness, control of corruption and are used to capture governance.

Nigerian oil export share of total export accounts for the largest component of its total exports, from 1996 to 2000, the average of oil export share of total export stood at 97.68 % while non-oil export share of total export stood at 2.32 percent; control of corruption index, political stability and absence of violence/terrorism index and government effectiveness index stood at -1.20, -1.14 and -1.01 respectively. During this period, oil export growth rate stood at an average of 23.86 % while non-oil export growth rate stood at 5.48 percent. This indicated that between 1996 to 2000, oil export growth rate was higher than non-oil export growth rate by a growth rate differential of 18.36%. Between 2001 to 2005, the average of oil export share of total export stood at 97.22 % while non-oil export share of total export stood at 2.78 percent; control of corruption index, political stability and absence of violence/terrorism index and government effectiveness index stood at -1.36, -1.66 and -0.95 respectively. This showed that during this period oil export recorded a marginal declined while non-oil export recorded a marginal increment in terms of share of total export. In term of growth rate, the average growth rate of oil export growth rate stood at 35.19 % while non-oil export growth rate stood at 52.83%. This indicated that between 2001 to 2005, non-oil export growth rate was higher than oil export growth rate by a growth rate differential of 17.64% (World Bank's World Development Indicators, 2022).

Between 2006 to 2010, the average of oil export share of total export stood at 95.80 % while non-oil export share of total export stood at 4.20 percent; control of corruption index, political stability and absence of violence/terrorism index and government effectiveness index stood at -1.04, 2.02 and -1.08 respectively. In term of growth rate, the average growth rate of oil export growth rate

stood at 11.34 % while non-oil export growth rate stood at 55.27%. This indicated that between 2006 to 2010, non-oil export growth rate was higher than oil export growth rate by a growth rate differential of 43.93 %. Between 2011 to 2015, the average of oil export share of total export stood at 93.19 % while non-oil export share of total export stood at 6.81 percent; control of corruption index, political stability and absence of violence/terrorism index and government effectiveness index stood at -1.19, -2.03 and -1.05 respectively. In term of growth rate, the average growth rate of oil export growth rate stood at -4.29 percent while non-oil export growth rate stood at 1.39 percent. This indicated that between 2011 to 2015, non-oil export growth rate recorded a positive growth and was higher than oil export growth rate which recorded a negative growth rate by a growth rate differential of 5.68 percent(WBWDI, 2022).

Between 2016 to 2022, the average of oil export share of total export stood at 89.79 % while non-oil export share of total export stood at 10.24 percent; control of corruption index, political stability and absence of violence/terrorism index and government effectiveness index stood at -1.06, -1.96 and -1.10 respectively. In term of growth rate, the average growth rate of oil export growth rate stood at 10.9 % while non-oil export growth rate stood at 33.84%. This indicated that between 2016 to 2020, non-oil export growth rate was higher than oil export growth rate by a growth rate differential of 22.94%. and Between 2021 to 2023, the average of oil export share of total export stood at 88.62 % while non-oil export share of total export stood at 11.98 percent; control of corruption index, political stability and absence of violence/terrorism index and government effectiveness index stood at -1.09, -1.82 and -1.03 respectively. In term of growth rate, the average growth rate of oil export growth rate stood at 48.04 % while non-oil export growth rate stood at 40.71%. This indicated that

between 2021 to 2023, oil export growth rate was higher than non-oil export growth rate by a growth rate differential of 7.37% (WBWDI, 2022).

The study's main objective was to examine the impact of governance on export growth in Nigeria while the specific objectives were to examine the following: The effects of absence of terrorism and political stability on oil export and non-oil export growth respectively in Nigeria. The effects of government effectiveness on oil export growth and non-oil export growth respectively in Nigeria, and the effects of control of corruption on oil export growth and non-oil export growth respectively in Nigeria (Akpan & Udo 2022).

Sujianto *et al.*, (2023) examined the effect of the human development index and good governance practices on exports in several ASEAN countries using panel data from 2010 to 2021. The study estimated a regression panel and found that human development affects exports. While some good governance practice variables, including political stability and the absence of violence/terrorism, and regulatory quality can explain exports in several ASEAN countries. However, voice and accountability, government effectiveness, and the rule of law do not affect exports. The analysis shows that, simultaneously, the human development index and good governance practices affect exports in several ASEAN countries.

Munemo (2022) examined the impact of regulation-driven trade barriers on export entrepreneurship in a panel of 60 countries between 2006 and 2014. The paper finds robust evidence that unfavourable trade regulations significantly reduce the export entry rate and export entry density (two critical measures of export entrepreneurship) by increasing the time and cost associated with documentary and customs compliance procedures. These findings support the hypothesis that less conducive business regulations are an

important domestic supply constraint which impedes export entrepreneurship by increasing trade costs. In addition, the paper finds that the magnitude of the negative relationship between export entrepreneurship and regulation-driven trade barriers is significantly more pronounced in countries with poor governance quality. Two measures of governance quality (i.e., political stability and rule of law) are shown to be relatively more significant in aiding favourable trade regulations that promote export entrepreneurship. Furthermore, a reduction in regulation-driven trade barriers has a positive impact on the net entry rate and survival rates of first-, second- and third-year exporters and high-quality governance institutions significantly increase the magnitude of this positive relationship (Udo *et al.*, 2024)..

Sabry (2022) examined the effect of good governance in exporting to the highly competitive markets of developed countries, especially those committed to a developmental mission centred on promoting good governance using the two-stage least-squares and Poisson pseudo maximum likelihood models. Different indicators of German exports are used as dependent variables while the independent variables are various governance indicators. The study found that good governance generally boosts Arab exports to Germany relatively more than it does for non-Arab exporters to Germany. This is especially true for governance indicators that directly affect exporting activities, such as regulatory quality and government effectiveness. For some indicators that indirectly affect exporting, however, the results are mixed for both Arab and non-Arab countries, especially for the textile industry.

Dubey and Das (2022) investigated the effect of governance on the export performance of small and medium enterprises (SME) firms in India. The study used descriptive analysis and found that would surge for SMEs given the governance

structures considered. The authors consider several governance modes and two types of product classifications, namely, products and services. The study found conditional support for the two models – indicating that governance structures do not consistently support finding new markets. Further, given the governance structure, export performance is not consistently a means to improve performance. This is contrary to the expectations. However, at the same time, the study found evidence that governance matters and affects products and services differently.

Bah *et al.*, (2021) investigated the effects of governance quality on exports in sub-Saharan African countries. The study employed the six worldwide governance indicators (i.e. voice and accountability, political stability, regulatory quality, rule of law, control of corruption, and government effectiveness) as explanatory factors for exports and its components in a sample of 45 countries over the period 1996-2019. The system GMM method was employed as an estimation technique and the study found that total exports and exports of services are positively affected by the six governance indicators, while manufactured goods are positively associated with those indicators except government effectiveness. While political stability, voice and accountability, rule of law, and control of corruption have positive effects on exports of goods, only voice and accountability effects positively primary commodities.

Arif *et al.*, (2021) examined the impact of export and political stability on economic growth in D8 member countries using panel regression analysis. The study found that there is no impact between exports on economic growth. However, political stability had an impact on economic growth in developing countries. This result implies that the government should increase political stability to accelerate growth.

Soussi *et al.*, (2021) examined the effects of governance on the performance of agri-food exporting SMEs in Morocco using a sample of food SMEs in Agadir city and found that a good governance system improves export performance and accelerates the process of SME internationalization.

Moradi *et al.*, (2020) investigated the effect of corporate governance mechanisms on export performance using a sample of ninety-eight export companies listed on the Tehran Stock Exchange from 2010 to 2016 in Iran. Data mining and statistical analysis are used to test the research hypotheses. This paper operationalizes the corporate governance mechanisms by the board of directors' independence, the concentration of ownership, and institutional investors. It further operationalizes export performance by export sales, export sales intensity, and the volume of export sales. The results show that ownership concentration has a significant effect on export sales. Furthermore, institutional investors have a significant effect on the volume of export sales.

Nguyen and Wu (2020) examined the correlation between Vietnam's export efficiency and bilateral-specific governance performance indicators covering the period 1996 to 2014. The study found that Vietnam's export efficiency is positively correlated with the bilateral governance indicator and regional trade agreements, but negatively correlated with tariffs in the importing countries. The performance of Vietnam's export efficiency also displays an overall increasing trend, with some fluctuation before 2005 and a gradual rise afterwards.

An export-led growth strategy is one where a country seeks economic development by opening itself up to international trade (Malefane, 2021; Mora & Olabisi, 2022). This approach involves producing goods and services that are in demand globally and selling them to other countries. Export-led growth

allows countries to tap into larger markets and benefit from economies of scale. Nigeria has shifted from an import substitution development strategy, popular in the 1970s among developing countries, to an export promotion development strategy (Duma, 2023; (Kedir, 2023)). This involves diversifying the Nigerian export base from oil-dominated export, into non-oil export promotion. Non-oil exports refer to the export of goods and services unrelated to the oil industry.

Heckscher Ohlin's Theory states that a country should export only those goods which she has abundant resources to produce in the country and for which the means of production factors can be utilized more intensively. This theory is based on the idea that countries have different endowments of resources, such as land, labour, and capital. Therefore, a country should specialize in producing goods using abundant resources more efficiently. The Heckscher-Ohlin Theory also suggests that trade can benefit both countries involved by allowing them to exchange goods in which they have a comparative advantage. This means that each country can produce the goods for which it has the lowest opportunity cost and trade them for other goods produced more efficiently by its trading partner (Lancaster, 1957). However, critics argue that this theory oversimplifies the complexities of international trade and does not consider factors such as transportation costs, economies of scale, and government policies. However, another debate that is currently going on among scholars who have gone on to present empirical evidence is the role of governance in export growth (Bah *et al.*, 2021; (Chand *et al.*, 2020; Chishti *et al.*, 2021; (Egunjobi & Ngapah, 2022; Hernández *et al.*, 2022; Martínez-Zarzoso & Márquez-Ramos, 2019; Sabry, 2022; Sharma *et al.*, 2020; Zongo & Oyelami, 2021)).

RESEARCH METHODOLOGY

The study adopted an ex post facto research design. This type of research design uses empirical estimation methods to estimate the causal relationship between the dependent variable and the independent variables by examining existing conditions and searching back in time for plausible causal factors. To ensure robust analysis, the study employed relevant econometric techniques (Autoregressive distributed lag modelling method) for model estimation and analysis.

Pre-estimation tests, unit root, and co-integration tests (Bounds test) were conducted to determine the stationarity condition and the extent of long-run relationships among the study variables.

Model Specification

This study is anchored on the Heckscher-Ohlin theory of international trade and endogenous growth theory. The Heckscher-Ohlin theory of international trade posits that the specific natural resources, land, capital, and human resources which a country has in abundance will give it an advantage in producing and exporting a particular commodity. Endogenous growth theory posits that economic growth is generated from internal forces within a system as a direct result of investment in [human capital](#), knowledge and innovation. More specifically, the theory notes that enhancing a nation's human capital and knowledge-based economy will lead to economic growth by developing new forms of technology and efficient and effective means of production. The endogenous growth theory primarily posits that the long-run growth rate of an economy depends on policy initiatives such as [subsidies](#) for education, [research and development](#) and increasing incentives for innovation. With these theoretical foundations, the basic endogenous model, which is of a similar structural form to the exogenous model, is presented as:

$$Y = f(K, L, A) \quad (1)$$

Where:

Y = aggregate output in the economy; K = capital; L = labour; and A = Technological progress or total factor productivity.

In the study context, the model will be augmented with governance indicators and some controlled variables, and Y will be substituted for non-oil export growth and oil export growth respectively. Since growth (RGDP) is a function of capital, labour and technological progress, it is represented in the export models here as RGDP, one of the factors that influence exports. Thus functionally, the non-oil export growth-governance equation and oil export growth-governance equation are stated in equations 2 and 3 respectively as follows:

$$NOXGR = f(RGDP, EXR, INVS, POL, COC, COEFF) \quad (2)$$

$$OXGR = f(RGDP, EXR, INVS, POL, COC, COEFF) \quad (3)$$

Where:

NOXGR = non-oil export growth rate, measured in percentage

OXGR = oil export growth rate, measured in percentage

F = functional notation

RGDP = real gross domestic product, proxy for economic growth, measured in naira

EXR = exchange rate, measured by units of naira by one US dollar

INVS = total investment, the sum of domestic investment and foreign direction investment, measured in Naira.

POL = Political Stability and Absence of Violence/Terrorism index. Ranging from the scale of -2.5 to 2.5.

COC = control of corruption index. Ranging from the scale of -2.5 to 2.5.

COEFF = government effectiveness index. Ranging from the scale of -2.5 to 2.5.

The mathematical specification of equation (2) is given as:

$$\text{NOXGR}_t = \alpha_0 + \alpha_1 \text{RGDP}_t + \alpha_2 \text{EXR}_t + \alpha_3 \text{INVS}_t + \alpha_4 \text{POL}_t + \alpha_5 \text{COC}_t + \alpha_6 \text{GOVEFF}_t$$

The econometric specification of equation (4) is given as:

$$\text{NOXGR}_t = \alpha_0 + \alpha_1 \text{RGDP}_t + \alpha_2 \text{EXR}_t + \alpha_3 \text{INVS}_t + \alpha_4 \text{POL}_t + \alpha_5 \text{COC}_t + \alpha_6 \text{GOVEFF}_t + \mu_t \quad (5)$$

Equation 5 can be written in linear log form, because the some of the variables involve are dominated in percentage and some at level, as thus:

$$\text{NOXGR}_t = \alpha_0 + \alpha_1 \log(\text{RGDP}_t) + \alpha_2 \text{EXR}_t + \alpha_3 \log(\text{INVS}_t) + \alpha_4 \text{POL}_t + \alpha_5 \text{COC}_t + \alpha_6 \text{GOVEFF}_t + \mu_t \quad (6)$$

Where:

μ_t is the error term which represents all other variables that affect non-oil export not captured by the equation with NOXGR as dependent variable.

α_0 is the constant term while $\alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5$, and α_6 are parameters of $\log(\text{RGDP})$, EXR , $\log(\text{INVS})$, POL , COC and GOVEFF respectively.

The mathematical specification of equation (3) is given as:

$$\text{OXGR}_t = \beta_0 + \beta_1 \text{RGDP}_t + \beta_2 \text{EXR}_t + \beta_3 \text{INVS}_t + \beta_4 \text{POL}_t + \beta_5 \text{COC}_t + \beta_6 \text{GOVEFF}_t \quad (7)$$

The econometric specification of equation (7) is given as:

$$\text{OXGR}_t = \beta_0 + \beta_1 \text{RGDP}_t + \beta_2 \text{EXR}_t + \beta_3 \text{INVS}_t + \beta_4 \text{POL}_t + \beta_5 \text{COC}_t + \beta_6 \text{GOVEFF}_t + e_t \quad (8)$$

Equation 8 can be written in linear log form, because the some of the variables involve are dominated in percentage and some at level, as thus:

$$\text{OXGR}_t = \beta_0 + \beta_1 \log(\text{RGDP}_t) + \beta_2 \text{EXR}_t + \beta_3 \log(\text{INVS}_t) + \beta_4 \text{POL}_t + \beta_5 \text{COC}_t + \beta_6 \text{GOVEFF}_t + e_t \quad (9)$$

Where:

e_t is the error term which represents all other variables that affect oil export not captured by the equation with OXGR as dependent variable.

β_0 is the constant term while $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5$, and β_6 are parameters of $\log(\text{RGDP})$, EXR , $\log(\text{INVS})$, POL , COC and GOVEFF respectively.

Presentation and Analysis of Descriptive Data

Descriptive statistics

The result of the descriptive statistics of NOXGR, OXGR, COC, EXR, GOVEFF, INVS, POL and RGDP is presented in Table 1. The mean or average value of NOXGR, OXGR, COC, EXR, GOVEFF, INVS, POL and RGDP over the study period stood at 30.57%, 17.82 %, -1.16 rank, N178.97, -1.038 rank, N12,300 billion, -1.77 rank and N75,500 billion respectively. The maximum value of NOXGR, OXGR, COC, EXR, GOVEFF, INVS, POL and RGDP over the study period stood at 238.22%, 81.46 %, -0.90 rank, N443.67, -0.90 rank, N38,200 billion, -0.5882 rank and N230,000 billion respectively. The minimum value of NOXGR, OXGR, COC, EXR, GOVEFF, INVS, POL and RGDP over the study period stood at -51.50%, -40.80 %, -1.50 rank, N21.88, -1.200 rank, N1,500 billion, 2.211 rank and N3,53 billion respectively. The analysis of the skewness of the variables as shown in Table 1 showed that the variables NOXGR, OXGR, EXR, INVS, POL and RGDP were skewed to the right as evidenced by their respective positive values of skewness. This implies that the mean values of NOXGR, OXGR, EXR, INVS, POL and RGDP were greater than their respective median values, implying that they were higher than their sample mean. While COC and GOVEFF were skewed to the left as evidenced by their respective negative values. This implies that the mean values of COC and

GOVEFF were greater than their respective median values, implying that they were lower than their sample mean. The kurtosis analysis also in table 1 showed the distribution of the variables used in the study. The kurtosis analysis showed that NOXGR, COC, EXR, INVS and POL were leptokurtic, which implies that the respective kurtosis values of

these variables were greater than 3, that is, it peaked and possessed a thick tail. This indicates that there is a possible outlier in the NOXGR, COC, EXR, INVS and POL variables. But OXGR, GOVEFF and RGDP were platykurtic, meaning that their respective kurtosis values were less than 3 which implies that OXGR, GOVEFF and RGDP respectively are normally distributed.

Table 1: Descriptive statistics, 1996 -2022

	NOXGR	OXGR	COC	EXR	GOVEFF	INVS	POL	RGDP
Mean	30.5728	17.8171	-1.1648	178.9716	-1.0378	12,300,000,000,000	-1.7685	75,500,000,000,000
Median	22.8287	12.7855	-1.1600	148.8800	-1.0200	9,590,000,000,000	-1.8741	53,200,000,000,000
Maximum	238.2241	81.4616	-0.9000	443.6700	-0.9000	38,200,000,000,000	-0.5882	230,000,000,000,000
Minimum	-51.5001	-40.8011	-1.5000	21.8844	-1.2000	1,500,000,000,000	-2.2111	3,530,000,000,000
Skewness	1.8302	0.0768	-0.6735	0.9555	-0.2873	1.1294	1.6369	1.0642
Kurtosis	6.6938	1.8816	3.1696	3.0947	1.9060	3.0862	5.5431	2.9577
Obs	27	27	27	27	27	27	27	27

Source: computation by Author, 2024, with the assistance of E-view 9.

The Correlation Matrix of the Study's Variables

The correlation matrix of the study's variables is presented in table 2 and the result of the correlation coefficient between NOXGR and COC is -0.0902. This revealed that there is a very weak negative correlation or association between NOXGR and COC. The result of the correlation coefficient between NOXGR and EXR is 0.0033. This revealed that there is a very weak positive correlation or association between NOXGR and EXR. The result of the correlation coefficient between NOXGR and GOVEFF is 0.0187. This revealed that there is a very weak positive correlation or association between NOXGR and GOVEFF.

The result of the correlation coefficient between NOXGR and INVS is 0.0442. This revealed that there is a very weak positive correlation or association between NOXGR and INVS. The result of the correlation coefficient between NOXGR and POL is -0.1139. This revealed that there is a very weak negative correlation or association between NOXGR and POL. the result of the correlation coefficient between NOXGR and RGDP is -0.0209. This revealed that there is a very weak negative correlation or association between NOXGR and RGDP. The result of the correlation coefficient between OXGR and COC is -0.1549. This revealed that there is a very weak negative correlation or association between OXGR and COC. The

result of the correlation coefficient between OXGR and EXR is 0.0696. This revealed that there is a very weak positive correlation or association between OXGR and EXR. The result of the correlation coefficient between OXGR and GOVEFF is 0.3521. This revealed that there is a very weak positive correlation or association between OXGR and GOVEFF. The result of the correlation coefficient between OXGR and INVS is -0.0770. This revealed that there is a very weak negative

correlation or association between OXGR and INVS. The result of the correlation coefficient between OXGR and POL is -0.1053. This revealed that there is a very weak negative correlation or association between OXGR and POL. The result of the correlation coefficient between OXGR and RGDP is 0.0045. This revealed that there is a very weak positive correlation or association between OXGR and RGDP.

Table 2: Correlation matrix of the study's variables

	NOXGR	OXGR	COC	EXR	GOVEFF	INVS	POL	RGDP
NOXGR	1	-0.0063	-0.0902	0.00332	0.01867	0.04422	-0.1139	-0.0209
OXGR	-0.0063	1	-0.1549	0.06962	0.35214	-0.077	-0.1053	0.00454
COC	-0.0902	-0.1549	1	0.3765	-0.3655	0.45528	0.15563	0.43239
EXR	0.00332	0.06962	0.3765	1	-0.2891	0.93714	0.02511	0.98728
GOVEFF	0.01867	0.35214	-0.3655	-0.2891	1	-0.3954	-0.045	-0.316
INVS	0.04422	-0.077	0.45528	0.93714	-0.3954	1	-0.0353	0.95847
POL	-0.1139	-0.1053	0.15563	0.02511	-0.045	-0.0353	1	0.04563
RGDP	-0.0209	0.00454	0.43239	0.98728	-0.316	0.95847	0.04563	1

Source: computation by Author, 2024, with the assistance of E-view 9.

Presentation and Analysis of Econometric Results

Unit Root Test Results

Table 3: Unit Root Test Summarized Result Results: ADF and PP

Variable	At level		After first difference		Remark
	ADF	PP	ADF	PP	
COC	-2.2022 (0.4688)	-2.4123 (0.3652)	-5.1641 (0.0027)	-4.8197 (0.0037)	I(1)
EXR	-0.1666 (0.9900)	-0.9523 (0.9338)	-4.3475 (0.0111)	-4.0766 (0.0190)	I(1)
GOVEFF	-3.9586 (0.0237)	-3.9598 (0.0236)	NE	NE	I(0)
Log(INVS)	-2.1343 (0.5040)	-2.1343 (0.5040)	-4.7363 (0.0045)	-4.7233 (0.0046)	I(1)

NOXGR	-5.7125 (0.0005)	-5.7125 (0.0005)	NE	NE	I(0)
OXGR	-5.1122 (0.0019)	-4.1808 (0.0147)	NE	NE	I(0)
POL	-5.0790 (0.0018)	-5.0787 (0.0018)	NE	NE	I(0)
Log(RGDP)	-2.5429 (0.3068)	-2.7812 (0.2159)	-4.5348 (0.0074)	-5.4771 (0.0008)	I(1)

Figures in brackets are corresponding probability values of ADF and PP statistics.

NE stands for “not estimated”, this is for variables whose series was stationary at level and there was no need to go further. **Source:** Computation by Author, 2024, with the assistance of E-view 9.

The unit root result is presented in Table 3. The table shows both the ADF and PP unit root test results for all the variables, and it shows that GOVEFF, NOXGR, OXGR and POL variables were stationary at a level while COC, EXR, log (RGDP) and log (INVS) were

stationary after first difference. The order of integration of the variables in Table 3 using ADF and PP unit root test showed a mixed stationarity, and this justified the use of the ARDL estimation techniques in this study.

Optimal Lag Selection

This study used VAR lag order selection criteria to determine the lag length. The result is shown in Table 4, and using the greater number of criteria to choose from, the result showed that the optimal lag selection for estimating the ADRL models is two (2).

Table 4: Optimal Lag Selection

VAR Lag Order Selection Criteria						
Endogenous variables: NOXGR COC EXR GOVEFF LOG(INVS) POL LOG(RGDP)						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-309.88	NA	241.248	25.3507	25.692	25.4453
1	-185.43	169.2609*	0.67845	19.3141	2.04442*	20.0714
2	-122.03	50.7169	0.671240*	18.16245*	23.2817	19.58232*
Endogenous variables: OXGR COC EXR GOVEFF LOG(INVS) POL LOG(RGDP)						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-289.64	NA	47.7811	23.7315	24.0728	23.8261
1	-163.16	172.0198*	0.11424	17.5327	20.2629	18.2899
2	-81.979	64.9437	0.027248*	14.95829*	20.07757*	16.37816*

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level) FPE: Final prediction error; AIC: Akaike information criterion; SC: Schwarz information criterion; HQ: Hannan-Quinn information criterion **Source:**

computation by Author, 2024, with the assistance of E-view 9.

The Bound test (co-integration) results

Table 5 shows the results of the Bounds test result for the estimated model for NOXGR

and OXGR as dependent variables respectively. For model one, that is, when NOXGR is a dependent variable, the Bounds test results found F-statistics value of 5.2491 is greater than the critical value of 3.61 of the upper bound at the 5 per cent level of the upper bounds. This means that the null hypothesis of no long-run relationship in model one (NOXGR as dependent variable) is rejected, and the alternative hypothesis of the existence of a long-run relationship in the variables of the model (NOXGR as dependent variable) cannot be rejected. This means that at a 5 per cent significance level, there is a co-integration or long-run relationship among the variables in model one (NOXGR as dependent variable). In model two, (OXGR as dependent variable) the

Bounds test results found F-statistics value of 4.2663 is greater than the critical value of 3.61 of the upper bound at the 5 per cent level of the upper bounds. This means that the null hypothesis of no long-run relationship in model one (OXGR as dependent variable) is rejected, and the alternative hypothesis of the existence of a long-run relationship in the variables of the model (OXGR as dependent variable) cannot be rejected. This means that at a 5 per cent significance level, there is a co-integration or long-run relationship among the variables in model two (OXGR as dependent variable).

Table 5: Bounds Test Results.

Null Hypothesis: No long-run relationships exist			Critical Value Bounds Significance		
Test Statistic	Value	K		I0 Bound	I1 Bound
F-statistic for model one (NOXGR)	5.24914	6	10%	2.12	3.23
F-statistic model two (OXGR)	4.2663	6	5%	2.45	3.61
			2.50%	2.75	3.99
			1%	3.15	4.43

Source: Computation by Author, 2024, with the assistance of E-view 9.

ARDL error correction and parsimonious results for the non-oil export growth - governance equation

The results for the non-oil export growth -governance equation is shown in Table 6. The short-run coefficient result of the current period of COC is -627.43, with its corresponding probability value of 0.0467. This shows a negative and statistically significant impact of control of corruption on non-oil export growth in the short run at a five per cent level of significance given that the corresponding probability value of 0.0467 is less than the five percent level of significance. This result implies that a one percent increase in control of corruption index will lead to about 627.43 percent decrease in non-oil export growth, all other things being equal. The short-

run coefficient result of lag one period of COC is -541.54, with its corresponding probability value of 0.1255. This shows a negative but not statistically significant lag impact of control of corruption on non-oil export growth in the short run at a five per cent level of significance given that the corresponding probability value of 0.1255 is greater than the five percent level of significance. This result implies that a one percent increase in last year control of corruption index will lead to about 541.54 percent decrease in non-oil export growth, all other things being equal. In the long run, the coefficient of COC is 457.69 with its corresponding probability value of 0.1161. This shows a positive impact of control of corruption on non-oil export growth in the long run, but this is not statistically significant at a five per cent level of significance given that the

corresponding probability value of 0.1161 is greater than the five percent level of significance. This result implies that a one percent increase in control of corruption index will lead to about 457.69 percent increase in non-oil export growth, all other things being equal in the long run.

The short-run coefficient result of the current period of EXR is 1.0511, with its corresponding probability value of 0.2471. This shows a negative but not statistically significant impact of exchange rate on non-oil export growth in the short run at a five per cent level of significance given that the corresponding probability value of 0.2471 is greater than the five percent level of significance. This result implies that a one percent increase in exchange rate will lead to about 1.05 percent increase in non-oil export growth, all other things being equal. The short-run coefficient result of lag one period of EXR is -3.1976, with its corresponding probability

value of 0.0196. This shows a negative and statistically significant lag impact of exchange rate on non-oil export growth in the short run at a five per cent level of significance given that the corresponding probability value of 0.0196 is less than the five percent level of significance. This result implies that a one percent increase in last year increase in exchange rate will lead to about 3.20 percent decrease in non-oil export growth, all other things being equal. In the long run, the coefficient of EXR is 0.9251 with its corresponding probability value of 0.061. This shows a positive and statistically significant effect of exchange rate on non-oil export growth in the long run at a five per cent level of significance given that the corresponding probability value of 0.0061 is less than the five percent level of significance. This result implies that a one percent increase in exchange rate will lead to about 0.93 percent increase in non-oil export growth, all other things being equal in the long run.

Table 6: The Results for the Non-Oil Export Growth -Governance Equation

Dependent Variable: NOXGR						
Selected Model: ARDL(2, 2, 2, 2, 2, 2, 1)						
Variable	Coefficient	t-Statistic		Probability		
short run coefficients						
D(NOXGR(-1))	-0.353512	-1.73173				0.1439
D(COC)	-	-2.46731	0.0467	Diagnostic test results		
	627.42536					
D(COC(-1))	-	-1.83812	0.1255	Adj. R-squared		0.743346
	541.53681					
D(EXR)	1.051065	1.310004	0.2471	F-statistic		12.006041
D(EXR(-1))	-3.19758	-3.38143	0.0196	Durbin-Wat.		2.00201
D(GOVEFF)	54.134936	2.529951	0.012	Prob(F-statistic)		0.026481
D(GOVEFF(-1))	-	-4.08947	0.0095			
	1091.5976					
DLOG(INVS)	130.69231	1.076213	0.331	Breusch-Godfrey Serial Correlation LM		
DLOG(INVS(-1))	-	-3.1434	0.0256	Test: Obs*R-squared		2.8465
	351.33794					

D(POL)	28.742676	2.53879	0.052	Prob. Chi-Square (2)	0.1027
D(POL(-1))	-5.213499	-0.67675	0.5286		
DLOG(RGDP)	-	-1.62005	0.1661	Heteroskedasticity Test: Breusch- Pagan-Godfrey	
ECT (-1)	-0.4341	-14.2726	0.0136	Obs*R-squared	22.9536
long run coefficients				Prob. Chi-Square(11)	0.2394
Variable	Coefficient	t-Statistic			Prob.
COC	457.6921	1.898136			0.1161
EXR	0.925122	2.407535			0.061
GOVEFF	7.671747	2.545499			0.0182
LOG(INVS)	106.07082	1.337216			0.2388
POL	19.24876	1.041899			0.3452
LOG(RGDP)	44.068863	0.863106			0.4275
Constant	3809.0941	2.59829			0.0483

Source: Computation by Author, 2024, with the assistance of E-view 9.

The short-run coefficient result of the current period of log (INVS) is -12.5673 with its corresponding probability value of 0.7946. This shows a negative but not statistically significant effect of total investment on oil export growth in the short run at a five per cent level of significance given that the corresponding probability value of 0.7946 is greater than the five percent level of significance. This result implies that a one percent increase in total investment will lead to about 0.13 percent decrease in oil export growth, all other things being equal. The short-run coefficient result of lag one period of log (INVS) is 89.9407, with its corresponding probability value of 0.1084. This shows a positive but not statistically significant lag impact of total investment on oil export growth in the short run at a five per cent level of significance given that the corresponding probability value of 0.1084 is greater than the five percent level of significance. This result implies that a one percent increase in last year total investment will lead to about 0.90 percent

increase in oil export growth, all other things being equal. In the long run, the coefficient of log (INVS) is -59.7326 with its corresponding probability value of 0.0109. This shows a negative and statistically significant impact of total investment on oil export growth in the long run at a five per cent level of significance given that the corresponding probability value of 0.2388 is less than the five percent level of significance. This result implies that a one percent increase in total investment will lead to about 0.49 percent decrease in oil export growth, all other things being equal in the long run.

The short-run coefficient result of the current period of POL is 3.0663, with its corresponding probability value of 0.3306. This shows a positive but not statistically significant impact of political stability and absence of violence/terrorism on oil export growth in the short run at a five per cent level of significance given that the corresponding probability value of 0.3306 is greater than the five percent level of significance. This result

implies that a one percent increase in political stability and absence of violence/terrorism index will lead to about 3.07 percent increase in oil export growth, all other things being equal. In the long run, the coefficient of political stability and absence of violence/terrorism index is 1.7127 with its corresponding probability value of 0.3273. This shows a positive but not statistically significant effect of political stability and absence of violence/terrorism index on oil export growth in the long run at a five per cent level of significance given that the corresponding probability value of 0.3272 is greater than the five percent level of significance. This result implies that a one percent increase in political stability and absence of violence/terrorism index will lead to about 1.71 percent increase in oil export growth, all other things being equal in the long run.

The short-run coefficient result of the current period of $\log(\text{RGDP})$ is 64.0765, with its corresponding probability value of 0.0215. This shows a positive and statistically significant effect of economic growth on oil export growth in the short run at a five per cent level of significance given that the corresponding probability value of 0.0215 is less than the five percent level of significance. This result implies that a one percent increase in RGDP will lead to about 0.65 percent increase in oil export growth, all other things being equal. In the long run, the coefficient of $\log(\text{RGDP})$ is 36.0765 with its corresponding probability value of 0.0334. This shows a positive and statistically significant effect of economic growth on oil export growth in the long run at a five per cent level of significance given that the corresponding probability value of 0.0334 is less than the five percent level of significance. This result implies that a one percent increase in economic growth will lead to about 0.36 percent increase in oil export growth, all other things being equal in the long run.

The error correction coefficient, otherwise called the speed of adjustment, is -0.7904 with a corresponding probability value of 0.0001. This is a correct sign and statistically significant because the probability value is less than a 5% significance level. This means that about 79.04 percent of the disequilibrium in the short run is corrected in the long run. This is a good speed of adjustment from the short-run disequilibrium to the long-run. The correctness of the sign and the statistical significance of the error correction coefficient confirm the existence of a long-run relationship between the dependent and the independent variables. The oil export growth-governance equation passed the diagnostic tests, as shown in Table 7. The adjusted R-squared is 0.6553. This means that about 65.53 per cent variation in the dependent variable, oil export growth, was explained by the variations of the independent variables (OXGR (-1), COC, EXR, GOVEFF, $\log(\text{INVS})$, POL and $\log(\text{RGDP})$). This shows that the oil export growth-governance equation has a good fit. Also, the F-statistics for the oil export growth-governance equation is 7.8239 with its corresponding probability of 0.0393. This shows that all the independent variables have a significant joint effect on OXGR, and this is equally good. The Durbin-Watson (D-W) statistics for the non-oil export growth-governance equation is 1.9908, which is approximately two and, by the rule of thumb, shows no presence of autocorrelation in the estimated non-oil export growth-governance model. Breusch-Godfrey for Serial Correlation LM test observed R-Squared is 3.1868 with a chi-Square probability of 0.2032. This is not statistically significant at five per cent, meaning there is no serial correlation in the estimated model. Heteroskedasticity Test: Breusch-Pagan-Godfrey observed R-Squared is 5.7585 with a chi-Square probability of 0.889. This is not statistically significant at a five per cent significance level, and it shows the presence of homoscedasticity (equal spread or equal

variance) in the estimated the oil export growth-governance model.

Stability test results for the estimated Models

The stability test using the cumulative sum (CUSUM) in Figure 1 and Figure 2 reveals that the variables in the estimated non-oil export growth- governance equation and the estimated oil export growth- governance

equation remained consistent throughout the study period. The swing of the trend within the CUSUM limit at a 5 per cent significant level bound portrays this assertion. This implies, on the other hand, that the parameters of the estimated non-oil export growth-governance model do not suffer from any structural instability over the study period, which means that all the coefficients of the model are stable and can be used for policy recommendations.

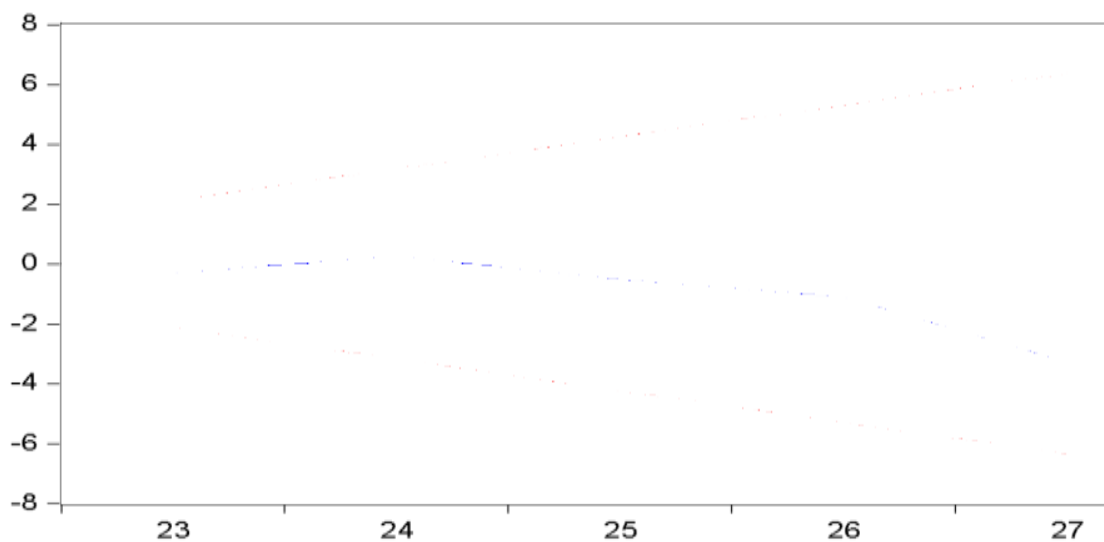


Figure 1: Cumulative sum for test of stability of the non-oil export growth- governance model

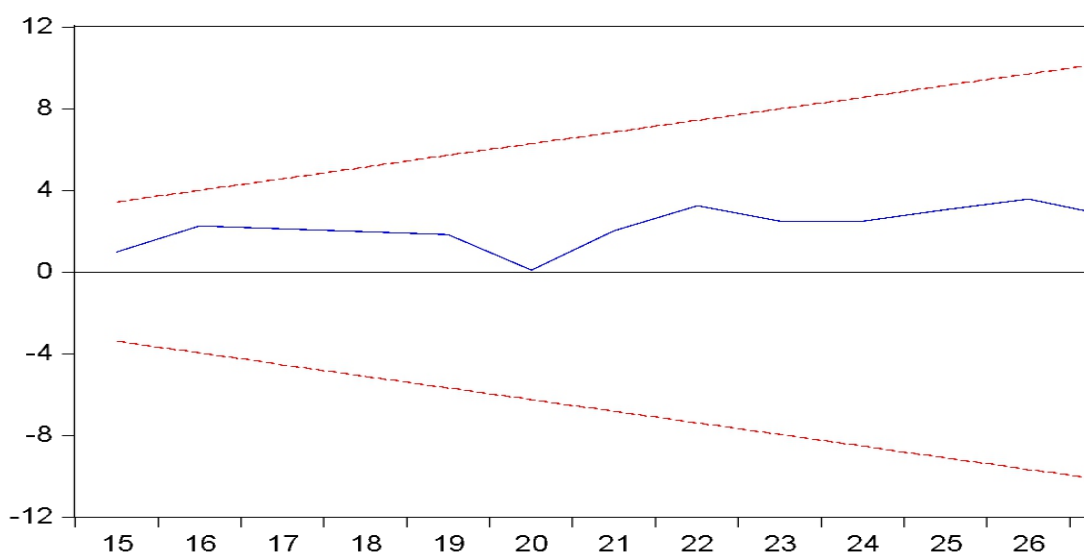


Figure 2: Cumulative sum for test of stability of the oil export growth- governance model

Figure 2: Cumulative sum for test of stability of the oil export growth- governance model

DISCUSSION

The study found a negative and statistically significant impact of control of corruption on non-oil export growth in the short run at a five per cent level of significance. This finding implies that an increase in control of corruption will decrease non-oil export growth, all other things being equal. This suggests that efforts to improve control of corruption may inadvertently hinder the growth of non-oil exports in the short term. But in the long run, the study found a positive but not statistically significant effect of control of corruption on non-oil export growth at a five percent level of significance. This result implies that an increase in control of corruption will lead to an increase in non-oil export growth, all other things being equal in the long run. This means that control of corruption is not a significant factor in promoting non-oil export growth in Nigeria. The study found a positive and statistically significant effect of control of corruption on oil export growth in both the short run and the long run periods at a five per cent level of significance. This means that an increase in control of corruption will lead to an increase in oil export growth, all other things being equal both in the short run and in the long run period. Additionally, the results suggest that efforts to improve control of corruption could potentially have a substantial impact on the economic performance of countries heavily reliant on oil exports. This highlights the importance of addressing corruption issues to promote sustainable growth in these economies. This finding is in line with Bah *et al.*, (2021) whose study that found political stability and control of corruption have positive effects on exports of goods, in sub-Saharan African countries.

The study found a positive and statistically significant effect of government effectiveness on non-oil export growth in both

the short-run and long-run periods at a five per cent level of significance. This result implies that an increase in government effectiveness will lead to an increase in non-oil export growth, all other things being equal. This suggests that improving government effectiveness can have a direct impact on promoting non-oil export growth in the economy. This finding is not in line with Sabry (2022) whose study found that good governance generally boosts Arab exports to Germany relatively more than it does for non-Arab exporters to Germany, but this finding does not agree with Sujianto *et al.*, (2023) whose study found government effectiveness does not affect exports in several ASEAN countries. The study found a positive but not statistically significant effect of government effectiveness on oil export growth in both the short-run and long-run periods at a five per cent level of significance. This result implies that an increase in government effectiveness will lead to an increase in oil export growth, all other things being equal.

The study found a positive and statistically significant effect of political stability and absence of violence/terrorism on non-oil export growth in the short run at a five per cent level of significance. This result implies that an increase in political stability and the absence of violence/terrorism will lead to an increase in non-oil export growth, all other things being equal. Additionally, the findings suggest that addressing political instability and violence could potentially have a direct impact on economic growth through the promotion of non-oil exports. This highlights the importance of maintaining peace and stability for sustainable economic development. But in the long run, the study found a positive but not statistically significant effect of political stability and absence of violence/terrorism on non-oil export growth at a five per cent level of significance. This result implies that an increase in political stability and absence of violence/terrorism will lead to

an increase in non-oil export growth, all other things being equal in the long run. The study found a positive but not statistically significant impact of political stability and absence of violence/terrorism on oil export growth in both the short run and the long run periods at a five per cent level of significance. This result implies that an increase in political stability and the absence of violence/terrorism will lead to an increase in oil export growth, all other things being equal.

Conclusion and Recommendations

This study examined the effects of governance on export growth in Nigeria from 1996 to 2022 using the ARDL estimation technique. Export growth was disaggregated into non-oil export growth and oil export growth while governance was captured by three World Bank's governance indicators which are the control of corruption index, government effective index and political stability and absence of violence/terrorism index. The study found a negative and statistically significant impact of control of corruption on non-oil export growth in the short run but a positive but not statistically significant effect of control of corruption on non-oil export growth in the long run; a positive and statistically significant effect of control of corruption on oil export growth in both the short run and the long run periods; a positive and statistically significant effect of government effective on non-oil export growth in both the short run and short run periods; a positive but not statistically significant effect of government effective on oil export growth in both the short run and long run periods; a positive and statistically significant effect of political stability and absence of violence/terrorism on non-oil export growth in the short run but a positive and statistically insignificant effect of political stability and absence of violence/terrorism on non-oil export growth in the long run; and a positive but not statistically significant impact of political stability and absence of

violence/terrorism on oil export growth in both the short run and the long run periods at a five per cent level of significance.

Thus, the policy implications of these findings can be summarized: first, there is a need to put in place a mechanism that is capable of reducing corruption and increasing transparency in the Nigerian oil industry. This could be done by implementing the Petroleum Industry Governance Act, which is intended to promote transparency, establish clear obligations, and foster an environment that is conducive to the oil business. Furthermore, the implementation of robust supervision mechanisms and strict enforcement of anti-corruption legislation will serve to deter illicit operations within the sector. In addition to bolstering the protection of whistleblowers, raising public awareness regarding the dangers of corruption will be crucial to fostering accountability. Infrastructure development, including roads, airports, and seaports, should be a government priority to reduce transportation costs and facilitate the flow of products. Enhanced accessibility to global markets will facilitate exporters' operations and bolster the competitiveness of Nigerian goods. The government should conduct consistent monitoring and evaluation of the efficacy of export promotion policies, while also taking appropriate measures to rectify any obstacles that may emerge. The government should improve the security infrastructure of the country to improve the business environment capable of encouraging export activities.

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REFERENCES

- Adewale, A. R. (2017). Import substitution industrialisation and economic growth—Evidence from the group of BRICS countries. *Future Business Journal*, 3(2), 138-158.
- Ahmed, F. Z., Greenleaf, A., & Sacks, A. (2014). The paradox of export growth in areas of weak governance: The case of the ready-made garment sector in Bangladesh. *World Development*, 56(1), 258-271.
- Akpan, O. M. & Udo, E. G. (2022). Private Sector Credit and Selected Macro-Economic Variables. *International Journal of Novel Research in Marketing Management and Economics*, Vol. 9 (3), Pp. 57-71.
- Álvarez, I. C., Barbero, J., Rodríguez-Pose, A., & Zofío, J. L. (2018). Does institutional quality matter for trade? Institutional conditions in a sectoral trade framework. *World Development*, 103(1), 72-87.
- Arif, M. N. R. A., Arisman, A., & Harahap, D. (2021). Export, political stability, and growth in developing-8 countries. *Studies of Applied Economics*, 39(2), 1-10.
- Bah, M., Ondo, H. A., & Kpognon, K. D. (2021). Effects of governance quality on exports in Sub-Saharan Africa. *International Economics*, 167(1), 1-14.
- Chand, R., Singh, R., Patel, A., & Jain, D. K. (2020). Export performance, governance, and economic growth: evidence from Fiji—a small and vulnerable economy. *Cogent Economics & Finance*, 8(1), 18-28.
- Chishti, M. Z., Hussain, B., & Khursheed, M. A. (2021). Impact of institutional quality on bilateral exports: exploring the role of development. *Journal of Applied Economics and Business Studies*, 5(2), 17-34.
- Cooray, A. (2009). Government expenditure, governance and economic growth. *Comparative Economic Studies*, 51(2), 401-418.
- De Ferranti, D., Perry, G. E., Lederman, D., & Maloney, W. E. (2002). *From natural resources to the knowledge economy: trade and job quality*. Washington, DC: World Bank.
- Dubey, V. K., & Das, A. (2022). Role of governance on SME exports and performance. *Journal of Research in Marketing and Entrepreneurship*, 24(1), 39-74.
- Duma, S. (2023). *Developmental Integration and Industrialisation in Southern Africa*. UJ Press.
- Eegunjobi, R., & Ngepah, N. (2022). The determinants of global value chain participation in developing seafood-exporting countries. *Fishes*, 7(4), 186.
- Gries, T., & Grundmann, R. (2020). Modern sector development: The role of exports and institutions in developing countries. *Review of Development Economics*, 24(2), 644-667.
- Hassan, S. T., Xia, E., Huang, J., Khan, N. H., & Iqbal, K. (2019). Natural resources, globalization, and economic growth: evidence from Pakistan. *Environmental Science and Pollution Research*, 26, 15527-15534.
- Hernández, V., Nieto, M. J., & Rodríguez, A. (2022). Home country institutions and exports of firms in transition economies: does innovation matter? *Long Range Planning*, 55(1), 1-17.
- Huang, C. J., & Ho, Y. H. (2017). Governance and economic growth in Asia. *The North American Journal of Economics and Finance*, 39(4), 260-272.
- Irwin, D. A. (2021). The rise and fall of import

- substitution. *World Development*, 139(1), 1-10.
- Isham, J., Woolcock, M., Pritchett, L., & Busby, G. (2005). The varieties of resource experience: natural resource export structures and the political economy of economic growth. *The World Bank Economic Review*, 19(2), 141-174.
- Jackson, E. A., & Jabbie, M. N. (2021). *Import Substitution Industrialization (ISI): An approach to global economic sustainability. In industry, innovation and infrastructure*. Cham: Springer International Publishing
- Kamal, D. M., & Batool, D. S. (2021). Institutional failure: A challenge to good governance in Pakistan. *South Asian Studies*, 1(35).
- Kauffman, D., Kraay, A., & Mastruzzi, M. (2007). World Governance Indicators. *World Bank*.
- Kedir, A. S. (2023). Developmental States in Africa: The Mauritian miracle. *Akademik İncelemeler Dergisi*, 18(1), 123-140.
- Lancaster, K. (1957). The Heckscher-Ohlin trade model: A geometric treatment. *Economica*, 24(93), 19-39.
- Malefane, M. (2021). Export-led growth hypothesis: Empirical evidence from the Southern African Customs Union countries. *Entrepreneurial Business and Economics Review*, 9(2), 55-69.
- Martínez-Zarzoso, I., & Márquez-Ramos, L. (2019). Exports and governance: is the Middle East and North Africa region different? *The World Economy*, 42(1), 143-174.
- Mora, J., & Olabisi, M. (2022). Export growth drivers and economic development. *Empirical Economics*, 63(5), 2389-2426.
- Moradi, M., Ghodratpanah, A., & Salarmoradi, F. (2020). The effect of corporate governance on export performance of Iranian listed companies. *Iranian Journal of Accounting, Auditing and Finance*, 4(4), 1-14.
- Munemo, J. (2022). The effect of regulation-driven trade barriers and governance quality on export entrepreneurship. *Regulation & Governance*, 16(4), 1119-1140.
- Nguyen, S. T., & Wu, Y. (2020). Governance and export performance in Vietnam. *Journal of Southeast Asian Economies*, 37(1), 1-25.
- Qiao, H., Kang, Y., Yan, J., Zhang, J., Zheng, Z., & Liang, Q. (2023). What role does trade expansion play in the natural resource sustainability of highly resource-consuming countries? Testing moderating role of exports and innovation. *Resources Policy*, 82, 103424.
- Sabry, M. I. (2022). Arab-German trade and institutions: The effect of good governance on Arab exports to Germany. *The European Journal of Development Research*, 34(5), 2400-2437.
- Shahzad, U., Madaleno, M., Dagar, V., Ghosh, S., & Doğan, B. (2022). Exploring the role of export product quality and economic complexity for economic progress of developed economies: Does institutional quality matter? *Structural Change and Economic Dynamics*, 62, 40-51.
- Sharma, P., Cheng, L. T., & Leung, T. Y. (2020). Impact of political connections on Chinese export firms' performance—Lessons for other emerging markets. *Journal of Business Research*, 106, 24-34.
- Soussi, N. E., Elfathaoui, H., & Agouram, J.

- (2021). Governance and performance of Agri-Food Exporting SMEs. *Asian Journal of Social Sciences and Management Studies*, 8(4), 83-91.
- Sujianto, A. E., Dwiningtias, K., Luksita, A. C., & Narmaditya, B. S. (2023). Human Development Index, good governance practice and export: Evidence from ASEAN countries. *Journal of Eastern European and Central Asian Research (JEECAR)*, 10(3), 468-477.
- Sultanuzzaman, M. R., Fan, H., Mohamued, E. A., Hossain, M. I., & Islam, M. A. (2019). Effects of export and technology on economic growth: Selected emerging Asian economies. *Economic research-Ekonomska istraživanja*, 32(1), 2515-2531.
- Udo, E. G., Uko, F. E. & Akpan, O. M. (2024). The Sovereign Wealth Fund and Nigerian Economic Development. *East African Finance Journal Vol 3 Issue 1*, Pp. 48-76
- Wang, G., Sharma, P., Jain, V., Shukla, A., Shabbir, M. S., Tabash, M. I., & Chawla, C. (2022). The relationship among oil prices volatility, inflation rate, and sustainable economic growth: Evidence from top oil importer and exporter countries. *Resources Policy*, 77(3), 22-34.
- Zongo, A. M. I., & Oyelami, L. (2021). The impact of institutional quality on intra-African trade: Evidence from sub-Saharan African countries. Available at SSRN 3866424.



The Influence of Poverty on Human Trafficking in Contemporary International System: Impact on Third World Countries.

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Abstract

This paper examined the influence of poverty on human trafficking in contemporary international system and its impacts on third world countries. Poverty was seen as the single most important factor that caused human trafficking. The theoretical framework adopted was Paul Prebiseb dependency theory. This theory stated that the dependence of third world countries on developed countries is the main cause of underdevelopment and poverty of the third world countries. This is so because the developed countries control and dominate the international capitalist economy and thus create policies and initiatives that impoverish third world countries thus necessitating migration from third world countries to the first world countries. The study argued that poverty contributed greatly to human trafficking. The study also observed that most people allowed themselves to be trafficked out because of their attempt to escape poverty back home. Others trafficked in drugs, contraband goods and engage in other shady businesses in order to escape poverty. Young girls are trafficked out for sexual exploitation and other menial jobs majorly because of poverty back home. Human trafficking was seen as contributing immensely to political, economic, social and security upheavals in third world countries. The study concluded that as a major component of organized crime with enormous financial power, human trafficking has a complex negative impact across the international system. As a way out of this political, social, economic and security cul-de-sac, it was recommended that government of third world countries should create more job opportunities for their citizens, strengthen the implementation of immigration laws, embarked on adequate enlightenment to tell people about the dangers of human trafficking among others.

Keyword: Poverty, Human Trafficking, Capitalist Economy, Third World Countries.

INTRODUCTION

Poverty is one of the strongest push factors for human trafficking in third world countries. In fact most of those who are trafficked out of Nigeria and other third world countries are those who try to escape poverty back home. Their belief is that grasses are greener in other countries than their own. Thus, they japa (move) out of their mostly poor

countries to countries they believe have better opportunities for them to work, earn a living and make remittances back home. Also, most of those who are involved in human and organs trafficking engage in this illegal and despicable business to 'earn' a living and to escape poverty. Victims of human trafficking are mostly from poor countries, poor families, and

poor background. Their belief is to go outside their poverty-stricken countries to the 'new world' countries which they believe are better governed with good job opportunities to work and make money.

Most third world countries are politically unstable, economically weak, and militarily dependent on world power for their survival. Besides, most, if not all of these third world countries are indebted to Bretton woods institutions as a result of incessant borrowings to finance social programmes and infrastructures. They increasingly see the developed countries of Western Europe and America as big brothers and "Father Christmas", not minding that these loans will hang as albatross on the neck of these third world countries and extend to future generations thus exacerbating the incident of poverty in these countries. This is so because these incident of poverty in these countries. This is so because these third world countries will remain in the "bondage" of servicing these loans in several years to come and continue to push the people of these countries deep down the abyss of poverty. Third world countries usually expect political, economic, financial and military aids from these developed economies of the west.

Furthermore, the developed countries or the first world countries have adopted several strategies to keep third world countries perpetually dependent on them for survival. One of such strategies is giving loans to these third world countries after meeting certain stringent conditionalities which in the long run will work in favour of the donor countries and continuously keep these third world countries in poverty chain that appears difficult to break. This paper therefore seeks to examine how poverty in third world countries influences human trafficking in contemporary international system and impact on third world countries.

Human Trafficking in the International System

States that fail in its functions to the people, have their citizens leave such states to seek for greener pastures in other strong, well organized and prosperous states. Some leave on their own, others are trafficked out as cheap labour to these developed or better organized states. This is what culminates in human trafficking. Human trafficking involves trade in human beings. Trafficking means illegal or unlawful trading of something prohibited. Trafficking may involve drugs, stolen goods or anything prohibited by law.

Human trafficking is defined by Kenb, Ijeoma, Nwamuo and Anyaoha (2016) as an illegal act of recruiting or trading on person(s) for commercial exploitation. According to the United Nations (UN) 2013, human trafficking refers to the recruitment, transportation, transfer, harbouring or receipt of persons, by means of threat or other forms of coercion, of abduction, of fraud, of deception, of the abuse of power or of a position of vulnerability or of the giving or receiving of payments or benefits to achieve the consent of a person having control over another person, for the purpose of exploitation, forced labour and services, slavery and such other similar inhuman practices. Poverty leads to both migration and trafficking in which victims move from conditions of extreme poverty to conditions of less-extreme poverty. This is one condition that seriously engenders human trafficking.

Conceptual Explication

In order to enhance a better understanding of this paper, we find it necessary to throw light on the following concepts as used in this work.

Poverty: This is a situation where a person or group of persons is unable to provide his or her basic needs. These basic needs are necessary for the survival of any individuals. The inability to provide these basic needs is what usually pushes people to look for job in order to

earn a living. Failure to get a job usually exacerbates poverty.

Human Trafficking: This usually involves the movement of persons across national boundaries for work, exploitation, and businesses, among others. Trafficking is not limited only to humans but also includes trafficking on drugs, human organs, contraband goods etc.

Contemporary international systems: This is a global system of inter-relationship among different countries and continents of the world. All these different countries and continents have been incorporated into the world capitalist system so that economic exchanges and transactions can take place.

Third world Countries: These are seen as poor, backward and developing countries of the world that lack basic ingredients of development such as good roads, potable water, constant electricity, employment opportunities, functional education, good health care etc. Poverty rate is very high in third world countries as a result of economic mismanagement, corruption and political instability. Most of the third world countries are found in Africa, Asia, Latin America and the Caribbeans.

It is believed by Marxist Scholars that the under development of these third world countries enhances development of the first world countries. In other words, the under development of the third world countries is dependent on the development of the metropole. Resources of third world countries are used to enhance the development of the west. It is the development of the west or first world that attracts migrants from third world countries. Most of these migrants believe that Western Europe and America are rich countries that can make them rich if they travel there and work. They also believe there are abundant employment opportunities in these continents

and their currencies are equally strong that can help them make remittances back home. Western Europe and America thus becomes the beautiful bride that attracts many suitors from third world countries.

These “suitors” believe that Western Europe and America have the magical wand that can by the snap of a finger, turn their poverty into wealth.

Thus, because of the assumed wealth of the first world countries, third world countries expect so much from these developed countries politically, financially and in terms of military aids.

The definition of human trafficking by the United Nations contains three major things: the ACT, MEANS and PURPOSE.

ACT (what is done): Recruitment, transportation, transfer, harbouring or receipt of persons.

MEANS (how it is done): Through threat, coercion, abduction, deception and monetary inducement.

PURPOSE (why it is done): For the purpose of commercial exploitation. Human trafficking is a kind of modern day slavery where people are lured, tricked or forced to work against their will for the profit of others.

The victims of human trafficking are made to believe that they will be sent to schools, secure well-paid jobs, run lucrative businesses overseas which will help improve their standard of living (Kenb, *et al*, 2016).

The traffickers smartly convince the victims into believing that all is well in the destination countries not knowing that they will be engaged in degrading domestic work or child labour, forced labour, prostitution, begging and servile marriage. Human trafficking is a multi-faceted illegal business that knows no borders and spares no race but majority of those trafficked are from third

world countries. According to the UN (2003), trafficking of human beings is now the third largest source of money for organized crimes after arms and drugs.

Theoretical Framework

This work adopts Raul Prebisch Dependency theory. The dependency theory states that the dependence of third world countries on developed countries is the main cause for the underdevelopment of the former. According to apostle of dependency theory, the whole world is divided between two sets of countries – the developed countries or first world countries and less developed countries or third world countries. The former are in the centre – western Europe, Britain and the United States of America while the latter (third world countries) are in the periphery (that is backward countries of Asia, Africa and Latin America). (Peters, 2010).

Some dependency theorists like Santos (1970), Frank (1972), as well as Amin (1975), hold that the present economic and socio-political conditions prevailing in the periphery, that is, third world countries are the result of a historical international process that assigned to third world countries the role of producing raw materials while the core countries (First world countries) produce manufactured and sophisticated products and sold to third world countries at exorbitant rates. Santos (1970) further states that both the developed countries and third world countries are integral parts of the capitalist system, but the global system is such that the development of the center (first world countries) and third world countries are integral parts of the capitalist system, but the global system is such that the development of the centre (first world countries) occurs at the expense or underdeveloped of the periphery.

There exist three major formulations of dependency theory – neo – classical dependence theory, the false-paradigm model and the dualist-dependence model. All these theories tend to have similar view of the failure

of many third world countries to undergo successful integration into the world capitalist system. Dependency theorists thus conclude that the wealth and prosperity of the developed countries in Europe, North America and East Asia are dependent upon the poverty of the rest of the world.

Dependency theorists further argue that the west (developed countries) actively perpetuate dependency through various policies and initiatives including the giving of loans / grants, the use of trans-national companies, military training / assistance, award of scholarships, development aids, and several conditionalities before loans or assistance is given. All these conditions invariably favour the donor countries while impoverishing the third world countries and thus intensify the tempo of conflict and political instability which result in trafficking to these developed countries (Okereke & Ekpe, 2002).

The relevance of this theory to this work is that the first world countries, that is, the developed countries that control and dominate the international capitalist economy create policies and initiatives that impoverish and subjugate third world countries to their whims and caprices. The scenario is such that when the first world (developed countries) sneeze, third world countries catch cold. First world countries also create conditions that make their countries look strong, stable, attractive and rich while at the same time make third world countries seem weak, unstable, filthy and poor. Naturally these result in exodus of people from third world countries to these core or developed countries to escape poverty back home. Such poverty creates a source of cheap labour of immigrants to developed countries.

Poverty and Human Trafficking: The International Connection

Poverty may not be adequately defined for others to appreciate because it is a multifaceted phenomenon. One has to experience it before he understands it better.

According to Ekong (1988), it is not only an expression of life condition, but a state of mind and a perception of self in the complex web of social relations. Economists tend to view poverty as a distance on a continuum towards zero purchasing power while its opposite – affluence, is a distance on the same continuum toward full purchasing power. This view of poverty in terms of purchasing power is useful when we consider who is able to get what in the society.

Central Bank of Nigeria (CBN) report (2001) identifies three main types of poverty, namely, absolute poverty, relative poverty and zero-sum poverty. (Ekong, 1988)

Absolute poverty is connected to an insufficient resource base, lack of income, narrow margins, high risk of failure, hunger, disease etc.

Relative poverty according to Ekong (1988) “is misery linked to experiencing outcomes which are less satisfactory than those of relevant others while not being able to do much about improving one's own outcome so that one has to adopt one's aroused aspirations to one's inescapable unsatisfactory outcomes instead of through innovation”.

On the other hand, zero-sum poverty is poverty linked to patronage, oppression, exploitation, usurpation, extraction and an abuse by powerful others.

Poverty, especially absolute poverty is one of the most significant drivers of human trafficking.

Absolute poverty is perceived as living with less than 1.90 Dollar a day. To find better work, many people migrate which makes them more vulnerable to traffickers. Because of poverty, some people sell their own family members, including their children to traffickers in order to earn some money to escape poverty. Others connive with traffickers for their loved ones to be trafficked outside the country with the hope that their loved ones will get a chance of a better life outside the country and send remittance back home.

According to the United Nations

Department of Defense and Crime in the Borgen Project (2015), “Poverty is a compelling factor in the human trafficking industry”.

Human trafficking occurs in every single country on the globe. It is a global epidemic that is mostly driven by poverty. The most common countries which victims are trafficked from are mostly in Eastern Europe, West Africa, Asia, Arab nations and North America. The highest destination countries are Belgium, Germany, Greece, Israel, Italy, Japan, the Netherlands, Thailand, Turkey, United Kingdom and the United States. (Borgen Project Report, 2015).

The main countries of origin of victims are Africa, Asia, Central and Eastern European countries, for Eastern European countries, former Eastern bloc and the defunct soviet countries, Latin America and the Caribbean. The most prevalent among the main trafficking countries are: Albania, Belarus, Bulgaria, China, Lithuania, Nigeria, Republic of Moldova, Romania, Russian Federation, Thailand and Ukraine, each with large population affected by extreme poverty (Borgen Project, 2015).

People experiencing extreme poverty are mostly vulnerable to traffickers due to the deplorable circumstances they face back home and also occasioned by desperation to japa (or move outside the country). The victims of trafficking are always forced to do other works other than what they were promised such as prostitution, hard labour, drugs peddling, organs harvesting business etc, with little or no pay, sometimes still making the victims live in poverty they tried to escape from home.

Those usually targeted by traffickers are persons mostly adolescents and teenagers for exploitation. In most instances, victims are told to work to pay off debts which include the cost of bringing them from their various countries of origin to the destination countries. Those who are unable to offset such debts are usually subjected to violence or handed over to the police and immigration officials. Others

may be re-sold to many different other traffickers.

The Impact of Poverty on Human Trafficking in the International System

The human development approach recognizes that poverty is multi-faceted and dynamic with both monetary and non-monetary aspects, including social constraints and personal circumstances. It is about creating an environment in which people can develop their full potential and lead productive, creative and meaningful lives in accordance with their needs and interests (Danailova – Trainor and Laczko, 2010).

Poverty is often seen as the “root cause” of human trafficking. However, the links between poverty, lack of development and trafficking are interwoven. At the country level, poor economic, political and social infrastructure, which lead to poverty, conflict and bad governance which are inherent in failed states provide fertile ground for criminal activity and compel some people with limited access to resources to leave their country of origin and look elsewhere for opportunities. The vast majority of men and women in third world countries seeking to escape poverty are lured into trafficking by the false promise of economic gain (Danailova – Trainor and Laczko, 2010).

A significant issue that cannot be separated from poverty and trafficking is that of gender and gender relations. Human trafficking is the only trans-national crime women are significantly represented, importantly, not only as victims but also as perpetrators and activists (Shelley, 2010). Gender discrimination and violence, forced marriage, and bonded labour are among the many practices that make people vulnerable and potential targets of both transnational and internal trafficking (Danailova-trainor and laczko, 2010). Trafficking in girls is most common in areas where girl child education is low and in situations where families use girls to

advance their economic wellbeing.

Scholars such as Kenb, *et al.* (2016); Danailova-Tranor and Laczko (2010); Aronowitz (2009), Belser (2005), have all agreed that poverty is one of the main causes of human trafficking in the contemporary international system. The vast majority of men, women and children seeking to escape poverty are lured into trafficking with the elusive hope of economic gain.

However, a study conducted by the United Nations office on Drugs and Crime (UNODC) found no simple correlation between poverty and human trafficking. Almost all the countries studied in their work, (Albania, Belarus, Bulgaria, China, Lithuania, Nigeria, Republic of Moldova, Romania, Russian Federation, Thailand and Ukraine)_ are lower to upper-middle-income country of origin of trafficking victims with low human development indicator values (UNODC, 2006). However, it is also clear that economic, political, social, religious and ethnic crisis within, between and among countries, and regional conflicts in most parts of the world and sub-sahara Africa have contributed to a significant rise in poverty, which have contributed to a rise in trafficking (Aronowitz, 2009).

According to Kenb, *et al* (2016), poverty is the greatest cankerworm that has eaten up the social fabrics of the world. In their view, poverty is a major cause of human trafficking. In their own words:

...when there is abject poverty in the land and in a bid to survive, the people are ready to do anything, both as an agent and as victims of traffickers. This is why most impoverished countries have their citizens as the highest casualties and victims of

human trafficking in the world.

This clearly shows that citizens of poor countries, mostly third world countries are the victims and agents of human trafficking in an attempt to escape poverty and economic hardship back in their respective home countries.

The Political Impact of Human Trafficking on Third World Countries

In addition to the tragic impact on individuals, human trafficking has now reached such a scale that it has begun to influence the domestic and foreign policies of many countries such that the problem has become particularly endemic. Also, because trafficking in persons involves the movement of people across international borders, one of the most important areas of it, is migration policy. However, because trafficking in persons is also a deeply human issue, it has become a major issue of discussion and concern in human rights circles. Thus, so many states equate trafficking with “illegal migration” or “smuggling of aliens” or movement of “asylum seekers”, although these phenomena are not the same (Shelley, 2010). Thus, trafficking has helped to shape migration policies in countries both of origin and destination. In third world countries, the impact is particularly serious. Recently, European Union (EU) as a bloc is enacting immigration policies that discriminate against third world countries in movement of people into other countries as a result of this problem (Borgen Project, 2015).

Border control is another response area. There is increased law enforcement around borders in these affected countries. There is also the impact of the abuse of human rights and the increasing cost in governance in an attempt to contain the problem in the third world countries.

Again, there is also the impact of the abuse of human rights of citizen from the countries of origin where people are forcefully trafficked

out of the country against their will.

The Economic Impact of Human Trafficking on Third World Countries

The cost of crime is essentially a measure of the impact of that crime on the society. The costs of trafficking include the value of all resources devoted to its prevention, the treatment and support of victims and the apprehension and prosecution of offenders. For example, as a component of organized crime, there are costs to the police (who investigate suspected crime and gather and record evidence), the prosecution services, criminal courts, legal aid and non-legally aided defense costs, and costs of the prison (correctional centres administration of the victims) and probation services. There may also be costs to witness protection schemes and health, welfare and other government services; expenditure on trafficking prevention programmes, advocacy and research project, among others (Aronowitz, 2009). All these impact negatively on the economy of the third world countries.

Another area of economic impact is lost resources. Human trafficking results in the loss of human resources and reductions in revenue. Trafficking yields no tax revenues, and may even lead to a net revenue loss as a result of tax evasion. When the victims are repatriated back to their countries of origin, the burden of such repatriation is usually borne by the third world countries which are already poor and most time devastated by poverty (Belser, 2005).

However, it must be acknowledged that most third world countries also benefit directly or indirectly from human trafficking. This is so because some of the trafficked individuals usually end up procuring lucrative jobs in the destination countries and thus make some remittances back home which may help to boost or rejuvenate the economic health of most of these economically ailing third world countries (Borgen Project, 2015).

Trafficking undermines law enforcement efforts, slow down economic growth, raises the cost of regional trade and disrupts the transition to a market economy (Sofia, 2003). In most regions or countries of origin and destination, trafficking in persons along with its links to organized crime has endangered human lives as well as national security. For example, trafficking in persons is described in the European security strategy (ESS), as one of the five key threats for the region.

In many countries, in particular in source areas, the prioritization of anti-human trafficking efforts compete with a wide range of significant national concerns, such as addressing poverty, corruption, and or civil unrest as well as competing demands for scarce resources (Esson, 2020). As long as people continue to benefit from it, human trafficking may not come to an end any time soon.

Conclusion

The work examined the influence of poverty on human trafficking in contemporary international system with a focus on its impact on third world countries. Human trafficking causes extreme hardship to the suspected millions of people worldwide, especially in the predominantly third world societies which have incessantly become victims of this crime. Human trafficking has negative impact on the financial markets, the economies and the social structures of countries where trafficking is allowed to flourish. In the social structures, people are separated from their families, sometimes for life as a result of death or refusal to come back home. As a major component of organized crime with its enormous financial power, trafficking in persons has a complex and interlocking negative impact across human, social, political and economic facets of the society. It should be noted however, that trafficking is not limited only to humans but also includes trafficking on drugs, human

organs, contraband goods etc.

The destabilizing and dangerous consequences of human trafficking across international borders range from readily recognized violence, direct economic losses and major migration concerns to the less easily quantified but equally serious, but with more debilitating effects or risks and harms to environment. Human trafficking also has social, health and safety challenges as well as violations of human rights. Trafficking in persons directly challenges the development of a stable and more prosperous society. The range of trafficking related crimes and their broad and interrelated impacts have created a cumulative threat to global peace, security and stability of the polity and have shaped political, social and economic responses at both national and global levels.

Recommendations

The following recommendations are made to checkmate the problem of poverty on human trafficking in the contemporary international system

- (i) Government of third world countries should create more job opportunities for their large army of jobless citizens if ever they are serious in making human trafficking less attractive. This will hopefully checkmate the drift and quest to “japa” or go to foreign countries for greener pastures or the so called proverbial Golden Fleece
- (ii) Immigration laws should be stringently implemented to inhibit reckless borders infiltration by questionable elements some of whom reasons for migration are dubious and detrimental to national and international interests and security.
- (iii) That there should be adequate enlightenment, education and awareness creation such that individual citizens would be sufficiently aware of the dangers of being trafficked since most victims in third world countries

become victims as a result of ignorance of what they consented to. Thus, advocacy visits, seminars, international conferences and workshops should be organized to enlighten the people on the evils, dangers and consequences of human trafficking.

- (iv) There is the need for inclusion of security studies or security education in school curricula in third world countries, from primary through tertiary levels. This will help in no small way to enlighten children on the effects of common crimes such as rape, child stealing, child trafficking, human trafficking, child labour, drug dealings, forced marriage, child marriage and the dangers inherent in engaging in them. The dangers of these common crimes will remind the youth what bleak future and consequences they will face if they embark on these ill-fated trips.
- (v) Efforts should be made to breathe life into the economies of third world countries in order to arrest illegal migration since most victims of human trafficking do as a result of the bad economy in their home countries.
- (vi) Finally, there should be international collaboration among state and non-state actors in order to effectively combat the menace of human trafficking in the contemporary international system

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REFERENCES

- Amin, S. (1975). *Accumulation on a World: A Critique of the Theory of Underdevelopment*. New York, USA. Monthly Review Press.
- Aronowitz, A. (2009). *Human Trafficking, Human Misery: The Global Trade in Human Beings*. International Criminal Justice Review, 12(8), 91-102.
- Belser, P. (2005). Forced Labour and Human Trafficking: Estimating the Profits' Force Labour. Paper 17, Declaration on Fundamental Principles and Rights at work; and International Labour Office. <http://digitalcommons.ilr.cornell.edu/forcedlabour/17>
- Borgen Project (2015). *Poverty and its contribution to Human Trafficking*. Published online. Accessed September 30, 2023.
- Central Bank of Nigeria (2015). *Economic and Financial Review*. 39(4), 22-30.
- Danailova-Trainor, G. & Laczkó, F. (2010). Trafficking in Persons Development: Towards Greater Policy Coherence. *International Migration*, 48 (21), 17-26.
- Ekong, E. (1988). *An Introduction to Rural Sociology*. Uyo, Nigeria. Dove Publishers.
- Esson, J. (2020). Playing the Victim? Human Trafficking, African Youth, and Geographies of Structural inequality. *Special Issues Paper*, 26 (6).
- Frank, A. (1972). *Crisis in the Third World*. New York, USA. Monthly Review Press.
- International Labour Organization (2005). *A Global Alliance against Forced Labour. Global ILO Declaration on Fundamental Principles and Rights at Work*. Geneva Office, online.
- Kenb, M., Ijeoma, B., Nwamuo, P., & Anyaoha, C. (2016). *Basic Civic Education for Senior Secondary School 3*. Owerri, Nigeria. Meybiks

Publishers

- Okereke, O. & Ekpe, A. (2002). *Development and Underdevelopment. Politics of the North-South Divide*. John Jacob's classic publishers. Enugu, Nigeria.
- Peters, K. (2010). *The matrix of Development: An Introduction to Study of Development Administration*. Aba, Nigeria. Cheedal Publishers.
- Santos, T. (1970). *The Structure of Dependence*. American Economic Review, ix, p.23
- Sofia, N. (2003). *Democracy, Corruption, Contraband and Organized Crime in South East Europe*. <http://unplain/un.org/intradoc/groups/public/document/UNTC/UNPANO16997.pdf>
- (Shelley, L. (2010). *Human Trafficking: A Global Perspective*. New York, USA. Cambridge University Press.
- (United Nations (2003). Protocol to prevent, suppress and punish trafficking in persons, especially women and children, adopted by *General Assembly Resolution 55/25*.
- (United Nations Office on Drugs and Crime (UNODC) (2006). *Trafficking in Persons: Global Patterns*. <http://www.unodc.or/pdf/traffickingpersonsreport.04.pdf>



Empirical Investigation of Optimal Monetary Policy Instrument for Nigeria Using the Bondstest Approach to Cointegration

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Abstract

Evidences from academic literature shows that, it is inappropriate for the Central Bank of Nigeria (CBN) to adjust both liquidity in circulation and the rate of interest at the same time. It therefore, becomes imperative to use appropriate monetary policy instrument for the effective implementation of micro and macroeconomic goals in Nigeria. To ensure this, the study adopted secondary time series data collected from Central Bank of Nigeria, spanning the period of 1990Q1 to 2020Q2. The bonds test approach to cointegration was used to analyse the data. Results of study showed the superiority of monetary policy combined instrument and interest rate instrument. Also, the study indicated that the influence of CBN on money supply is significant than her influence on credit supply. This is because monetary base is the most important determinant of total supply of credit, which the CBN has less influence to control. The study, therefore, recommends that the central Bank of Nigeria (CBN) should implement effective contractionary monetary policy instruments, especially, if its goal is to stimulate investment, full employment, balance of payments surplus and economic growth in Nigeria.

Keywords: Interest rate, Money supply, Monetary policy, CBN

INTRODUCTION

Evidences from literature exists in both micro and macro economic theories on the inadmissibility of manipulating both price and quantity at the same time, in a laissez-faire market structure. In such market, the forces of demand and supply determine the quantity to be sold and bought. This is why in economics, the operators in this market are called “price takers” – they simply accept the price determined by the market forces. Thus, it is inappropriate for the Central Bank to adjust liquidity in circulation and the rate of interest (price of money) simultaneously at any prevailing time.

Opinions in literature on the efficacy and superiority of monetary policy instrument

exist. While some economists opined that interest rate is inferior because of its inability to determine equilibrium, and rate of inflation that has posed a significant problem particularly, in term of zero bonds interest rate environment (Solomon, 2015), others like market regulators favoured interest rate instrument based on the fact that, changes in the reserve requirement are usually too small to a noticeable impact. They believed that the implementation of reserve requirement imposes an unbearable cost on the monetary authorities (Solomon, 2015).

Microeconomic principles posit that, the efficacy of monetary policy instruments to an extent, largely depend on the economic

situation at any point in time. This principle is however negated by market players and participants who are in favour of interchanging both instruments. In their view, a mixture of the tools can be used as in the case of monetary condition index. (Anyawu, (2020) challenged a combination of the two instruments based on the fact that, it will be tantamount to a deterministic relationship between money stock and rate of interest. More so, it will lead to sub-optimal outcomes of monetary policy objectives.

Notably, the Central Bank of Nigeria (CBN), despite the lingering debates, is still using the two instruments in the implementation of monetary policy framework, (Abdul (2009). The lack of consensus in economic literature on the inappropriateness of the simultaneous application of both reserve money and interest rate as monetary policy instruments necessitate the need for appropriate instrument. Thus, this paper tries to determine the most suitable of the instruments, for appropriate implementation of monetary policy in the Nigerian economy, and/or the rightness of the mixture of the two instruments, so as to guide the monetary authorities in taking economic policies beneficial to the economy.

The Monetarist theory was propounded by Milton Friedman. The theory states increase in money supply promotes economic growth in a country. While the Keynesian theory advocates for government intervention through monetary policy to stabilize output and prices and promote gross domestic product during economic downturns. This study adopts both theories because they are more effective when combined than the use of a single instrument.

(James (2019) applied a mixture of mathematical and econometric models to ascertain the optimal monetary policy instrument for the Nigerian economy. The study covered a period of 1990 to 2018.

Results of the study showed that, nominal interest rate policy was not in line with inflationary trend at the period of the study, and the varying concern of the Central Bank of Nigeria with regard to growth of GDP do not largely explain the direction of the nominal interest rate policy. The study recommended that, the CBN should pay more attention to increase in output, considering the impact on the changes in nominal rate of interest.

(Ayuba (2020) adopted an electric approach ranging from basic tests and single equation to VAR, as well as rolling regression and vector error correction model to ascertain the optimal monetary policy instrument for Nigeria, between 2000 and 2018. The results of the study showed a positive relationship between the level of financial development, monopoly power (uniqueness) in exports, strength of the country's institution and the efficiency of interest rate as monetary policy instrument. Interest rate was revealed to be more effective monetary policy instrument during the period under study.

(Aruma, P. (2015) in a model based on a property of zero-sum two-player games to determine a robust optimal monetary policy rules, applied it to an optimal Taylor rules in a simple forward-looking macroeconomic model. Contrary to the general belief that monetary policy should be less responsive in case of parameter uncertainty, the result indicated a stronger reaction of interest rate to fluctuations in the rate of inflation and output gaps as against the period of certainty.

(Okafor, R.G (2008) using the rational expectations hypothesis, investigated the robustness attribute of optimal control policies. The study assumed that agents do not have insufficient knowledge about the structure of the economy, but also formed expectations based on the forecasting models that were formulated and updated based on the available data. Results of the study shows that the optimal control policy based on rational expectations performed poorly when expectations do not coincide with rational

expectation. The study recommended that, the efficiency of the Optimal Control policy can be enhanced simply by detaching the importance attached to stabilization of real economic activity and interest rate through the inaction in the CBN loss function.

(Sanusi, S. (2012) in a study on the optimal monetary policy instrument for Nigeria, applied Error Correction Model (ECM) between 1999 to 2011. The study revealed that interest rate is more effective than reserved money because it yields the least minimum loss in output when compared with reserve money instrument. The study equally revealed that a combination of both instruments minimize losses from equilibrium output far better than the other two instruments considered separately. The study recommended that the CBN should pay more attention on the interest rate if it desires to use only one instrument at a time, but if the CBN wishes to utilize both instruments, Monetary Condition Index should be constructed by the CBN to determine the degree of adjustment of each of the variables that would yield the desired monetary policy outcome.

(Balogun, P.C. (2012) in a similar study developed a dynamic stochastic general equilibrium model for less developed economics of Singapore and Thailand, covering the period 1997Q3 to 2006Q2. The model was used to obtain a simple basket weight rule. The result although was sub-optimal, but comparison among cumulative losses associated with the policy instrument rules, shows that the use of a basket weight rule was superior to other instrument rules, especially in a market-regulated regime.

(Nwude, E. C. (2018) in a study on the superiority of interest rate to money reserve, used a micro-founded model of money under an overlapping generation's economy in which information asymmetry and stochastic relocation creates an endogenous transactions role for fiat money. The study revealed that welfare is higher under monetary growth

targeting in terms of real shocks, than during nominal shocks. Similarly, the optimality of an expansionary policy under inflation targeting is less than as money growth targeting.

RESEARCH METHODOLOGY

The study adopted the Autoregressive Distribution Lag (ARDL) approached developed by (Pesaran et al (2001). The justification for using the ARDL is based on the fact that the model does not require stationarity of data, i.e., the model can be applied irrespective of whether the underlying regressors are stationary at 1(0) or 1(1) or a mixture of both. Another reason for the choice of the model is that, it provides unbiased estimate of the long-run model as well as valid t-stat even when some of the regressors are endogenous (Harris and Sollis, 2003).

$$\Delta y_t = \alpha_0 + \alpha_1 y_{t-1} + \alpha_2 r_{t-1} + \alpha_3 m_{t-1} + \alpha_4 l_{t-1} + \alpha_5 U_t + \epsilon_t \quad (1)$$

$$\Delta l_{t-1} = \alpha_0 + \alpha_1 l_{t-1} + \alpha_2 y_{t-1} + \alpha_3 r_{t-1} + \alpha_4 m_{t-1} + \alpha_5 U_t + \epsilon_t \quad (2)$$

Where

y = Real GDP

r = Real Interest Rate

m = Real Money Supply (m_2)

l = natural logarithm

Δ = the first difference

U = an error term

α_0 to α_5 , α_1 to α_5 , Y_1 to Y_5 = coefficient of the respective variables.

Note: α_0 and α_2 in eqn (1) are the same as α_0 and α_1 , while α_0 , α_2 and α_3 in eqn (2) are the same as α_0 , α_1 and α_2

Recall that, optimal lag length is determined automatically using the Bayesian information criterion in Microfit 4.1.

Using the Granger Representation Theorem (GRT), when variables are cointegrated, there is an EMC that describes adjustment of the cointegration variables toward equilibrium values. Thus, the general error correction representation of eqn (1) and (2) are given as:

$$\Delta y_t = \alpha_0 + \alpha_1 \Delta y_{t-1} + \alpha_2 \Delta r_{t-1} + \alpha_3 \Delta m_{t-1} + \alpha_4 \Delta l_{t-1} + \alpha_5 U_t + \epsilon_t \quad (3)$$

$$lm_t = Y_0 + i=0mY1lm_{t-1} + i=0nY2ly_{t-1} + i=00Y3r_{t-1} + EC_{t-1} \text{----} 4$$

Note that, EC = error correction term, and according to Persaran, et al (2001), two stages are involved in estimating eqn (1) and (2). The first is that, the null hypothesis of the non-existence of long run relationship among the variances is defined as $H_0: \alpha_1 = \alpha_2 = 0$ for eqn (1) and $\alpha_1 = \alpha_2 = \alpha_3 = 0$ for eqn (2). H_0 is tested against the alternative of H_1 : not H_0 rejecting the null hypothesis implies that, there exists a long run relationship among the variables, irrespective of the integration properties of the variables.

More so, two sets of critical value are tabulated with one set assuming all variables are 1(1) and the other 1(0). Given the above, a band covering all possible classifications of the variables into 1(1) and 1(0) exist, and If the calculated F-stat lies above the upper level of the band, the null hypothesis is rejected, implying that there is co-integration, but if it lies below the lower level of the band, the null cannot be rejected, indicating lack of co-integration. If the F-stat falls within the band, the result is inconclusive.

RESULTS

Table 1: Unit Root Test (ADF and Phillips-Perron)

Variables	ADF						P-P Test Stat	
	AIC		SBC		H			
	Level	1st Diff	Level	1st Diff	Level	1st Diff	Level	1st Diff
M	2.519087	-4.55294*	2.179513	-	2.179513	-	2.592992	-
				11.75693*		11.785693*		11.80885*
Y	0.960944	-	1.849953	-	1.849953	-5.242515*	1.050033	-
		5.242515*		15.95531*				12.71563*
R	-	-	-	-	-	-10.35853*	-	-11.46957
	0.313438	6.584713*	0.451111	10.35853*	0.238211		0.447289	

* Significant at 1%

The calculated F-stat (i.e, 56.3 for eqn (1) and 14.2 for eqn (2) shows that, the null of no co-integration can be rejected at 0.05 percent level for both equations since they are higher than the upper bound critical value of 4.85 and 4.35

at 0.05 percent for investment-savings (IS) and Money Supply (LM) equations, respectively as shown in Persaran et al (2001). This indicates that a long-run relationship exist among the investigated variables.

Table 2: Estimated Long Run Coefficients ARDL Selected Based on Schwarz Bayesian Criterion

Dependent Variable: LY – (IS equation 1)			
Variables	Coefficient	t-stat	Prob-values
0	-4.0573	-0.8120	0.4180
2	10.7025	2.1202	0.0360
$R^2 = 0.99$ F-stat = (5,120) = 56.351(0.000) DW = 1.66			
Adjusted – $R^2 = 0.99$ AIC = 177.1320, SBC = 168.6232			
Estimated Long-Run Coefficients ARDL (2,0,0)			

Selected Based on Schwarz Bayesian Criterion

Dependent variable: LM – (LM Equation 2)

0	-0.4437	-0.7439	0.4590
2	1.1395	15.5278	0.000
3	-0.0746	-0.1369	0.8910
$R^2 = 0.99$ F-stat = (4,121) = 14.2356(0.000) DW = 2.0561			
Adjusted – $R^2 = 0.99$ AIC = 208.5662, SBC = 201.4754			

The relevant critical values for unrestricted intercept and no trend under 2 variables for 0.05 are 3.79 – 4.85 and 3.25 – 4.35 for 3 variables. They are obtained from Persaran et al (2001)(1(III) case III

Table 2 shows that, the two models are well fitted as the independent variables exert about 99.0 percent (R^2) influence on the dependent variables in the two equations.

Table 3: Error Correction Estimate of the ARDL Models

Dependent Variable: ly – Equation 2 – The IS Market			
Regressor	Coefficient	t-stat	Prob. Values
0	-0.053	-1.030	0.305
1(-1)	-0.532	-6.559	0.000
1(-2)	-0.240	0.914	0.010
2	0.139	3.279	0.001
2(-3)	-0.396	-5.018	0.000
	-0.013	-2.008	0.047
$R^2 = 0.43$ DW = 1.66			
Adjusted – $R^2 = 0.40$ F-stat = (5,120) = 17.6957(0.000)			
Dependent variable: Δ LM – Equation 3 - The Lm market			
Y_0	-0.031	0.768	0.444
$Y_1(-1)$	-0.257	-3.028	0.003
Y_2	0.079	2.342	0.021
Y_3	0.005	0.133	0.894
3	-0.069	-2.361	0.020

$R^2 = 0.14$

Adjusted – $R^2 = 0.10$ F-stat = (4,121) = 4.8506(0.000)

The IS-LM equation stability were tested using cumulative sum (CUSUM) of recursive residual and cumulative sum of square (CUSMSQ) for recursive residual test.

Thus, to determine an optimal instrument for Nigeria, the residuals of equations 1 and 2 yield the following standard deviation and variance as;

$\delta\epsilon = 0.0056791$, $\delta u = 0.044604$, $^2 = 0.0032252$,

$u^2 = 0.001985$ and $\epsilon u = 0.050961$

Note that from table 2, 0= -4.0573, 1= 107025, 0= -0.44369, 1= 1.1395 and 2= -0.0705

It therefore follows that, $\epsilon u = P\epsilon u$, u

$\therefore P\epsilon u = \delta\epsilon u \delta\epsilon \delta u = 0.0309610.00253 = 20.11777$ ----- 5

$\therefore P\epsilon u = 20.11777$ and $P\epsilon u^2 = 404.724$ ----- 6

From the loss in interest rate instrument as

represented as

$$Lr = \frac{2}{7} \text{-----}$$

∴ $Lr = 0.0032252$, and from the loss in monetary instrument

$$Lm = (10.7025 * 1.1395 - 0.074615)^2 [-0.074615^2 * 0.0032252 + 10.7025^2 * 0.01983 - 2(10.7025 - 0.074615 * 0.05091)]$$

$$Lm = 0.002105 \text{-----}$$

$$\text{Thus, } LmLr = 0.0021050.0032252 = 0.652673 \text{-----}$$

From the above result, we deduce that monetary policy instrument is more effective than interest rate instrument, given that,

$$LmLr < 1$$

Thus, for the combination policy,

$$Lc = 0.0032252 * 0.0019895 (1 - 404.724)0.044604 + 20.5454041 + 1.13952 * 0.032252$$

$$Lc = -0.023 \text{-----}$$

$$Lc < Lm < Lr \text{-----}$$

From equ. (11), the combination policy is the most optimal considering the monetary aggregate and the interest rate policy. Thus, the result is in tandem with that of Nwudu E.C (2018), who contends that, the target of monetary instruments in enhancing welfare is robust even during economic shocks.

Conclusion

There has been a debate against the simultaneous manipulation of price and quantity in a market-controlled economic structure, and this has led to search for optimal monetary policy instrument by the CBN in its monetary policy operations. Some economists are of the opinion that either price or quantity should be controlled at any given time, but not the two at a time. Evidences from literature shows that, some countries adopt the two instruments especially, during economic crises. This paper investigated the optimal monetary policy instrument for the CBN between 1990Q1 to 2020Q2, using a bound

testing approach to co-integration.

The study provides a strong support for the optimality of monetary instrument over interest combination of both instruments is superior to the two when used separately. Also revealed is that, the influence of CBN on money supply is significant than her influence on credit supply. This is because the monetary base is the most important determination of total supply of credit, which the CBN has less influence to control.

In addition, with insignificant influence on credit supply, it becomes difficult for the bank to considerably affect the equilibrium level of interest rates. This account for the reason the CBN can hardly achieve the low lending rate being advocated over the years, despite all efforts toward achieving such. This study therefore, recommends that, the CBN should continue the use of the combined instruments as it is more effective then the use of a single instrument. More so, emphasis should be placed on monetary instrument, especially when growth in GDP is the main goal of the CBN monetary policy in the long run.

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REFERENCES

- (Anyanwu, J.C (2020) optimal choice of monetary policy instruments in a simple stochastic macro model, Quarterly Journal of Economics, 84:197-216.
- (Baba, N. (2015). Description versus policy rules in practice, Carnegie Rochester conference series on public policy, 39:195-214.
- (Ayuba (2001). The optimal monetary policy

- regime in an emerging market economy, the case of Thailand. Department of Economics, University of Bristol, Uk.
- (Arunma (2015). How forward-looking is optimal monetary policy? *Journal of money, credit and banking*, 35(6): 1425-1469.
- (Balongu, et al (2012). Choices of optimal monetary policy instruments under floating and the Basket-Peg Regimes. *The Singapore Economic Review*, 57(4):1-31
- (James (2019) political pressure on the choice of the optimal monetary policy instrument, *journal of Economics and Business* 2000(52):325-341.
- (Obaseki, P.G (2008) Federal Reserve Bank of St. Louis Review, July/August 2008, 9(4):275-93.
- (Okafor, R.G (2008) *Applied Time Series Modeling and Forecasting*, West Essex Wiley.
- (Nwudu, E.C (2018) optimal choice of monetary instruments in an economy with real and liquidity shocks, *journal of economic dynamic and control* 32 (2008):1273-1311.
- (Sanusi, et al (2012). The choice of optimal monetary policy instrument for Nigeria. *International Journal of Economics and Management Science*, 1(9):1-23.



Extent of Teaching of Contemporary Issues by Basic Technology Teachers in Junior Secondary Schools

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Abstract

The study adopted a survey research design and was carried out in Etinan Local Government Area of Akwa Ibom State, Nigeria. The study was conducted to investigate the evaluation of the implementation issues in basic technology teaching by junior secondary schools teachers. Four research questions were posed to guide the study to a logical conclusion. A structured questionnaire was administered on a sample of twenty-two (22) basic technology teachers and one hundred and ten (110) students who were involved in the study. Data generated from the questionnaire were analyzed using simple percentages. The findings showed that contemporary issues are taught in basic technology classrooms, that the existing basic technology curriculum is integrated with contemporary issues. It was equally found that the teaching of contemporary issues motivate interest in the teaching and learning of basic technology. Moreso available data shows that the recent teaching method of contemporary issues does not inspire reflective thinking, curiosity and sound evaluation of factual information. The result also shows that quality of teachers and updating the ICT capabilities of the teachers improve their teaching of contemporary issues. The result revealed that the teaching of contemporary issues is yet to inculcate vocational skills in the learners. Based on the findings, one of the recommendations is that basic technology teachers training institutions should equip teachers with adequate knowledge of contemporary issues and they should be provided with opportunities to explore contemporary knowledge for their instructional effectiveness.

Keywords: Teaching, Teachers, Basic technology, Contemporary issues

INTRODUCTION

The word technology is derived from the Latin word “Technic” which means craft or skill. However, in line with current application, technology has been redefined as the standard which is used in assessing the way of life of people (Udoh, 2020 and Udofia, 2000). The change in definition was a result of a shift in the philosophy of developmental

status of nations to appropriate the influence and affluence of technological standards in the current practical socio-cultural, economical, and political realities of a world that has metamorphosed into a global family, only if our students must understand the realities, problems and challenges of their society. To remain relevant, various nations embarked on

curricular reforms to emphasis technological base education at the expense of a literary based education. The theoretical basis of it being that technological development could best be conceived and put to birth by technologically literate citizens.

Furthermore, human society is never static, it is dynamic. In the history of the human society, there has always been the need to improve upon the existing life and to live a better one (Maduewesi, 2001 and Mezieobi, 2008). This is one of the reasons the Nigerian education system was reorganized to 9-3-4 system. The new educational system among other things was to properly emphasis technical and vocational education. Consequently, basic technology was introduced in the junior secondary schools while technical colleges were accorded proper recognition. In order to foster the teaching of vocational subjects such as basic technology, technical workshops were built and equipped at the junior secondary school for students with pre-technical/pre-vocational skills (Udoetuk & Usoro, 2022).

Ideally, basic technology effectively focuses on sensitive issues unfolding in man and technological societies. As such, viable basic technology curriculum content ought to be embrative of new ideas, changes, challenges and new frontier of learning in order to keep the learner abreast with current developments in his immediate and distant environment. By the new plan, the former 6-3-3-4 system has became 9-3-4 system through National Policy in education (FRN, 2013) that came with existence to review the old and identify new national goals for Nigerian Education at all levels with respect to the needs of individual youth and adult in the task of national building, social and economic needs, aspiration and well being of the Nigerian society.

In the study of basic technology, classroom setting, motivation is based on the

favourable motivational conditions, materials, procurement of effective technical workshops, learning experiences, challenges, policy formulation and opportunities provided by the vocational teacher to enhance learners self concept and active participation in instruction. Therefore, Adah (2008) explains that qualitative educational programme on basic technology teacher instructional effectiveness is regarded as a reinforcement of the new National Policy on Education or basic education curriculum offering but rather in the implementation of the programme to reinforce and enhance effective teaching. Adah (2008) reiterates that basic technology programme would not be meaningfully implemented without effective basic technology instruction to meet up with the objectives of vocational education which revolves on the achievements of socio-economic, industrial and technological development that will eventually manifest into improved standard of living for the citizens as well as in economic stability.

It would be reiterated that effective teaching of contemporary issues through basic technology instruction, exposes the learner to innovative knowledge, learning and information for meaningful existence in a dynamic world. It is motivating as concrete realistic technological issues are illuminated for learner awareness (Meziobi, 2008). Research by Meziobi (2008) have shown that lack of interest in mathematics, sciences and technology resulted in poor performance. Basic technology teachers should therefore motivate their students for high academic attainment through knowledge and information acquired from exposure to contemporary instruction. It is therefore observed that contemporary issues are the exposing factors of functional education to the learner which is the integration of both social and technological issues in curricular of schools in any nation is sluggish (Ibiam, 2007 and Meziobi, 2008).

Similarly, exposure to contemporary issues challenges learners' reflective thinking process and inquiry orientation. Conversely, ineffective teaching of contemporary issues entails blinding the scope of the learners reducing their intellectual viability and relevance. But the present situation in the area of student's interest and number of trained manpower has drastically reduced despite the provision of facilities/equipment by the Government to schools (Uwaifo, 2009). This paper is primarily intended to explore some of the outstanding values to be derived through the use of the differing methods of teaching in vocational education and appraise a few limitations and danger involved in it.

According to Akpan (2019), Howard and Brandom (2011), teaching contemporary issues has definite benefits over traditional classroom training. While the most obvious are which can lead to retention and a stronger grasp on the subject, active participating in E-learning activities, has uniformity of curriculum contents, others are: its teaching motivates interest, inspire reflective thinking, curiosity and sound evaluation of facts, updating knowledge easily and quickly, integrating contemporary innovation and crucial educational informs in the curriculum of schools at all levels such as political, social, economical and cultural factors, it is self spaced learning, among other numerous benefits. A critical evaluation of these benefits makes teaching of contemporary issues in basic technology must-attain training for all Nigerian teachers and students.

However, Nwoji (2000) noted that training teachers to use modern technologies and teaching of contemporary in the third world schools is an extremely complex and demanding task. This is because according to the writer, there are many influences on Nigerian education system. These influences are especially based on political, social, economic and cultural factors (Nwoji, 2000). Skill acquisition in the use of communication

technologies will enable educators grasp the potentials fro e-learning opportunities in the contemporary society. Apparently, N. Nwoji (2000), Okeke & Edika (2011) articulated that experience has shown that a well-conceived and structured educational programme will fail if those to implement it at the grassroots level are not adequately prepared in educational technology and innovative techniques. Therefore, providing e-learning opportunities in the contemporary society for Nigerian educators remain a sine-qua non since it provides lifelong learning opportunities by making formal learning available at home, workplace, industrial firms, anywhere and at anytime. Teaching and learning of contemporary issues increase teachers opportunities to learn relevant skills from the global world for survival in their work place and society and then assist the students in achieving effective teaching and learning processes. Technology has revolutionized business, now it must revolutionize learning.

Statement of the Problem

The implementation of any instructional programme or new method of teaching is rarely hitch free as associated efforts always meet with challenges. In order to provide for a more direct involvement of students in the learning process, widely differing methods of teaching and learning have been underdeveloped such as role-playing, laboratory methods, field trips, simulation methods and the case method. The case method of teaching at the Curriculum Research Centre represents almost the most valuable, versatile teaching tool to be developed in methodology in the contemporary world or society (Uwaifo 2009; Akpan, 2019). Static school curriculum is less adequate to address the felt needs and aspirations of a dynamic modern society with compounding societal problems, challenges and frustrations to overcome.

Generally, the prolonged habit of integrating contemporary innovations and crucial educational reforms in the curricula of schools at all levels in Nigeria is a great hindrance to functional education which is meant to equip the learner with qualitative and relevant knowledge, values and skills to overcome their personal and societal problems. The case of implementation of basic technology curriculum under the basic education scheme is not an exception as technical teacher education programmes face increasing responsibilities. Therefore, the teacher, especially that of basic technology education need to possess appropriate knowledge and information as well as attending workshops, conferences and seminars organized to update their knowledge on contemporary issues in order to function well in the classroom. Unfortunately, classroom instructions in our secondary schools are still dominated by the traditional teacher-centred, chalkboard-duster approach (Nwafor, 2007 and Uzodinma, 2005).

Most secondary school students graduate being equipped with contemporary issues; meaning that they were never exposed to computer or they were never taught contemporary issues. Government at various levels have introduced ICT policies and programmes as well as instruction on contemporary issues in our curriculum to equip both the teachers and students with the required technological skills, reflective thinking, interest, information, economic/social change or facts to be globally competitive. But these efforts seem not to have produced the expected results. This situation aroused the questions; are technical education teachers and students being exposed to contemporary practices in the technical education programmes? To what extent does the teaching of contemporary issues motivate the teaching and learning of basic technology? What is being done by educators to keep pace with the contemporary issues? Are

contemporary issues increasingly taking place in today's industrial firms?

It therefore becomes imperative for the study of this kind to be conducted to identify the extent of teaching contemporary issues in basic technology for effective skills acquisition in Junior secondary schools in Akwa Ibom State.

Research Questions

The main purpose of this study was to investigate the extent of implementation of contemporary issues by basic technology teachers in Junior Secondary School. Most specifically, this study was designed to provide answers to the following research questions:

- (i) To what extent do Basic Technology Teachers teach contemporary issues in Basic Technology instruction?
- (ii) To what extent is Basic Technology Curriculum equipped with contemporary issues?
- (iii) What are the common interest areas motivated by contemporary issues in teaching and learning of basic technology.

The hypothesis of the study stated thus:

There is no significant difference in the mean rating of students and teachers on the teaching/learning of contemporary issues in Basic Technology instruction in Junior Secondary School.

RESEARCH METHODOLOGY

This study is a survey research design. A survey research is one in which a group of people or items is studied by collecting and analyzing data from only a few people or items considered to be representative of the entire group (Nworgu, 2006). This was focused on investigating the extent of implementation of contemporary issues through basic technology

instruction in Junior Secondary Schools. Structured questionnaire was the instrument for data collection.

The study was carried out in all the 30 public secondary schools in Etinan Local Government Area of Akwa Ibom State. The population of the study was 150 made up of all the basic technology teachers and students in Etinan Local Government Junior Secondary Schools. From the above, one basic technology teacher was available per school to make up 30 teachers and in the same manner, 4 students were sampled from each of the 30 secondary schools used for the study. In all 30 basic technology teachers and 120 students were involved in the study making total of 150 respondents.

The instrument used for data collection was a questionnaire titled “Basic Technology Teachers and Students Perception of the Implementation of Contemporary issues in Basic Technology Classroom” (BTSICIC) which was designed to answer the research questions posed to guide the study. The research instrument was validated by two experts in basic technology from University of Uyo and one expert in measurement and

evaluation from Akwa Ibom State College of Education, Afaha Nsit. The comments and observations of the experts formed the basis for the modification of the instrument. The reliability coefficient of the instrument established with Crunbach Alpha reliability techniques was 0.88.

The researcher and 3 other trained research assistants administered copies of the questionnaire to respondents. In the analyses of data, the researcher used frequencies and simple percentages. Decision was that any result below 40% was not accepted. The data collected were edited and presented in tables according to the three research questions used for the study.

RESULTS

Research Question I:

To what extent do Basic Technology Teachers teach contemporary issues in basic technology instruction?

Table 1: Mean and standard deviation rating of teachers on the extent of exposure of contemporary issues in basic technology class

S/N	ITEMS	N	$\bar{X}$	SD	DECISION
1.	Basic technology teachers teach contemporary issues in basic technology classroom	150	3.08	.87	HE
2.	Does the teaching of contemporary issues reflect adequate events in the society	150	2.81	1.08	HE
3.	Basic technology teachers preparatory institutions equip teachers/students with appropriate knowledge and information during class delivery	150	1.69	1.69	Low extent
4.	Conferences, workshop and seminars are organized to update teachers knowledge on the teaching of contemporary issues	150	2.66	1.121	HE
5.	The teaching of contemporary issues provides opportunity for high manpower training for societal development	150	2.75	1.03	HE

Table 1 shows that the items 1, 2, 4 and 5 are with mean scores above 2.50. This indicates in high extent (HE) that basic technology teachers teach contemporary issues in basic technology class. While the response of only item 3 of basic technology teachers are disagreed or opposed to the view. It is imperative from the generated data of the study that contemporary issues are taught in basic technology classroom. However, the teaching do not substantially reflect current happenings in the society. The implication is that most basic technology teachers are not resourceful

in incorporating latest developments in their instruction as they are based on information in textbooks.

Research Question 2: To what extent is the basic technology curriculum equipped with contemporary issues.

Table 2: Mean rating of the extent basic technology curriculum is equipped with contemporary issues (N=150)

S/N	ITEMS	N	Yes		No		DECISION
			Freq	%	Freq	%	
6.	Basic Technology curriculum is designed for teachers to reflect or promote contemporary issues	150	100	66.6	50	33.4	A
7.	Basic Technology curriculum is adequately adjusted to integrate evolving socio-political, technological, social and economic change	150	25	16.7	125	83.3	DA
8.	Basic Technology curriculum provides ICT skill amongst staff and students to improve learning beyond classroom	150	150	%			A
9.	There are so many abstract areas in basic technology curriculum in relation to contemporary issues	150	90	60	60	40	A
10.	The curriculum is so vast that it is difficult to be covered	150	120	80	30	20	A
11.	Every topic on the curriculum should be associated with contemporary issues and facilitate the development of problem solving and psychomotor skills	150	140	93.3	20	6.7	A

Table 2 indicates that the items 6,8,9,10 and 11 of percentage of teachers accepted that basic technology curriculum is organized in a manner to be integrated and equipped with contemporary issues; this is because the items had upto 50% and above which was regarded as agreed. Based on the data, only item 7

(16.7%) of basic technology teachers agreed that basic technology curriculum is adequately adjusted to accommodate contemporary issues while 83.3% disagreed. This shows that basic technology curriculum contents are equipped with opportunities for teachers to reflect or promote contemporary issues; thus basic

technology curriculum is static in the midst of intermittently evolving changes in the global society.

Research Question 3: To what extent do contemporary issues motivate interest in teaching and learning of basic technology?

Table 3: Mean rating of the place of motivation of interest in the teaching and learning of basic technology (N=150)

S/N	ITEMS	RESPONDENTS	N	Yes		No		Remarks
				Freq	%	Freq	%	
11.	The teaching of contemporary issues motivates interest in learning basic technology	Teachers	30	20	66.7	10	33.3	A
		Students	120	90	75	30	25	
12.	Methods of teaching contemporary issues in basic technology institution improve reflective thinking, curiosity and sound evaluation of facts	Teachers	30	25	83.3	7	16.7	A
		Students	120	85	70.8	35	29.7	
13.	Does the teaching of contemporary issues in basic technology encourages learners (students) to become independent and participate in collaboration works	Teachers	30	30	100	Nil	Nil	A
		Students	120	120	100	Nil	Nil	
14.	Contents should be organized based on low students learn	Teachers	30	19	63.3	11	36.7	A
		Students	120	95	80	25	20	
15.	Motivation of technical educators is through incentive and remuneration	Teachers	30	24	80	6	20	A
		Students	120	110	91.7	10	9.3	
16.	Teachers' methods of teaching the subject is a reason for the students low interest	Teachers	30	10	33.3	20	66.7	DA
		Students	120	20	16.7	100	83.3	
17.	There are not enough motivation for the instructions and learners in the school	Teachers	30	27	90	3	10	A
		Students	120	115	95.8	5	4.2	

Table 3 indicates the views of the respondents in the place of motivation of interest in the teaching and learning of basic

technology. The data reveals that, the 6 items except 16 are accepted as the place of motivation of interest in the teaching and

learning of contemporary issues by both teachers and students since each of the items scored more than 50% and above. Also, all the variables on the table are areas where a place of motivation of interest in teaching basic technology in schools can be acquired by both teachers and students. Therefore, it can be deduced that motivation of interest in learning basic technology depends on the exposure of new knowledge and information relevant to societal and economic development. The findings therefore revealed that the inclusion and teaching of contemporary issues in basic technology motivate interest in the learners and that teacher quality, exposure and ability are instrumental in making the teaching of

contemporary issues relevant, imperatives and meaningful to learners.

Hypothesis I: There is no significant difference between the mean rating of students and teachers on the teaching/learning of contemporary issues in basic technology instruction in Junior secondary school.

Table 4: Summary of t-test result on the mean ratings of students and teacher on the teaching and learning of contemporary issues in basic technology instruction in junior secondary school

Group	No.	$\bar{X}$	Sd	Df	Sin level	t-cal	t-cri	Decision
Teacher	30	3.41	0.85	148	0.05	0.03	1.96	Not significant
Students	120	3.40	0.78		0.05			

NS = Not Significant, S = significant

DF = $N_1 + N_2 - 2 = 30 + 120 = 148$

T = Critical at df 148 and 0.05 level of significant = 1.960

Table 4 reveals that the calculated t-value is 0.03 at 148 degree of freedom and at 0.05 level of significance is less than the table value of 1.96. Since the calculated values is less than the table of value, the null hypothesis is accepted. Therefore, there is no significant difference in the mean ratings of teachers and students on the teaching and learning of contemporary issues in basic technology in junior secondary schools.

DISCUSSION

Based on the data collected and analyzed in this study, the following finding were made with respect to the research questions.

Result of data analysis revealed that contemporary issues are being taught by basic technology teachers in basic technology classroom, but do not reflect or flow with

adequate current events in the society. Uwaifo (2009) and Njoku (2005) said that any basic technology instruction that does not develop reading culture and critical thinking or make the learner vocationally skilled in the teaching of contemporary issues would not have better way of responding to new challenges and is attributed to ineffectiveness. In the same vain, Mezieobi (2008) and Madnewesi, (2001) observed that meaningful teaching to the extent of focusing actual situations in the society promote acquisitions of skills in the learner.

The finding with respect to the extent basic technology curriculum is filled with contemporary issues revealed that the existing basic technology curriculum is integrated with contemporary issues, but the basic technology curriculum is not always adjusted to accommodate contemporary issues.

Therefore, it must be flexible to meet the stated needs of the learners and society. This finding is in agreement with that of Maduewesi (2001) and Ibiam (2007) who found that innovative developments take time to be integrated into curriculum of schools in Nigeria. In addition, Eginana (2009) supported that fine arts and technical education have close relationship with other subject areas of the school curriculum and experiences outside the school.

The finding also showed that teaching of contemporary issues motivate interest in the learner and also makes the teaching and learning of contemporary issues relevant. The finding however meant that the recent teaching methods of contemporary issues does not inspire reflective thinking, curiosity and sound evaluation of factual information. This is in line with the views of Agwagah (1994), Mezieobi (2008), Adeniyi (1988) and Ihebereme (2006) on the teaching of contemporary issues who opined that students interest improve their learning and performance in the classroom when aided by teacher instructional effectiveness. When students participate effectively in classroom activities, their psyche is stimulated; they imbibe a sense of responsibility and so will be eager to learn, confirms the findings of Atkinson (2004), Agwai (1991), Mezieobi (1993), Anakwe (2009), who perceived that motivation as the arousal of tendency to act and produce one or more effects, as there are specific actions that teachers can take to increase students' motivation in classroom tasks.

As found in the study, basic technology teachers are not appropriately exposed to contemporary issues during training as well as serving teachers. This finding is in agreement with Maduewesi (1992) and, Usosro and Udoetuk (2015). To this effect, appropriate teaching of contemporary issues challenged teacher training institutions to improve the quality of their teachers through constant enrichment of their curriculum and updating

the ICT capabilities of the teachers in order to improve their teaching of contemporary issues. Finally, based on the above discussion, motive sensitizes behaviour to be elective. For instance, a student who is motivated to excel in any examinations concentrates in his studies by selecting appropriate means to reach his goal and experiences, spelt out in a beautifully planned curriculum.

Recommendations

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

- (i) Basic technology teachers training institutions should equip teachers with adequate knowledge of contemporary issues and they should be provided with opportunities to explore contemporary knowledge for their instructional effectiveness.
- (ii) The teaching of contemporary issues should be focused at equipping the learners (students) with social, technological, environmental and vocational skills.
- (iii) Students should be involved in searching factual information in such that the teaching of basic technology should be made to stimulate interest and natural consciousness.
- (iv) Through professional practitioners of basic technology, curriculum should always be revised and integrated to accommodate contemporary issues; and must be flexible to meet the urgent needs of the learner and society.
- (v) Professional practitioners of the subject should also make deliberate efforts to challenge students to examine a variety of positive values, skills and attitudes and emphasize the need for adopting these in the pursuit of objective which bear on national survival, value reorientation.

- (vi) Information communication technologies (ICT) materials and facilities need urgently be provided in schools and basic technology teachers should equally be trained in their utilization through in-service programmes to update their knowledge in teaching basic technology in Nigeria such as seminars, workshop and study programme, sandwich and conferences.
- (vii) Government should recruit more basic technology teachers for secondary school to rescue the shortage of such teachers across the country. This is to enable more prospective teachers to acquire basic creative knowledge and skills that would help them in the production of useful instructional materials and resources for the enhancement of their contemporary issues during classroom pedagogy.
- (viii) Government and relevant agencies should adopt and address the identified factors affecting the teaching and learning of contemporary issues, and communication technologies in the secondary school in the state.

Conclusion

The findings of this study shows that basic technology teachers in Akwa Ibom State Junior Secondary Schools are guided by the recent national curriculum. The need for training of the secondary school teachers for effective teaching of contemporary issues and information technology opportunities in basic technology should not be over emphasized. This is because it is quite obvious that those teachers lack the necessary knowledge and skills for competence in the use of contemporary issues in the subject area and with this limitation, they cannot effectively teach contemporary issues as well as the use of the technologies to impact knowledge or better

their lot. This call for urgent engagement of the teachers in special conferences, workshop, seminars, adequate provision of the information technologies as well as teaching of other identified problems on factors affecting the teaching and learning of contemporary issues in schools.

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REFERENCES

- Adah, O. C. (2008). Toward achieving functional vocational and technical education in Nigeria – *Journal of Vocational Education*. 2(12)p.26.
- Adeniyi, M. E. (1988). Mathematics in the secondary school. *Journal of mathematics Association*, Abacus 18 (1) 89-106.
- Agwai, M. (1991). “Evaluation of introductory technology curriculum” proceedings of National Association of Teachers of Technology Conference in Jos Plateau State, P. 27-34.
- Agwagah, U. N. V. (1994). The effect of instruction in mathematics teaching in pupils achievement and pretention in mathematics education. *Journal of Quality Education* 1 (1) 65-72
- Akpan, V. C. J. (2019). Contemporary problems of business teacher education in Nigeria. The case method in Business Education. *International Journal of educational development (IJED)* 1 (2) 78-83.
- Anakwe, A. I. (2009). Motivation in classroom teaching and learning a challenge to

- teacher education programmers. *Nigeria Journal of teacher education and teaching*. 7 (1) 17-22
- Anderson, R. A. (1967) "Let's look at the Instructional Systems Approach", *Business Education World* 47. retrieved on 20/12/2016 from www.gw.edu/evichive
- Atkinson, J. W. (2004). *An introduction to motivation*, 3rd edi New York: Harper and Row publisher.
- Federal Republic of Nigeria (2013). National policy on education, 6th Ed. Lagos, NERDC press.
- Howard, B. & Brandom, D. (2011). The e-Bang theory. *Accessed on April, 10 2011 from hHp://www.Benefits of e-learning*.
- Ibiam, J. U. (2007). Primary school teacher's information and communication technology (ICT) conferences in Kogi State. *Nigeria Journal of curriculum studies* 14 (3), 291-298.
- Ihebereme, C. (2006) Motivating Nigeria students to productive learning. The social administrator imponderables. *Education trends* 25(8), 55-58.
- Jarolimek, J. (1977). Social studies in elementary education: fifth edition. New York: Macmillan publishing Co. Inc.
- Maduewesi, B. U. (1992). Curriculum innovation and revision. In M. A. Mkpa and B. U. Maduewesi (Eds). *Readings incurriculum Innovation*. Pp39-43 Warri: Gented publishing company.
- Maduewesi, E. J. (2001). Emergent curriculum issues and how are the teachers coping in West Africa. Final report of the seminar/workshop held in Lagos Nigeria. Lagos Unesco.
- Mezieobi, D. I. and Mezieobi S. A. (2008) Teaching Contemporary issues in social studies education. *Review of Education, Institute of education Journal*, University of Nigeria, Nsukka, 19 (i) 58-63.
- Mezieobi, K. A. (1993). Social Studies curriculum: Owerri: Whyte and Whyte publishers.
- Nwoji, J. N. (2000) Teacher Education and Information Technologies (IT). The state of art in Nigeria. A publication of Nigeria Association of Educational Media and Technology (NAEMT) P. 100.
- Njoku, A. O. (2005). Contemporary public issues in social studies education in Nigeria. (2nd edition) Enugu: Redeemed Printing and Publishing Company.
- Nwirgn, B. G. (2006). *Educational Research: Basic Issues and Methodology*. Nsukka Universal Trust Publishers.
- Okeke F. C. & Edika E. C. (2011) Competency and Utilization of information management among secondary school teachers: implication for e-learning service delivery. *Optimizing e-learning opportunities for effective educational services delivery* p. 115-127.
- Udoetuk, U. S. and Usoro, H. S. (2022). Implementation of basic technology curriculum under the universal basic education (UBE) scheme in secondary schools in Akwa Ibom State, Nigeria. A paper presented at the 3rd International Conference of World Educators Forum at University of Buea, Buea, Cameroon between Monday 16th to Friday 14th November, 2014.
- Udoh, E. N. E (2020) Study and the Development of Social studies education in *Nigeria Journal Social studies* 1 (1) 2-5.
- Udofia, N. A. (2000). Development and validation of a project package for JSS

in integrated science. Unpublished, Ph.D Thesis, University of Nigeria Nsukka.

Uwaifo, V. O. (2009) Industrializing the Nigeria Society through creative skill acquisition in vocational and technical education programmes in Nigeria. *International NGO Journal* 4 (4) 142-146.



Google Classroom for Secondary School Students' Engagement and Achievement in Mathematics

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Abstract

The study investigates the effect of google classroom on secondary school students' performance in mathematics. Two research questions and two hypotheses guided the study which adopted pretest posttest non-equivalent group quasi-experimental design. The sample comprised 67 SS2 students in two intact classes drawn using purposive sampling technique. Data were gathered using 'Students' Learning Engagement Questionnaire' (SLEQ) and 'Mathematics Achievement Test' (MAT) whose reliability indices were 0.76 and 0.74 obtained using Cronbach Alpha and Kuder-Richardson20 methods respectively. Mean and standard deviation were used to answer the research questions while ANCOVA was used to test the hypotheses at .05 level of significance. Results showed that face-to-face method had a significantly positive effect on students' engagement in mathematics than google classroom while google classroom had a significant positive effect on students' achievement in Mathematics than face-to face. It was recommended that google classroom should be used in the teaching mathematics in schools.

Keywords: Google classroom, Students; Engagement, Performance, Mathematics

INTRODUCTION

Online learning emphasizes the importance of digital learning in ensuring learning continuity and protecting students' educational rights. Along this line of thought many countries of the world such as China, Bulgaria, Finland, the USA, Britain and Nigeria among others recommended a migration from the traditional face-to-face teaching and learning to online learning (Patrick, *et al.* 2021). Online learning according to Senad (2021), has become an option for schools as substitute to classroom teaching. Online learning as defined by Oguguo, *et al.* (2021) is the process of employing technology to give education and training applications electronically, observe learners' performances, and provide feedback on learners' progress. One of the recent

additions to virtual and online learning platforms is the Google classroom.

Google Apps for Education was introduced in 2014 with Google Classroom is a new component. This classroom allows teachers to easily create and manage assignments, provide timely feedback, and communicate with their students (Shaharane, *et al.* 2018). Abidin and Saputro (2020), posit that Google classroom is a useful tool for supporting learning activities because of its flexibility and numerous features. Google classroom has features that can be used in the learning process like class preparation, display student assignments, storing data on Google Drive and developing learning material, namely creating questions, creating assignments, and creating topics will be

discussed in virtual classes (Ulum, 2020). Teachers can use Google Classroom to give online assignments, promote collaboration among their colleagues, students, and students, and maintain constant communication with students. Furthermore, teachers can establish virtual courses, offer tasks, send feedback, and view all of this information in one place. Google Classroom features communication and discussion tools such as online debates, forums, reviews, brief messages, and emails, allowing students to engage in collaborative learning which can be used for teaching and learning of mathematics. Besides, Google classroom may be considered one of the inquiry-based learning media since it can fully engage students' talents in finding, understanding, exploring, analyzing, and formulating learning outcomes (Ghofur, 2018).

By this, it helps the students to find out information for themselves which may help increase their level of learning engagement and consequent achievement in school subjects like mathematics. Learning engagement was described by Wiseman, *et al.* (2016) as students' active participation or conscious investment of effort in their educational activities. Students' engagement, Bender (2017), defines it as students' cognitive investment in, active participation in, and emotional commitment to learning specific information. In this study, learning engagement is the extent to which students participate in a teaching and learning activities, when students are actively engaged in an activity, it is most likely that they could gain useful insights and knowledge on how to solve problems for themselves. This in turn may enhance their academic achievement in mathematics.

Students' academic achievement has been a major source of concern to educationist and researchers. Academic achievement according to Steinmayr, *et al.* (2015) is the performance outcomes which shows the extent

individuals, students, teachers and the school have accomplished specific goals that were the focus of instruction especially in school settings. Academic achievement involves what a student had achieved in several disciplines during the course of their career which includes progress in core academic subjects such as mathematics, science, language, arts, and social studies and performance in areas such as athletics, music and art among others (Andortan, *et al.* 2022). The above definitions imply that academic achievement covers all aspects of what a student is expected to cover during the course of schooling. This may reflect why much attention is paid on students' achievement. Despite the importance of high students' achievement in mathematics and school subjects generally, the problem of mass failure across the different levels of education is a common knowledge (Afolabi, *et al.* 2020). This has been attributed to many factors including teaching methods and as such researchers are interested in finding methods that may be effective in improving students' achievement especially post COVID 19 era. One of such methods the present researchers feel could be efficient in promoting student's achievement and engagement is the google classroom. This is because google classroom makes learning student-centered, motivated, creative and improve problem-solving skills (Cook & Sonnenberg, 2014). It is imperative for the present study to investigate the effect of google classroom on students' engagement and achievement in mathematics.

Literature evidence revealed that google classroom and other online learning platforms may be effective in improving students' interest, participation and achievement in school subjects including mathematics. Cacace (2019) study revealed that, student achievement did not show much improvement and that students were not very passionate about using Google Classroom to complete assignments but preferred it for keeping track of assignments. However,

Oyarinde and Komolafe (2020) showed that Google classroom platform positively affected students' academic achievement, attitudes and their perception. Senad (2021) study revealed that students have positive perceptions on using Google Classroom in mathematics. More so, Sari and Yin (2021) revealed that the group of students who were exposed to the google classroom using collaborative approach showed a better interest in economics learning than the group of students who were not exposed to it. In a similar vein, Sri Sasmita, *et al.* (2021) revealed that students' learning achievement taught by online learning of the Google Classroom was better than that of the WhatsApp group.

The above literature shows that the result of the effect of google classroom on students' engagement and achievement is mixed and contradictory. More so, in the case of mathematics, there were fears that learning mathematics outside of the classroom could impede students' engagement to learning mathematics in a variety of ways. This is due to the fact that face-to-face learning may allow students to learn from one another's tactics (Russo & Hopkins, 2017). A synchronous in-class facilitator is likely to be required for such a discourse-intensive approach to learning mathematics. Also, mathematics is a practical subject that requires active participation of students on activities. The teacher in the face-to-face learning situation may be able to assign activities to students and follow up such activities to a reasonable conclusion. Furthermore, teachers may anticipate or respond to negative attitudes toward mathematics and mathematics learning held by some students (Clarke, Roche, Cheeseman, & Sullivan, 2014). This means that more research is required on the effect of google classroom on students' learning outcomes so as to inform policies and programmes that may lead to the digital switch from face-to-face learning to google classroom. Google Classroom is a

program for teachers to create a digital classroom for students to communicate with their teachers and peers (Phan, 2015). It is a free application that integrates e-mails and documents to save into storages. Teachers can upload files, videos, links, announcements and assignments for students to retrieve and view. Document files can be edited in class and shared with peers to learn collaborative skills. When students complete an assignment, they can submit by posting on the teacher's board or on the classroom board. This program can be accessed using any device at any place, which is convenient for both teachers and students. Google platform allows learners to chat and discuss topics learned in class, and allows teachers to view student discussion, and post comments. Different assignments can be posted such as video segments, PowerPoint presentations, documents and web quests.

Google classroom is considered as one of the best platforms for enhancing teachers' workflow. It provides a set of powerful features that make it an ideal tool to use with students. Google classroom helps teachers save time, keep classes organized, and improve communication with students. It is available to anyone with Google Apps for education, a free suite for productivity tools including Gmail, Drive and Docs (2015). The Google classroom application depends on Google documents and cloud storage and Gmail service in order to accomplish the required functions research and follow-up with students. On the other hand, the service also provides tools for teachers to continue and to allow them to publish the assignments, homework, questionnaires and tests for students and get answers to students in real time.

There are many synonyms for the term virtual classrooms such as electronic classrooms, smart classrooms, online learning, distance learning classrooms, live classrooms, and digital classrooms. Indeed e-learning plays a major role in promoting virtual learning through modern electronic media,

since both e-learning and virtual learning are two terms with one goal that is the possibility for anyone to get access to education through Internet resources without having to go to any educational institution. Rion and Hasan (2015, p. 7) stated that *“many developed countries are using virtual classroom to provide online education to the students”*. Sayed (2017) defined virtual classrooms as *“An interactive teaching and learning environment that allows live online interaction between the teacher and students, and works simultaneously and asynchronously as traditional classrooms, where the teacher and students work together at the same time regardless of the places they are at”* (p. 373). In the same context Khleif (2011) defined virtual classrooms as *“one of the main means of providing direct lessons and lectures on the Internet, in addition to distance training where the basic elements needed by both teacher and student are based on the interactive learning method”* (p. 12). Rizq (2009) indicated that virtual classrooms are similar to traditional ones in terms of teacher and students' presence, *“yet they are available online, where teachers and students do not adhere to time or place, and can create virtual environments where students access through different networks to participate in collaborative learning”*. Also, Al-Salem (2004) defined virtual classrooms as *“tools and software on the Internet that enable the teacher to share lessons, homework and tasks, and communicate with students through multiple techniques”* (p. 21). In the meantime, these tools and software enable the students to read the lessons and do the homework and tasks, as well as *“participate in discussion forums and follow up on their academic achievement and the degrees obtained”* (ibid). Regardless of the definition, virtual classroom is surely an exceptional part of the learning systems in online education (Rion & Hasan, 2015). Indeed, virtual classrooms are getting commended for providing students with quality education. Abdulrazeq (2010)

mentioned a number of elements and components that characterize the structure of the virtual classrooms on the Internet including: Home page, log in tool, learning content pages, communication tools (synchronous and non-synchronous) including e-mail, chat rooms and forums, self-test tool, timetable of the content, tools to communicate to search engines, activities and assignments tools, educational resources, setting control panel, and organizational map.

In order to make full use of the advantages of virtual classrooms, there must be a connection to the Internet or a local information network (Intranet), in addition to the availability of an electronic management system and a follow-up system by both the teacher and the school or university to ensure the virtual classrooms objectives are being achieved. Also, students should have good computer skills, while teachers should have good deal of knowledge about virtual classrooms and how to interact with students through them. Al-Salem (2004) states several important advantages of virtual classrooms, which are: (i) achieve application sharing, (ii) provide immediate feedback to the learner, (iii) direct interaction between teacher and learner, (iv) interactive content with all its elements, (v) direct verbal chat, (vi) interacting with a large number of participants from different places, (vii) supporting scientific content with multimedia, (viii) navigating different educational sites online in class, and (ix) provide direct assessment.

Abu Alia (2013) on the other hand mentions other advantages of virtual classrooms including, teacher's role in the virtual classroom, students prefer the engagement in GC where teachers have passive roles, rather than being engaged in a class where teachers have the main role (Maroof & Emran, 2018). A proper virtual classroom must be flexible and allows the teacher to explain the educational content in more than one language, use multimedia,

include an efficient control panel that allows ease of use, and include the main functions of electronic classrooms (Mwanza, 2005). This requires new roles from the teacher in the virtual classrooms as mentioned by Mwanza as follows: 1. The teacher transforms from a simply a teacher providing information to an instructor providing students with educational resources guiding them on exchanging knowledge. 2. The teacher encourages students to work in groups to increase their learning experiences and to share these experiences. 3. The teacher seeks to achieve quality teaching through competition with his colleagues. 4. The teacher encourages students to deal with educational subjects with multiple perspectives. 5. The teacher inspires students to become self-independent, and manage time and learning process.

Furthermore, Al-Talwaty (2014) enlists the following tasks for the teacher in the virtual classroom: 1. Define the objectives and outcomes of the lessons and the courses that he seeks to achieve. 2. Select or prepare assessment methods to measure the extent of achieving these objectives. 3. Follow up on students' attendance and academic progress and attainment. 4. Organize the learning environment by making it comfortable, cooperative, and interactive. 5. Instruct students to do assignments, activities and projects and conduct discussions. 6. Ask questions that provoke understanding and critical thinking and accept different answers. 7. Provide academic assistance and guidance to students and solve their academic problems.

Google Apps for Education (GAFE) is an influential cloud-computing solution that works to connect and engage with every student no matter where they are and what tools are used (Google, 2013). The GAFE suite includes Gmail, Google Drive, Google Groups, Google Calendar, Google Docs, Google Sites, and Google+ (Google, 2013). The integration of GAFE tools have been used to overcome barriers that students have in

communicating with their teachers within classroom settings (Sviridova, Sviridova, & Tymoshenko, 2011) and increase productivity and learning gains in the classroom. Google Classroom is a free application that is part of GAFE. Its purpose is to facilitate communication and interaction between teachers and students and streamline educational workflow (Catapano, 2019). It was launched in May 2014 (Beaumont, 2018) and is currently available in 42 languages. GC provides a unique experience for students and teachers in managing the daily tasks and activities. GC *“uses Google Cloud to save and share files between students and teachers with the possibility of keeping track of students' progress in performing the daily tasks and it is free”* (Amour & Alimat, 2016, p. 156). In order to use GC, an e-mail account should be created for each student. Teachers can add students to classrooms, where they can post students' e-mail addresses. GC can also upload the student's Gmail contacts, or export members of Google Groups. Teachers can create classes, post assignments, organize folders, and view work in real-time (Beaumont, 2018; Catapano, 2019). The app also allows teachers to *“constantly control their observations, surveys, and analyses of student's demography”* (Maroof & Emran, 2018, p. 3). Another important characteristic of the application is that the way students are added to the classroom by coding is obtained from the application and sent by the teacher, which enables the students to join the class, and there is ability to reset or disable the encoding by clicking on the encoding itself. Further, the teacher can create the desired number of classrooms, and students can join the classes they want.

Once the invitation has been sent, the teacher can follow up the status of each invited person. The teacher can also give permission to students, and read any comments and messages written by students. Google has stated the following characteristics of its GC

application (Lujvato, Vesan & Angorino 2015): 1. Prepare and collect assignments: GCs combine Google Docs, Google Drive, and Gmail to help teachers prepare and collect paperless assignments, know who did or did not submit the assignment, and provide direct feedback to each student. 2. Improve class interaction: Teachers can make announcements, ask questions and comment on students' performance instantly, and improve interaction inside or outside the classroom. 3. Maintain the organization: The classrooms may have folders for each assignment and each student, and students can follow up on the results and feedback provided by teachers. Many students prefer using GC in their learning process due to its usefulness, ease of use, and practicality in accomplishing the intended tasks (Maroof & Emran, 2018). They can begin working with just one click by viewing the assignment, and then when opening a Google Doc teacher will have a real-time view into their students' progress which allows them to offer feedback and comments along the way (Catapano, 2019).

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Statement of the Problem

Teaching programmes implementation in Nigerian educational institutions have been affected by the Petrol subsidy removal. Teaching programme is one of the most cardinal programmes of educational institutions (Ogunode, 2021) Teaching programme is the act of imparting knowledge to the learners. Teaching involves physically or

virtually delivering a lesson or instruction that has the capacity to modify behavior. Teaching in most Nigerian educational institutions is mostly done with the traditional teaching model of physical presences. Physical teaching method is a system that involve the teachers to deliver the lesson or lecture physically in the school environment. Physical teaching method is characterized with movement from teachers' abode to school environment. It involves the use of school buses, cars, or motorcycles to move from the teachers' homes to school facilities. The removal of Petrol subsidy in Nigeria has led to increment in price of fuel. The increment in fuel price has led to increment in transportation fare which directly and indirectly affects teachers' movement to schools. Many teachers are now missing classes due to their inability to be in schools, while in tertiary institutions many lecturers have decided to compress their lectures to one or twice in a week, while other lecturers have changed to virtual model of teaching. The post-subsidy removal in Nigeria has affected implementation of teaching programme in Nigeria educational institutions. Petrol Subsidy removal has impacted negatively on the entire educational system leading to reduction in the teaching hours in schools because teachers cannot cope with the increment of transportation fare. Okonkwo (2023) observed that teachers are also affected by the removal of the fuel subsidy, as they have to pay more for transportation to and from work. Many teachers rely on public transport, such as buses, taxis and motorcycles, which have also increased their fares due to the higher cost of fuel. Some teachers may have to spend more than half of their salaries on transportation alone, leaving little for other expenses such as food, rent and health care.

Learning programme as implemented in educational institutions are planned programmes for students or learners. Studies by (Ogunode, *et al.* 2021; Ogunode, *et al.* 2020) observed that students are learners in

educational institutions, their studentship starts from the early child education to basic education to secondary school education and ends in the higher institutions. Higher institutions students are matured learners from 18 years and above. Learning programme in most Nigerian educational institutions are anchored on movement of students from their homes to schools specially in the junior basic schools and senior secondary schools, this movement is done mostly by buses, motorcycles or cars that use fuel. The subsidy removal has led to an increase in the fuel price which have also led to increase in transportation fare. The removal of subsidies has led to a hike in the price of fuel, which automatically leads to inflation in the country, it is evident that this hike in the price of fuel making it difficult for student's movement to schools. Okonkwo (2023) asserted that students are another group that is affected by the removal of the fuel subsidy, as they must pay more for transportation to and from school. Many students depend on public transport or private vehicles to get to school, which have become more expensive due to the higher cost of fuel. Some students may have to drop out of school or defer their studies if they cannot afford the transportation costs. Some students may also have to cope with poor learning conditions, such as inadequate facilities, overcrowded classrooms and frequent power outages, as schools struggle to provide quality education with limited resources. Consequently, the introduction of virtual learning in form of Google Classroom will go a long way in addressing the issue of absenteeism of teachers and students in teaching and learning. Based on the problem of the study, the study will investigate the effect of google classroom on secondary school students' engagement and achievement in mathematics.

Research Questions

In line with the purpose of the study, the

following research questions that guide the study

- (i) What are the mean engagement scores of students taught mathematics using google classroom and those taught using face-to-face method?
- (ii) What are the mean achievement scores of students taught mathematics using google classroom and those taught using face-to-face method?

Research Hypotheses

The following hypotheses will also be tested at 0.05 level of significance in line with the research questions

- (i) There is no significant difference in the mean engagement scores of students taught mathematics using google classroom and those taught using face-to-face method
- (ii) There is no significant difference in the mean achievement scores of students taught mathematics using google classroom and those taught using face-to-face method

RESEARCH METHODOLOGY

Description of Study Area

The study will be conducted in Ikot Ekpene Education Zone of Akwa Ibom State, Nigeria. Three local government areas namely, Ikot Ekpene, Obot Akara and Essien Udim. The study area was used because it has schools with facilities that could facilitate the conduct of the study in the area. Besides, the area has students with iPad and laptops that could be used for google classrooms.

Research Design

A non-equivalent control group, pretest and posttest quasi-experimental research design was adopted in the study with a population that consisted 4,528 SS11 students in 24 private secondary schools in the area for 2021/2022 academic session. Two schools were selected using purposive sampling technique where

two intact classes were used for the study. To avoid disrupting the schools' usual teaching and learning operations, intact classrooms option was employed. The two intact classrooms were divided into two groups, one for google classroom (experimental) and the other for face-to-face method (control). There were 31 students in the experimental group and 36 in the control group.

Data Collection

Two instruments titled; Students' Learning Engagement Questionnaire (SLEQ) and Mathematics Achievement Test (MAT) developed by the researchers were used for data collection. The SLEQ consisted of 20 items that elicited data on students' learning engagement in mathematics. The ratings for each were on a four-point scale of strongly agree (SA), agree (A), disagree (D) and strongly disagree (SD) respectively. The MAT contains 20 dichotomously scored multiple choice items with four response options of A, B, C and D that elicits data with respect to students' achievement in mathematics. Students' achievement was drawn using Bloom's taxonomy of educational objectives. The test covered Geometry because this topic is one of the areas of mathematics in which students continue to perform poorly (WAEC, 2019). The SLEQ and MAT was pilot tested on 20 SS2 students in a school that were not part of the study. Cronbach alpha reliability coefficient of 0.76 was established. The reliability coefficient of the MAT employed Kuder-Richardson 20 method as the items had to be dichotomously scored and the reliability coefficient of 0.74 was established.

Methods of Data Analysis

Data collected was analyzed using mean and standard deviations to answer the research questions while the null hypotheses will be tested using analysis of covariance (ANCOVA) at 0.05 level of significance.

Presentation

Permission was sort before commencement of the study, the researchers recruited the services of regular mathematics teachers as research assistants. The reasons for using regular mathematics teachers were to ensure that the students are not aware they were involved in an experiment. The research assistants were very well informed about the objective of the research. The research assistant for the experimental group was trained for four days on the use of google classroom while the one of the control group was asked to use the traditional face-to-face lecture method.

The experiment lasted for a period of five weeks. In the first week, the research assistants were trained for four days. The instruments were administered on both groups on the fifth day as pretest. The normal lesson periods on the school's timetables were used to conduct the experiment which lasted for 40 minutes per lesson for four times a week. The control group were taught in the class while the experimental group were taught in a computer laboratory where Google Apps for Education (GAPE) was downloaded into the computers and the teacher made an online class for physical classes using programmes such as Google Docs, Google

Forms and Google Presentation. There was one teacher computer that was connected to an overhead projector and interactive Smart Board from where the teachers created virtual classes, distributed assignments, sent feedback, and observed all activity within one media. Two sets of lesson plan, with the same content, specific objectives, duration and evaluation were developed for the two groups, except that the lesson plan for the experimental group was electronically prepared for online learning with google classroom app while that for the control group was prepared for lecture method. At the fifth week, items in the same SLEQ and the MAT were reshuffled and re-administered to the students as posttest in order to determine the effect of the treatments on the students' engagement and achievement in mathematics. The students in both groups manually rated the SLEQ and manually answered questions in the MAT and were scored by the teachers. Each correct option in the MAT was scored one point whereas each wrong option attracted zero point.

Table 1: Mean and standard deviation of mean engagement scores of students taught Mathematics using Google classroom and those taught using face to face method

Groups	Pretext			Posttest		Mean Difference
	N	$\bar{X}$	SD	$\bar{X}$	SD	
Experimental (google classroom)	31	48.77	8.04	59.97	7.02	11.20
Control (face to face method)	36	47.27	3.66	61.86	6.08	14.59

Result in Table 1 shows that the mean differences of 11.20 and 14.59 for the experimental and control groups respectively depicts that face-to-face teaching method had positive effect on students' engagement in mathematics than Google classroom.

Table 2: Analysis of Covariance (ANCOVA) of the effect of google classroom on students' engagement in Mathematics

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squares	Dec.
Corrected Model	164.561	2	82.280	1.972	.148	.058	
Intercept	2671.039	1	2671.039	64.015	.000	.500	
Pretest	104.849	1	104.849	2.513	.118	.038	
Groups	79.767	1	79.767	1.912	.172	.029	NS
Error	2670.424	64	41.725				
Total	252020.000	67					
Corrected Total	2834.985	66					

a. R Squared = .058 (Adjusted R Squared = .029)

The result in Table 2 shows that the effect of google classroom on students' engagement in mathematics was not significant ($F(1, 66) = 1.92, p > .05, \eta^2 p = .029$), thus the hypothesis is not rejected. This is because the exact probability value of 0.172 is greater than 0.05 set as level of significance. The effect size of ($\eta^2 p = .029$), moreover, indicates that 2.9 percent changes in students' engagement in

mathematics is due to the use of google classroom. Thus, inference drawn is that google classroom has no significantly positive effect on students' engagement in mathematics

Table 3: Mean and standard deviation of mean performance scores of students taught Mathematics using Google classroom and those taught using face to face method

Groups	Pretest			Posttest		Mean Difference
	N	$\bar{x}$	SD	$\bar{x}$	SD	
Experimental (google classroom)	31	10.00	1.71	14.35	2.56	4.35
Control (face to face method)	36	9.53	1.55	11.61	2.01	2.08

Result in Table 3 shows that the mean differences of 4.35 and 2.08 for the experimental and control groups respectively depicts that google classroom had positive effect on students' achievement in mathematics

than face-to-face method.

Table 4: Analysis of Covariance (ANCOVA) of the effect of Google classroom on students' engagement in Mathematics

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squares	Dec.
Corrected Model	134.823	2	67.412	13.065	.000	.290	
Intercept	202.340	1	202.340	39.215	.000	.380	
Pretest	9.431	1	9.431	1.828	.181	.028	
Groups	113.088	1	113.088	21.918	.000	.255	S
Error	330.222	64	5.160				
Total	11581.000	67					
Corrected Total	465.045	66					

a. R Squared = .290 (Adjusted R Squared = .268)

The result in Table 4 shows that the effect of google classroom on students' achievement in mathematics was not significant ($F(1, 66) = 21.918$, $p < .05$, $\eta^2 p = .255$), thus the hypothesis is rejected. This is because the exact probability value of 0.00 is less than 0.05 set as level of significance. The effect size of ($\eta^2 p = .255$), moreover, indicates that 25.5 percent changes in students' achievement in mathematics is due to the use of google classroom. Thus, inference drawn is that google classroom has a significantly positive effect on students' achievement in mathematics.

DISCUSSION

The findings of the study revealed that the face-to-face method had a positive effect on students' engagement in mathematics than the Google classroom. However, the effect was small and not significant. This means that the face-to-face method is better in engaging the students in mathematics activities than the Google classroom. The above findings are in line with previous findings by Cacace (2019) who indicated that students were not very passionate about using Google Classroom to complete assignments but preferred it for keeping track of assignments. These findings may be true because in the face-to-face classroom setting, students meet one another, collaborate and share ideas while engaging in class activities. More so, the teacher has the leisure of interacting with the students direct and getting them involved actively in the teaching and learning process.

Findings of the study also revealed that the google classroom had a significant positive effect on students' achievement in mathematics, thus implying that students' achievement in mathematics would improve if taught using google classroom. The above findings corroborate previous findings by Oyarinde and Komolafe (2020) and Sri Sasmita, *et. al.* (2021) who in their separate studies revealed that the Google classroom

platform positively affected students' academic achievement, attitudes and their perception during the pandemic in Nigeria's secondary school. The above findings are true because young students enjoy teaching platforms that are technologically driven. Therefore, the use of google classroom may be captivating and interesting to the students who may enjoy the lesson because of its technological nature. By being interested, students may become more actively engross in the teaching and learning of mathematics. This may help in their retention of concepts taught and which would culminate to an improvement in their achievement.

Recommendations

Based on the findings of the study, the researchers recommended that;

- (i) Google classroom should be used in teaching mathematics in schools
- (ii) Government should provide facilities in public schools that enhance the use of google classrooms in teaching.

Conclusion

There is always the need to find alternative teaching methods that could be used for teaching and learning in times of economic meltdowns. Based on this, the present study investigated the effect of google classroom on secondary school students' engagement and achievement in mathematics. Based on the findings of the study, it was concluded that the face-to-face method is more effective in enhancing students' engagement than the google classroom. It was further concluded that the google classroom has a significant positive effect on students' achievement in mathematics. The findings provided information on the effectiveness on google classroom on students' achievement in mathematics.

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REFERENCES

Abidin, Z. & Saputro, T.M.E. (2020). Google classroom as a mathematics learning space: potentials and challenges. *Journal of Physics. Conference Series*. 1567 022094.

Afolabi, B.Y., Wakili, L.B., Afolabi, A.O., Onwuegbunam, N.E. & Ademuwagun, A.A. (2020)

An investigation of class size on teaching and learning of mathematics in secondary schools (A Case Study of Chikun Local Government Area) of Kaduna State, Nigeria. *Journal of Education, Society and Behavioural Science*, 33(10), 40-52.

Andortan, J.A., Ubebe, S.A. & Aneshie-Otakpa, V. O (2022). Effect of activity based learning on junior secondary school students' interest and achievement in geometrical contents of mathematics. *African Journal of Science Technology and Mathematics Education*, 8(3). 232-238.

Bender, W.N. (2017). *20 strategies for increasing student engagement*. USA: Learning Sciences International.

Cacace, M. (2019). *"Effects of using Google Classroom on teaching math students with learning disabilities"*. Thesis and Dissertations. 2679. <https://rdw.rowan.edu/etd/2679>.

Clarke, D., Roche, A., Cheeseman, J., & Sullivan, P. (2014). Encouraging students to persist

when working on challenging tasks: Some insights from teachers.

Australian Mathematics Teacher, 70(1), 3-11.

Cook, C. W. & Sonnenberg, C. (2014). Technology and online education: Models for change.

Contemporary Issues in Education Research, 7(3), 171-188.

Ghofur, A. (2018). Using google classroom on inquiry-based learning to improve students' learning participation, *Journal of Penelit. Pendidik*, 10(2). Oguguo, B.C.E, Ocheni A.O & Adebayo F.K. (2021). Students' achievement in online test and

measurement course in synchronous and asynchronous e-learning platform. *European Journal of Open Education and E-learning Studies*, 6(2), 137-151. <https://doi.org/10.46827/ejoe.v6i2.3966> www.oapub.org/edu

Oyarinde, O.N. & Komolafe, O.G. (2020). Impact of google classroom as an online learning delivery during COVID-19 pandemic: The case of a secondary school in Nigeria. *Journal of Education, Society and Behavioural Science*, 33(9), 53-61

Patrick, P.C., Nnadi, E.M., Ukwueze, P.C. & Aneshie-Otakpa, V.O. (2021). "Role of Library and Information Science Virtual Classrooms in Curriculum Delivery: Nigerian Teachers' Perception. *Library Philosophy and Practice (e-journal)*. 6257. <https://digitalcommons.unl.edu/libphilprac/6257>.

Russo, J., & Hopkins, S. (2017). Student reflections on learning with challenging tasks: 'I think the worksheets were just for practice, and the challenges were for maths. *Mathematics Education Research Journal*, 29(3), 283-311. <https://doi.org/10.1007/s13394-017-0197-3>.

Sari, N. M., & Yin, K. Y. (2021). The effect of google classroom assisted learning on interest among form six economics

- students. *International Journal of Academic Research in Progressive Education and Development*, 10(4), 107–120
- Senad, O. (2021). Students' perceptions of using google classroom in math. *Journal of Social Education and Interdisciplinary Science University*, 24-31
- Shaharane, I.N.M., Jamil, J.M. & Rodzi, S.S.M. (2018). The application of google classroom as a tool for teaching and learning. *Journal of Telecommunication, Electronic and Computer Engineering*, 8(10), 5-8.
- Sri Sasmita, N., Redhana, I.W. & Suja, I.W. (2021). The effect of online learning on students' learning achievement on colloid concept. *Advances in Social Science, Education and Humanities Research*, 536, 357-360.
- Steinmayr, R., Meibner, A., Weidinger, A. F. & Wirthwein, L. (2015). *Academic achievement*.
<http://www.oxfordbibliographies.com/view/document/obo-xml/doi:10.1093/obo/9780199756810-0108>
- Ulum, F. (2020). Student perception of using google classroom in mathematics learning in COVID-19 pandemic. *International Conference on Information System*, 27-28. DOI 10.4108/eai.27-10-2020.2304171
- United Nations Educational, Scientific and Cultural Organization. (2020). *COVID-19 Impact on Education*. <https://en.unesco.org/covid19/educational-response>
- West African Examination Council (2019). Chief examiners' report. Yaba-Lagos. WAEC press.
- Wiseman, P.J., Kennedy, G.E. & Lodge, J.M. (2016). Models for understanding student engagement in digital learning environments. In S. Barker, S. Dawson, A. Pardo, & C. Colvin (Eds.), *Show Me The Learning*. Proceedings ASCILITE 2016 Adelaide (pp. 666-671).
- World Health Organization. (2019). *Coronavirus disease (COVID-19) advice for the public*.
<https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public>.



Revisiting Characterization of Semigroups: Exploring limitations of Independence

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Abstract

This paper reviews the evaluation of the characterization of semigroups Independence, generating systems by done by Sampson, M. I. (see [2]), which began with studying the work of Howie and Ribeiro (see [1]) to investigate the effect of the concept of independence on semigroup generating systems. While independence is often considered fundamental in determining minimal generators for semigroups, we show instances where this notion proves inadequate. Specifically, with illustrated variations in the role of independence in Semigroup as compared to vector spaces. The study shows reliable characterization of independent generating sets that helps in the selection algorithm for the basis elements of any given semigroups.

Keywords: Semigroups, Rank characterization, Independence, Counterexamples, Commutative semigroups, Non-commutative semigroups

1. Introduction

Blockchain technology has emerged as a transformative force in various industries, Semigroups, algebraic structures defined by a binary operation satisfying associativity, play a significant role in various areas of mathematics, including algebra, combinatorics, and theoretical computer science. One key aspect in the study of semigroups is the characterization of their rank, which measures the structural complexity of these mathematical objects.

The concept of rank in semigroups serves as a fundamental indicator of the size of the smallest generating set necessary to produce all elements of the semigroup. Understanding the rank of a semigroup provides insights into its algebraic properties, its structure, and its

computational complexity.

One approach to characterizing the rank of a semigroup is based on the notion of independence. Independence refers to subsets of elements within a semigroup that cannot be expressed as products of other elements in the subset. The significance of independence in rank determination lies in its ability to identify minimal generating sets, or bases, that efficiently generate the entire semigroup.

Historically, independence-based characterizations of rank have been widely studied and applied in the literature. Howie and Ribeiro (see [1]) proposed a specific characterization of rank in semigroups based on independence, which has been influential in the field. This characterization suggests that the basis elements of a semigroup should

correspond to the maximal independent subsets.

However, despite the apparent significance of independence in rank determination, there are cases where this concept fails to provide an accurate characterization of rank. In certain semigroups, the existence of finite bases coexists with the presence of a larger number of independent elements than expected based on conventional assumptions. These counterexamples challenge the traditional understanding of the relationship between independence and rank in semigroups.

In this paper, we delve into the intricacies of rank characterization in semigroups, focusing on the role of independence and its limitations. By examining specific instances where independence-based characterizations falter, we aim to shed light on alternative approaches to rank characterization and contribute to a deeper understanding of semigroup structures.

2. PRELIMINARIES

In this section, we provide formal definitions of key concepts related to semigroups and rank characterization. Definition 2.1 (Semigroup). Let S be a non-empty set " $\circ$ " be a binary operation on S . The pair $(S, \circ)$ is a semigroup if, for all $a, b, c \in S$, the operation $\circ$ satisfies the associative property:

$$(a \circ b) \circ c = a \circ (b \circ c).$$

Example 2.2. Consider the set $S = \{1, 2, 3, 4\}$ with the binary operation $\circ$ defined as *additional modulo 5*. Then, $(S, \circ)$ forms a semigroup since *additional modulo 5* is associative:

- $(1 + 2) + 3 = 3 + 3 = 6 \equiv 1(\text{mod}5)$
- $1 + (2 + 3) = 1 + 5 \equiv 1(\text{mod}5)$

Thus, the pair $(S, \circ)$ satisfies the associative property, fulfilling the definition of a semigroup.

Definition 2.3 (Rank). Let S be a semigroup and $A = \{a_1, a_2, \dots, a_n\} \subset S$. The rank, (S)

of S is the smallest non-negative integer n such that for any $x_j \in S$, $j \in N$,

$$x_j = \prod_{i=1}^n a_i, \quad \forall i \in N$$

Example 2.4 [3]. Consider the five element Brandt Semigroup,

$$B_2 = \{a, b, ab, ba, o \mid aba = a, bab = b, a_2 = b_2 = o\}$$

The multiplication is done on the rule below governing Brandt semigroup:

$$(i, a, j)(k, b, l) = \begin{cases} (i, ab, l) & \text{if } j = k \\ 0, & \text{otherwise} \end{cases}$$

The minimal generating subset of B_2 is $\{a, b\}$ and $\text{rank}(B_2) = 2$. The product of $B_2 \times B_2 \times B_2$ above is

$$\begin{aligned} & \{a, b, ab, ba, o\} \times \{a, b, ab, ba, o\} \\ & \times \{a, b, ab, ba, o\} = \{(a, a), (a, b), (a, ab), (a, ba), (a, 0), (b, a), (b, b), (b, ab), (b, ba), (b, 0), (ab, a), (ab, b), (ab, ab), (ab, ba), (ab, 0), (ba, a), (ba, b), (ba, ab), (ba, ba), (ba, 0), (0, a), (0, b), (0, ab), (0, ba), (0, 0)\} \times \{a, b, ab, ba, o\} \end{aligned}$$

$$\begin{aligned} & = \{((a, a), a), ((a, a), b), ((a, a), ab), ((a, a), ba), ((a, a), 0), ((a, b), a), ((a, b), b), ((a, b), ab), ((a, b), ba), ((a, b), 0), ((a, ab), a), ((a, ab), b), ((a, ab), ab), ((a, ab), ba), ((a, ab), 0), ((a, ba), a), ((a, ba), b), ((a, ba), ab), ((a, ba), ba), ((a, ba), 0), ((a, 0), a), ((a, 0), b), ((a, 0), ab), ((a, 0), ba), ((a, 0), 0), \dots, ((0, 0), 0)\}. \end{aligned}$$

Order of $(B_2 \times B_2 \times B_2) = 125$.

Minimal generator = $\{((a, a), a), ((b, b), b)\}$
which has 2 as the rank.

$\text{Rank}(B_2 \times B_2 \times B_2) = 2 \leq \text{Rank}(B_2) + \text{Rank}(B_2) + \text{Rank}(B_2) < 2 + 2 + 2 = 6$.

Remark 2.4.1. The rank of the direct product of any algebraic system depends on the structure of the system.

Definition 2.5 (Basis). Let S be a semigroup. A subset $B \subset S$ is a basis of S if it satisfies the following two conditions:

1. B is a generating set for S i.e., every element of S can be expressed as a product of elements from B
2. B is minimal in cardinality among all generating sets for S , i.e., there is no proper subset of B that is also a generating set for S .

Example 2.6 [13]. Consider the six elements semigroup S , which is a 2×2 real matrix under matrix multiplication,

$$o = \begin{pmatrix} 0 & 0 \\ 0 & 0 \end{pmatrix}, i = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}, a = \begin{pmatrix} 0 & 1 \\ 0 & 0 \end{pmatrix}, b = \begin{pmatrix} 0 & 0 \\ 1 & 0 \end{pmatrix}, ab = \begin{pmatrix} 1 & 0 \\ 0 & 0 \end{pmatrix}, ba = \begin{pmatrix} 0 & 0 \\ 0 & 1 \end{pmatrix}$$

Table 1. Multiplication table:

	0	i	a	b	ab	ba
0	0	0	0	0	0	0
i	0	i	a	b	ab	ba
a	0	a	0	ab	0	a
b	0	b	ba	0	b	0
ab	0	ab	a	0	ab	0
ba	0	ba	0	b	0	ba

Let $U = \{i, a, b\} \subseteq S$. Notice that every element from $\{o, i, a, b, ab, ba\}$ can be expressed as product of elements of U since the elements $i, a, b \in U$ multiply each other to produce $S = \{o, i, a, b, ab, ba\}$. Notice also that there is no other proper subset of elements, say, $A \subset U$ in S that generates S : Therefore U is a minimal generating set and by definition 2.5, the basis in S .

Remark 2.6.1. (Notation). We denote the subsemigroup generated by a as $\langle a \rangle$.

Definition 2.7 (Independence). Let S be a semigroup. A subset $I \subset S$ is independent if, for all distinct elements $ai \in I$, each ai fails to exist in the subsemigroup $\langle (S \setminus ai, \circ) \rangle$.

Example 2.8 (Independence). Consider the semigroup S defined in 2.6. The elements i, a and b are independent elements: If we take out i from U , notice that $\{i\}$ is excluded from the subsemigroup generated by the remaining elements $U \setminus \{i\}$ of S . That is, $\{i\}$ is excluded from $\langle U \setminus \{i\} \rangle = \{o, a, b, ab, ba\}$. Notice also that $\{a\}$ and $\{b\}$ are excluded from the subsemigroup $\langle U \setminus \{a\} \rangle = \langle \{o, i, b\} \rangle = \{o, i, b\}$ and $\langle U \setminus \{b\} \rangle = \langle \{o, i, a\} \rangle = \{o, i, a\}$ respectively. We conclude that the subset U is independent.

Remark 2.9. These definitions lay the groundwork for our subsequent analysis of rank characterization in semigroups, particularly focusing on the role of independence in this context.

3.0. CERTAIN CHARACTERIZATIONS ABOUT INDEPENDENCE IN VECTOR

SPACES AND THEIR EXPECTED ANALOGUE IN SEMIGROUP

Definition 3.1. Let the set $()$ be the power-set of the non-empty set W . A set $A \in (W)$ with a property pr is maximal (minimal) if $\nexists U \in (W)$ with the property pr such that $A \subset U$ ($U \subset A$) and $A \neq U$.

Let $\{V, +, *\}$ be a vector space over a field F and let $H \subset V$. The statements of the following theorem are popularly known to be true about independence and generating systems of vector spaces.

Theorem 3.2.

1. A maximal independent set $B \subset V$ is a basis;
2. A minimal generating set $B \subset V$ is a basis i.e. it is independent;
3. If $H \subset V$ is an independent set and $v \in V$ is independent from H then $H \cup \{v\}$ is an independent set.

Equivalently any independent set has an extension to a basis.

4. In a vector space $\{V, +, *\}$ over a field F the cardinality of all maximal independent sets is the same,

which is the dimension of a vector space.

The proof is left for the reader.

3.2.1. Basis in Vector Spaces.

The algorithm to select a basis in vector spaces is based on the properties of independence listed in Theorem

3.2. We give the algorithm below.

3.2.2. Algorithm for Vector Space Generating set $[]$.

Let $\{V, +, *\}$ be a vector space over a field F and let $B \subset V$ hold the selected basis elements, let $B = \emptyset$

for starting. Let $G \subset V$ be the starting system of vectors. Then

- (a) If $G \neq \emptyset$ then $\exists x \in G$ otherwise [exit];
- (b) If $x \notin (B)$ then $B = B \cup \{x\}$ and $G = G \setminus (B)$ otherwise $G = G \setminus \{x\}$.
- (c) goto (a).

This algorithm collects a basis in B by the theorem 3.2 (1) and (3). Since these ((1) and (3)) are not necessarily true in semigroups (as we shall soon see in section 3.3), this cannot be adopted to semigroups.

One most important consideration given in 3.3 is that a maximal independent subset of a semigroup may not be a generating set and a basis must be a generating set. Since a generating set may not be reached from an independent set, we will work from starting with a generating set and we will sustain it throughout the process. Note that if $\{S, *\}$ is a semigroup then $S \subset S = \langle S \rangle$ is a generating set. Therefore $G = S$ always can serve as a starting generating set.

3.3. INDEPENDENCE IN THE CONSTRUCTION OF GENERATING SETS IN SEMIGROUP

We start with some relevant definitions.

Definition 3.3.1. The set $H \subset V$ is a generating set if $L(H) =: \langle H \rangle = V$.

Definition 3.3.2. Let $\emptyset \neq H \subset V$ then $x \in V$ is independent from H if $x \notin L(H)$.

Definition 3.3.3. The set $H \subset V$ is an independent set if $x \notin (H \setminus \{x\}) = \langle H \setminus \{x\} \rangle$, $\forall x \in H$.

Definition 3.3.4. An independent generating set $B \subset V$ is called a basis.

Remark 3.3.5. It can be shown with examples (see Example 3.3.7) that handling generating sets and independence including construction of bases in semigroup theory requires a technique different from the technique used in vector spaces. Important conclusions are the deviations from the properties discussed in theorem 3.2 about vector spaces stated in theorem 3.3.9 about semigroups.

1. Independence: There may exist maximal independent set of elements in a semigroup which does not form a generating set.
2. There may exist independent set in a semigroup which cannot be expanded to a generating set 3.

Adding an element independent from an independent set may make the independent set dependent in a semigroup.

3.3.6. CONSTRUCTION OF GENERATING SETS AND BASES IN SEMIGROUPS.

Example 3.3.7. Consider the following semigroup $\{S, *\}$ where $S := \{a, b, c\}$, and the operation is defined by the operation table (Table 1.):

Table 2: The operation table of $\{S, *\}$.

$*$	a	b	c
a	a	c	c
b	c	b	c

c	c	c	c
-----	-----	-----	-----

Theorem 3.3.8. The structure $(S, *)$ is a semigroup, the operation is associative.

Proof. It suffices to check that associativity holds for $*$ in $(S, *)$: $a * (b * c) = (a * b) * c = c$,

$$a * (c * b) = (a * c) * b = c, b * (a * c) = (b * a) * c = c, b * (c * a) = (b * c) * a = c, c * (b * a) =$$

$$(c * b) * a = c, c * (a * b) = (c * a) * b = c.$$

Theorem 3.3.9. In the semigroup $\{S, *\}$ given in Example 1.8, the following are true.

- (1). The subset $\{b, c\} \subset S$ is a subsemigroup of S . The members of $\{b, c\}$ are independent:

$$\{b, c\} \setminus \{b\} = \{c\} \text{ and } b \notin \langle \{b, c\} \setminus \{b\} \rangle = \langle \{c\} \rangle = \{c\}. \text{ Similarly, } \langle \{b, c\} \setminus \{c\} \rangle = \langle \{b\} \rangle \text{ and } c \notin \langle \{b, c\} \setminus \{c\} \rangle = \langle \{b\} \rangle = \{b\}.$$

- (2). The subset $\{a, b\} \subset S$ is a generating set of S . Next, a and b are independent: We saw in (1) above that b is independent. Notice also that $a \notin \langle \{a, b\} \setminus \{a\} \rangle = \langle \{b\} \rangle = \{b\}$. Hence a and b are independent and $\{a, b\}$ is a basis and $a \in S$ is independent from $\{b, c\} \subset S$ since this set is a

subsemigroup of S and a is not in it (the subsemigroup generated by $\{b, c\}$).

- (3). Since $\{b, c\} \subset S$ is an independent subsemigroup, there is only one element in S which is independent from this set, it is $a \in S$ and adding a to $\{b, c\}$ forms a dependent set:

$$\{a, b, c\} \setminus \{c\} = \{a, b\} \subset S \text{ gives } \langle \{a, b\} \rangle = S \ni c.$$

Proof. We proved the statements of the theorem in the theorem.

3.3.10. Remarks. The example shows that handling generating sets and independence including construction of bases in semigroup theory requires a technique different from the technique used in vector spaces. Important conclusions are the deviations from the properties discussed in theorem 3.2 about vector spaces now stated in theorem 3.4 about semigroups.

Theorem 3.4. In the semigroup $\{S, *\}$, the following are true

1. Independence: There may exist maximal independent set of elements in a semigroup which does not form a generating set.
2. There may exists independent set in a semigroup which cannot be expanded to a generating set.
3. Adding an element independent from an independent set may make the independent set dependent in a semigroup.

4.0. Independent Generating Sets of Semigroups: The Algorithm [14].

The following is an algorithm for obtaining the basis set of any semigroup. We present some below.

Theorem 4.1. The algorithm below gives the basis of any semigroup $\{S, *\}$:

Let $\{S, *\}$ be a semigroup and let $\emptyset \neq G \subset S$ be a generating set. Let $S \supset B = \emptyset$.

(a) If $G \neq \emptyset$ then $\exists x \in G$ and $G_{test} = G \setminus \{x\}$ otherwise [exit];

(b) If $x \notin (G_{test} \cup B)$ then $B = B \cup \{x\}$ and $G = G \setminus (B)$ otherwise $G = G_{test}$;

(c) goto (a).

4.1. Illustration. At starting $G \cup B = G$ is a generating set. In step (a) $G_{test} = G \setminus \{x\}$ removes x from G hence the test $x \notin L(G_{test} \cup B)$ in (b) checks for $x \notin L((G \cup B) \setminus \{x\})$ which checks if x is independent from the generating set $G \cup B$.

Observe that in the case of vector spaces we check for the independence from B only.

In step (b) we change B to a new value $B_{new} = B \cup \{x\}$ and $G_{new} = G \setminus (B_{new})$ if the independence of x holds otherwise $G_{new} = G_{test}$ and $B_{new} = B$. The set $G_{new} \cup B_{new}$ is a generating set in the step (c): At step (a) $(G \cup B)$ was a generating set at starting since $B = \emptyset$ and G was a generating set.

After selecting $x \in G$ we have two options:

i). $x \notin (G \cup B)$: Then $x \in B_{new}(= B \cup \{x\})$ and $G_{new} = G_{test}$ hence $x \in G$ moves from G into $B \subset S$. The final value of G is G_{new} , $= G_{new} \setminus (B_{new})$.

The set $G_{new}, \cup B_{new}$ is a generating set: $(G_{new}, \cup B_{new}) \supset G_{new}, \cup (B_{new}) \supset G_{new} \cup B_{new}$.

Then $G_{new} = G \setminus \{x\}$ and $B_{new} = B \cup \{x\} \Rightarrow G_{new} \cup B_{new} = G \cup B$. Since $G \cup B$ was a generating

set and $L(G_{new}, f \cup B_{new}) \supset G \cup B$, $G_{new}, f \cup B_{new}$ is a generating set.

ii). $x \in (G \cup B)$: Then $G_{new} = G_{test}$ and $B_{new} = B$.

Since in this case $x \in (G \cup B)$ holds, $L(G \cup B) \supset G \cup B \cup \{x\} = G \cup B$. Hence

$G_{new} \cup B_{new}$ is a generating set.

$G \cup B \supset G_{new} \cup B_{new}$ and $G = G_{new}$, moreover if $x \in G$ is selected in step (a) then $x \notin G_{new} \supset G_{new}$, hence or otherwise, any x can be selected only once. Therefore, if we select basis

vectors $x_1, x_2, \dots, x_k, \dots$ one after the other then

$G_0 := G, B_0 := B = \emptyset, G_1 := G_{new}, B_1 := B_{new}, \dots, G_k := (G_{k-1})_{new}, B_k := (B_{k-1})_{new}, \dots$

Then the system of sets $\{G_S, B_S\}_{1 \leq S < \infty}$ and the selected points $\{x_S\}_{1 \leq S \leq \infty}$ fulfil:

$(G_k \cup B_k) \supset (G_{k+1} \cup B_{k+1}); G_k \supset G_{k+1}$
and $G_k \neq G_{k+1} \forall 0 \leq k < \infty$

$x_j \in B_j \forall 1 \leq j < k, B_k = \{x_j \mid 1 \leq j \leq k\}, \forall k \in \mathbb{N}$. (1)

Theorem 4.2. The set $B_k \subset S$ is independent $\forall 1 \leq k < \infty$.

Proof. The proof is Left for the reader

Theorem 4.3 (See [14]). In any semigroup $\{S, *\}$ there exists an independent generating set $B \subset S$ (basis). If in the semigroup $S, \exists x, y, z \in S$ such that $x * y = z$ and $z \notin \{x, y\}$, then there exists a basis $B \subset S, B \neq S$ (B is a proper subset of S).

Proof. The existence follows from our reasoning above. If there exists $x, y, z \in S$ as stated in the theorem

then let us select $z \in G = S$ as the first choice. Then $S \setminus \{z\} \supset \{x, y\} \Rightarrow x * y = z \in \langle \{x, y\} \rangle \subset \langle G \setminus \{z\} \rangle$ hence z is not independent from

$G \setminus \{z\}$ hence z is not a selected basis element. Therefore, the selected basis B is a proper subset of S .

Remark 4.4. The number of elements in the independent generating set of any given semigroup is the rank of the given semigroup

5.0. CONCLUSION

In any semigroup there exists a maximal independent subset that is a generating set. That subset is a basis.

With the example of the semigroup of integers in [13] and [5], unlike in vector spaces, it is proved that there are bases in a semigroup which can have different numbers of elements. A closely related situation is explained in [2]. With the example we showed that in a semigroup there may exists a maximal independent set of elements which is not a generating set.

The idea of the algorithm is as follows: When we select the next candidate to be a basis element from the current generating set then we assure that it is independent from all the previously selected basis elements (this is B) and it is independent from all possible future selections (this is the current G). This puts $x \notin (G \cup B) \setminus \{x\}$ into the selection condition.

About the Authors: The Authors do research in Algebra; Group theory, Computational Group theory, Algebraic Cryptography, Number theory and Mathematical Modelling.. See [2] – [14] for some of their work.

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REFERENCES

- J. M. Howie & M. I. M. Ribeiro: Rank properties in finite semigroups. *Comm. Algebra*, 27(11): 5333–5347, 1999.
- Sampson, M. I. (2023). Infinite Semigroups whose Number of Independent Elements is Larger than the Basis", *International Journal of Science & Engineering Development Research* www.ijrti.org), ISSN:2455-2631, Vol.8, Issue 7, page no.1001 - 1005, <http://www.ijrti.org/papers/IJRTI2307145.pdf>.
- Udoaka, O.G., & Sampson, M.I. (2018) Direct Product of Brandt Semigroup and Its Rank as a Class of Algebra. *IOSR Journal of Mathematics (IOSR-JM)* 14 (4 Ver. II), 68-71.
- Sampson M.I., L. Zsolt, Achuobi J.O., Igiri C.F., & Effiong L.E. (2023) On independence and minimal generating set in semigroups and countable systems of semigroups. *International Journal of Mathematical Analysis and Modelling* Volume 6, Issue 2, 2023, pages 377–388.
- Zsolt, L., & Sampson, M. I (2023). On Existence of Minimal Generating Sets and Maximal Independent Sets in Groups and the Additive Semigroup of Integers. *IOSR Journal of Mathematics (IOSR-JM)* e-ISSN: 2278-5728, p-ISSN: 2319-765X. Volume 19, Issue 4 Ser. 1 (July. – August. 2023), P P 57 - 64.www.iosrjournals.org.
- Sampson, M. I., Zsolt, L., Achuobi, J. O., Igiri, C. F., & Effiong, L. E. (2023). On the Relationship Between Minimal Generating Sets and Independence in Semigroups. *Journal of Algebra*, 45(3),321-335.
- Ebere, U. E., Udoaka, O. G., Musa, A, & Sampson, M, I. (2023). A typical semigroup in the class of generalized *-bisimple ample -semigroups. *IJRTI | Volume 8, Issue 8 | ISSN: 2456-3315*.
- Udofia, E. S. & Sampson, M.I. (2014). Mathematical model for the epidemiology of fowl pox infection transmission that incorporates discrete delay. *IOSR Journal of Mathematics (IOSR-JM)* 10 (4), 8 16.
- Udofia, E. S. & Sampson, M.I. (2014). Mathematical Model of the Effect of Complacency in HIV/AIDS Preventions. *IOSR Journal of Mathematics (IOSR-JM)* 10 (6), 30-33.
- Michael N. J., Sampson, M. I., Igiri C.F., Udoaka O. G., Effiong L.E., & Jackson A. (2024). A Study on the Relationship Between Minimal Generating Sets and Independence in Semigroups. *International Journal of Computer Science and Mathematical Theory (IJCSMT)* E-ISSN 2545-5699 P-ISSN2695-1924 Vol 10. No.1 2024. www.iiardjournals.org.

Marshal I. S., Ekere S. U., Christiana I., Effiong, L.E., & Eke N. (2024). Exploring Divisibility Properties of Coprime Integers: A Theoretical and Computational Study. International Journal of Applied Science and Mathematical Theory E- ISSN 2489-009XP-ISSN 2695-1908, Vol. 10 No. 1 2024. www.iiardjournals.org.

Sampson M.I., Jackson Ante, & Nduka Wonu (2020). On divisibility of Sum of Coprimes of Integers by Integers and Primes. IOSR Journal of Mathematics (IOSR-JM) e-ISSN: 2278-5728, p-ISSN: 2319-765X. Volume 17, Issue 1 Ser. III (Jan. – Feb. 2021), PP 39-49. www.iosrjournals.org.

Sampson, M.I. (2022) Generating Systems of Semigroups and Independence. PhD Thesis. University of Calabar, CRS, Nigeria.

Marshal I. S., Zsolt L., Akak E. O., & Mfon A. E. (2024). Algorithm for semigroup Bases I. Int. Journal of Mathematical Analysis and Modelling. Accepted for Publication.

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