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## CHEMISTRY EDUCATION FOR ECONOMIC GROWTH, DEVELOPMENT AND STABILITY

By

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### ABSTRACT

*This paper highlights the contribution of Chemistry Education to economic growth, development and stability of Nigeria. The nature of the Nigerian economy, Benefits of Chemistry Education, Maximizing the impact of Chemistry Education for the Benefit of Nigerian, Challenges of Chemistry Education to Economic Growth, Development and Stability in Nigeria and also Strategies for improvement of Chemistry Education for Economic Growth, Development and Stability in Nigeria. As way forward the paper recommended: needs to diversify the Nigerian Economy into a non oil sector such as agriculture, medicine from neem tree, moringa etc, needs to have a re-think on the budgetary allocation of her ministry of education and that of science and technology, encouragement of chemistry education and other science teachers, improvement of scientific research and industries and encouragement of entrepreneurial courses from the primary school to the tertiary level among others.*

**Keywords:** Chemistry education economy growth, development and stability.

### INTRODUCTION

Chemistry and indeed chemists are linked to everything on earth as aptly captured in a slogan “what on earth is not chemistry?” Chemistry plays a pivoted role in the economic growth, development and stability of any nation. It is used in most fields of human endeavour: Agriculture, engineering, industries, medicine, housing, textiles, security, environment, solid minerals, water supply, crime detection, sanitation, pulp and paper and waste management (Zuru, 2013). Chemistry is the catalyst of stable national growth and development. Chemistry education is a vehicle through which chemical knowledge and skills reach the people who are in the need of capacities and potentials for growth and development, it also addresses the social objective of substances development, as education is now the primary means for empowerment, participation cultural preservation, social mobility and equity (Emmanuel, 2013).

According to Ezeagwu (2013), even the present developed nations like America, Britain, Germany, Japan and France, were more or less underdeveloped at a certain stage in their history as the developed nations of today. They are now transformed from rural, peasant communities into highly urbanized, industrialized countries through the development of science and technology (chemistry). Ezeagwu (2013), further added that these developed nations have become rich and politically powerful today, noting that for Nigeria to develop like other advanced nations, she must develop scientifically and technologically. Though, Nigeria as a developing nation is also aware that chemistry is the vehicle for socio-economic development, she lacks the foundation necessary to develop chemistry which is potential in real terms. Nigeria lacks this foundation because of increased quest for material wealth by her populace. This behaviour does not favour the spirit of productivity and utilization of scare resource which leads to inhibition of scientific and economic development of a nation.

This paper therefore gives an overview of the following questions:

- i What is the nature of Nigerian economy?
- ii What are the benefits of chemistry education?
- iii How can the benefits of chemistry education be maximize for the benefit of Nigerian?
- iv What are the challenges in chemistry education?
- V What are the strategies for the improvement of chemistry education for economic growth, development and stability of Nigeria?

### **THE NATURE OF NIGERIA ECONOMY**

The economy of Nigeria is a middle-income, mixed economy and emerging market, with expanding manufacturing, financial service, communications, and technology and entertainment sectors. It is ranked as the 27<sup>th</sup> largest economy in the world in terms of nominal GDP and the 22<sup>nd</sup> largest in terms of purchasing power parity. Nigeria has the largest economy in Africa; its re-emergent manufacturing sectors became the largest on the continent in 2013, and it produces a large proportion of goods and services for the West African subcontinent. (Manufacturing sector Report, 2015). In addition, the debt to GDP ratio is 16.075 percent as of 2019 previously hindered by years of this management; economic reforms of the past decade have put Nigeria back on track towards achieving its full economic potential

**Petroleum:** Although oil revenues contribute two-third of state revenues. Oil only contributes about 9% to the GDP. Nigeria produces only about 2.7% of the world's oil supply (in comparison, Saudi Arabia produces 12.9%, Russia produces 12.7% and the United States produces 8.6%. Although the petroleum sector is important, as government revenues still heavily rely on this sector, it remains a small part of the country's overall economy. This oil and gas sector continue to drive the economy with average growth of about 8.0% compared to -0.35% for the non-oil sectors. Agriculture and the oil sectors b continues to dominate the economic activities in Nigeria, it also asserts that the outlook for economic growth remains positive.

**Agriculture:** This has not kept up with rapid population growth, and Nigeria, once a large net exporter, now imports food. Agriculture has suffered a relative decline because of the dominance of oil in the economy but it still accounts for about a third of GDP and provides employment for a large majority of the population. Agriculture is mainly dominated by traditional small house holders raising subsistence crops. In Nigeria, recently, poultry farming and fish farming are rapidly increasing (Marines & Ehul, 2013).

### **BENEFITS OF CHEMISTRY EDUCATION**

1. Chemistry being a course that touches the lives of the citizenry trough utilization of industrial products in agriculture, oil and gas sector, medicine, house hold cooking and cleansing materials, building, road constructions among others could provide various job opportunities to the unemployed graduates with the basic skills needed in production using available local materials and could therefore serve as an avenue for economic growth, development and stability in the country. chemistry have cut across almost all fields of human endeavours and could therefore be utilized to meet the needs and aspirations of the teaming unemployed graduates in the area of job creation and improvement of the economy of the nation through their innovation and creativity, since there are abundant opportunities which include the following(Dahiru, 2010):
2. Insecticides and pesticides production from local raw materials like neem tree seeds, sweet pepper and other plant materials used in grain storage, etc. Chemical knowledge foundation could greatly assist on the search for more plants materials to be used as insecticides, herbicides, pesticides e.t.c for boosting agricultural production and storage.
3. Enhancement of increase food production through sourcing of composts manure, production of fertilizer from local raw material that is common around us.
4. In water treatment, use of Maringa seeds in place if alum and other plant materials as coagulant exploits chemical knowledge to solve the problem of turbidity in drinking water.



5. In leather works and dyeing, some plant materials such as chlorophyll backs and stems are used to formulate the colours used in dyeing clothes and tanning leather.
6. In soap/liquid soap/detergent production and perfumery, chemical knowledge provides the basic skills that enable the production of all listed above in large and small quantities.
7. Environmental chemistry knowledge could offer the information regarding the hazards of some chemicals to human health, the release of which should be safe guarded/minimized e.g. old batteries both wet and dry smoke from exhaust chimneys e.t.c. The use of iron scraps, old plastics, iron materials, tin can, polythenes e.t.c for recycling and reuse also provide jobs is self reliant individuals which could also be of benefits to Nigeria economy.

### **MAXIMISING THE IMPACT OF CHEMISTRY EDUCATION FOR THE BENEFIT OF NIGERIA**

This requires the efforts of the government and publicly funded multidisciplinary teams of scientists and high levels of collaboration between chemistry educators, academia and industry, thus:

1. In the process of research, discovery and innovation, chemistry works in tandem with other science disciplines including Physics, biology, biotechnology and material science.
2. Collaborative and strategic partnerships between academia and industry are crucial to enhance the three-way flow of knowledge between chemistry educators, academic and industry. They accelerate the speed with which new products can get to market, and thus help assure Nigeria's has "first more advantage".
3. Conducting fundamental research is both costly and risky. The benefits from research often translate into impact only years or even decade later; they are also rarely confined to the form or research institution conducting the original research (even in the presence of patents) but instead spill over the society at large. For these reasons private sector investment in fundamental chemistry research will be sub-optimal for the economy as a whole. This is often referred to as market failure and justifies continued support from the public purse

### **CHALLENGES OF CHEMISTRY EDUCATION FOR ECONOMIC GROWTH, DEVELOPMENT AND STABILITY IN NIGERIA.**

Chemistry education has been seen, perceived and considered as vital input into the scientific and technological capability of any country all over the world. It is said that there is no country that rises above its advancement in science and technology. In Nigeria today there are a number of factors that militate against science and economic growth, development and stability. This is because Nigeria faces much challenge relating to good governance, economic growth, development, power supply, public health and education from primary to university level. This can be observed as being true of Nigeria (Anna, 2014). The electricity situation in the country has gone from bad to worse with many parts of the country being thrown into total or near-total black out (Akpihi & Idoko, 2009). They stressed that this has been identified as a major constraint to industrialization in Nigeria. Nigeria is currently generating below 3000 MW. Other factors as mentioned by US Envoy McCulley (2013) include "get-rich quick syndrome," religious intolerance and youth restrictiveness- yet, other factors include;

- i. **LIMITED TECHNOLOGY CAPACITY:** it is apparent that for a country, person or nation to become successful in this modern world, technology must be incorporated into the improvement process. It has been observed that Nigeria lacks a critical number of qualified technologists, scientist and engineers who will take advantage of scientific and technological advance [Daniel, 2013].
- ii. **POOR ECONOMY:** According to Daniel (2013) due to the reluctance of adopting technology in Nigeria, there is a slow change in other economic structures since independency. He further observed that most African nations, including Nigeria, rely heavily exporting various raw materials like gold, bauxite, diamonds, cocoa, timber, petroleum among others, all in raw forms without any-degree of processing the raw materials in order to add value of them before exportation so as it earn more money on the

global market . Akpihi and Idoko (2009) in Agbiye and Abolio (2014) observed that Nigeria is yet to develop industrially because of over reliance on oil which is a non-renewable resource. Daniel(2013) also point out that of African nations especially Nigeria, import matches, tooth picks, computers, toys and other industrial products abroad, what it means is that Nigeria does not have the capacity and ability to manufacture such things. Nigeria is blessed with many natural resources on which her economy rest upon; however over dependent on petroleum has seriously affected the economy. The effect is on chemistry education since chemistry equipment and apparatus are inadequate in the country and the cost of importing these materials is high because of the exchange rate. According to (Babatunde, 2013), all efforts to shift focus of economy from oil industry to other economic activities have not yielded positive result because of corruption. Science teachers' salary general and other allowances are not paid. Chemistry equipment are not supplied due to declining in output and slow economic growth because of labour distortion redundancy of the work force, brain drain among others (Ndiyo, 2013)

- iii. **LACK OF EDUCATION:** the education sector in Nigeria today has seen under a threat due to incessant strike actions. Being embarked on by the academic and non-academic staff of all levels of our educational institutions (Akpihi&Idoko, (2009). These strikes have almost paralyzed the educational system especially the calendar making everything to be in a rush peradventure the strike is called off, causing sciences especially chemistry and economic set back in Nigeria. It is also believed that educational vital tool for development individuals, country, nation as it promotes entrepreneurship and also creates a highly skill work force. Daniel (2013) emphasized that only quality education can give the African (Nigerian) populace the correct skills and knowledge to create and manufacture things. This implies that the current education offered in Nigeria has not enabled our student, teachers and lecturers to produce anything of worth.
- iv. **POOR SUPPLY OF ELECTRICITY:** the epileptic supply of electricity in Nigeria today has been the major factor militating against economic growth, development, any stability in Nigeria, industrialization and entrepreneurship in Nigeria requires regular power supply. Based on this, Akpihi and Idoko in Agbidy and Aboho, 2014 observed that due to poor power supply, entrepreneurs, industrialist resort to the use of plants for production while those who cannot afford it simply fold up .this has lead to high cost of production capacity under utilization of skills and that of most industries in Nigeria.
- v. **FUNDING:** Chemistry education in fact, science education and technology as a whole is the engine room for the development of any economy growth, development and stability of every nation (Itua, 2011). Itua documented that most countries commit as high as two percent of their gross domestic product (GDP) to science and technology research, growth development and innovation and stability but what Nigeria commit is about 0.1 percent which is too small to write home about. This means the low level of economic growth and development and stability in Nigeria can be attributed to the ministry of science and technology in Nigeria cannot boast of any technology that has been developed locally under its auspices with the federal allocation they get annually. Itua further lamented that the engineers from Nigerian schools are worse than road side mechanics.
- vi. **Security:** Security issue in Nigeria has been worrisome for more than two years now because of insurgence in Niger Delta, Boko Haram, kidnappers and herdsmen as averred by Horsfall (2018), stretching the averment further, the former is politically motivated while the latter are religiously motivated, fight for settlement and pasture ground: the reason for the insurgence is trivial to this paper but the effects on chemistry education development is very genuine. People in Nigeria live in fear of uncertainty of death from bomb explosion: of gunshot from terrorist or armed robber and many a time from kidnappers. Lecturers, teachers and student do not know their fate every day until they retired to bed at night: even while sleeping they cannot sleep and close their two eyes because of armed robbers. The recent attack on a northern university where students and lecturers were cold blooded murdered

including a professor of chemistry still remains an insomnia in academic arena. Science infrastructures built with huge amount of money for schools had been destroyed while gas and oil installations vandalised; the resultant effects of these is on education, many parents lost their jobs and the effects is on the children schools were closed down as in many parts of the country: universities, polytechnics, colleges, secondary and primary schools where learning environment are no longer safe for learning some remained under key and lock and some in long compulsory holiday for months.

- vii. **Corruption:**Corruption has eating deep into Nigeria system and it is manifesting in every sectors including education in Nigeria, it is not what you have but who you know. (Mton 2017) said recruitment for job is tied down to criteria such as political favouritism but not base on capability and competency , many of the teacher training institutions and universities cannot boast of the best academic staff because the best capable hands do not have godfather who can help them (Aina 2013)
- viii. **Political:**Nigeria has not been having a stable political system of government since her independence in 1960. Stable political system of government is very essential to educational development of any nation (Okebukola, 2014). Military ruled for 34 years in Nigeria out of 59 years of existence as a sovereign nation: these years can be regarded as an era of colossus waste in both human and natural resources for Nigerians. These leaders have no regard for education but concentrate on establishing their government for long years. The civilian rule has been years of lack of focus: yearly budget of Nigeria government revealed lack of focus and insincerity to good and quality education (Akindutirs 2016). The allocation to education in 2009 was 7.25 %, 2010 was 4.83%, 2011 was 6.16 %, 2012 was 8.20 %, 2013 was 8.55%, 2014 was 9.94%, 2015 was 7.74%, 2016 was 6.10%, 2017 was 7.38%, then 2018 was 7.03%,2019 was 7.02% and 2020 is 6.7% which shows the overall average percentage of 7.07% for 12 years. The figure did not show government commitment to education.
- ix. **Teachers:** Chemistry teachers are key factors to be considered when talking about the development of chemistry education in any nation. There are shortages of qualified chemistry teachers in Nigeria schools. So called chemistry teachers are not professionally qualified. They may have the knowledge of the subject but lack the method (Aina, 2013) on his study of challenges and prospects of primary science teaching affirmed that there are unqualified chemistry teachers in our schools. Attitude of many teachers to teaching are discouraging: they have been teaching for many years.

### **STRATEGIES FOR IMPROVEMENT OF CHEMISTRY EDUCATION FOR ECONOMIC GROWTH, DEVELOPMENT AND STABILITY IN NIGERIA.**

The strategies for addressing the challenges of chemistry education for economic growth development and stability in Nigeria can be:

- i. Establishing a sound workable program of man power training, capacity building and development that will ensure regular updating of skills.
- ii. Ensuring adequate provision of infrastructure, laboratory facilities for effective teaching and learning.
- iii. Constant review of chemistry curriculum it meets the challenges and demand of the nation industrial and or entrepreneurial development
- iv. Involvement of chemistry teachers in the education and industrial entrepreneurial development.
- v. Proper funding and increase in the salary and allowance of chemistry teachers serves as motivation.
- vi. Government and private sections should look back on other source of revenue generation trough creating rooms and improving our local innovations and creativities by sponsoring science exhibition and fun fairs

### **CONCLUSION AND RECOMMENDATIONS**

In the light of the above review it is obvious that chemistry education is very important to Nigeria economic growth, development and stability: insecurity, over dependence on oil and gas, corruption, lack of funding, politics, epileptic power supply, constant strikes, unqualified teachers factors, government laxity towards education e.t.c are our major challenges in achieving and improving the economy of our nation. For Nigeria to move forward economically, she must consciously agree to invest in chemistry education and in science and technology generally. The oil sector has done a lot for the Nigeria economy but needs to divert into other areas such as agriculture, medicine, entrepreneurship among others. Then we will be hitting the nail on the head at right angle.

In order to properly harness the contributions that chemistry education can contribute to the growth, development and stability of Nigeria. The following recommendations have been made:

- i. There is need to divert the Nigeria economy into a non-oil sector. For instance, the agricultural sector and medicine according to Abraham(2012), the neem tree, moringa tree e.t.c are impacting the economy of India and other countries; yet Nigeria is endowed with a lot of neem and moringa trees with great potential yet to be tapped.
- ii. Nigeria needs to have a re-think on the budgetary allocation of her ministry of science and technology and that of ministry of education. Research institutions, entrepreneurship centres, science primary and secondary schools and facilities of sciences and technology education in tertiary institutions in other to establish a sound and quality scientific base for technological growth and development. Without proper funding, no meaningful economic growth, development and stability will ever take place.
- iii. Chemistry education and all other science and technology teachers should be encouraged and motivated by organizing workshops for them to update their knowledge by giving them good incentives such as science teachers allowance and other rewards to enable their produce good results.
- iv. The proper sector must be improved upon if industries and scientific research must flourish and produce good result. Scientific research, entrepreneurship centers, and scientific industries depend on adequate, cheap and constant power supply to produce goods and services.
- v. Entrepreneurial courses should be introduced at primary, secondary and tertiary levels in other to encourage graduates to be self reliant and productive. this would promote economic growth and stability in Nigeria.
- vi. Greater emphasis should be placed on chemistry education because every country that wants to be developed must cultivate the science culture in her populace especially chemistry in her populace so as to have proper and requisites foundation on which to develop our science and technology which will in turn develop and create stability in the Nigerian economy.

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## **IMPACT OF TECHNOLOGY TOOLS ON STUDENTS' INTEREST IN BIOLOGY: A SURVEY IN JOS NORTH, PLATEAU STATE, NIGERIA**

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### **Abstract**

*This study investigates the impact of technology tools on Plateau State Secondary school students' interest in Biology. The method used for the study was descriptive survey. Three hundred Biology students were selected from the Senior Secondary schools in Jos north, Plateau State. Population sample of 300 students and two research questions were set for data collection. Data was collected using questionnaire designed by the researcher. The data collected was analysed using simple Likert scale descriptive statistics. Findings revealed that if students make use of technological tools*

*for learning in secondary schools, it had positive influence on their interest in learning Biology but technology tools for learning Biology are scarce. The study concluded that few students use technological devices in learning Biology in Senior Secondary schools and these technology tools influence students' interest in learning Biology. Based on the findings, the study recommends that government and other stakeholders in Biology education should provide support for the use of modern technological tools by the Biology teacher during the teaching and learning process in schools to enhance interest in Biology and in turn lead to National development.*

**Keywords:** Technology, education, teaching and learning, Biology.

## INTRODUCTION

Technological tools are devices used in teaching and learning which could be electronic, digital or physical tools such as an interactive whiteboard, email, or the Internet. The use of technological tools encourages interaction and participation, stimulate thought with application and synthesis. Science is a systematic acquisition of organized knowledge about the natural and physical world which is established in form of predictions, observations and experimentations, without which a nation's technological advancement becomes almost impossible. Biology is a Science subject that deals with the study of life that explains the structure, function, development and existence of living things, while also providing justifications for their reactions with the environment within which they exist, (Umar, 2011). The study of Biology provides an ideal preparation for future careers in the area of science, engineering and even in space exploration and rapid growth of biological knowledge for prominence among the sciences. For this reason, biologists are realizing that their responsibilities have changed, as modern technological tools are redefining Biology, teachers are looking for ways to pique students' interest. With new trend in information technologies, the biology teacher has to ensure that she/he is current in the content matter, method and technological devices. The objectives of the Senior Secondary School Biology curriculum offered in Nigerian is supposed to preparing students for the acquisition of adequate laboratory and field skills in Biology; acquire meaningful and relevant knowledge in Biology as well as acquire reasonable and functional scientific attitude (FME. 2009). Therefore, it is important for Biology students to be vast in both practical and theoretical skills as a result of the interest they develop for the subject.

Skills and competences are necessary tools needed for gaining employment in Nigerian society today as a result of the much technological advancement in this 21<sup>st</sup> century. This will bring about the needed boost for National development and desirable achievement of the goals of STEM as well. Although several students see Biology as bulky and difficult subject with which there is a decreasing focus on learning Biology at the Secondary levels (Lawler, 2016). It is difficult to break away from old pattern of teaching, there is need to present activities with new technological devices to students in a manner that excites and sustains their interests. (Bigler & Hanegan, 2011; Peterman, Pan, Robertson & Lee, 2014). However, (Cheung, et. al, 2011), discovered that the use of technology devices and its success in interest arousal was a factor of the type of technology that appeals to the students.

Inactive teaching methods and the use of textbooks are fast becoming obsolete and are replaced with the use of modern technology which is more likely to increase students' interest, motivation and achievement. Mobile and electronic-learning have transformed the traditional learning context from classroom to a virtual space (Gikas & Grant, 2013). Despite a significantly high presence of mobile devices, computers and interactive technologies in today's classrooms, teachers still lack the required skills and knowledge regarding how to integrate these technologies into the curricula (Ogwu & Ogwu, 2010). Modern technological devices if used could help students solve problems and provide solutions to the problems in the learning process. Knowledge acquisition becomes more accessible, and concepts in learning areas are understood while engaging students in the application of technology tools. The use of Modern technology tools is a student-

cantered and self-directed learning, (.Ndudi and Chinedu, 2016) asserted that despite the widely advocated benefits of implementing technology-based teaching/learning activities, hindrances still prevent the use of technology in science classrooms by teachers and students.

Importance of modern technology cannot be over stressed since its use and applications will help prepare students for their future careers, connect students with all learning styles, encourage collaboration with students and teachers, develop student's digital citizenship skills, helps students stay engaged since today's classrooms are aligned with the way students prefer learning, enhance the learning experience and create new opportunities, access the most up-to-date information quicker and easier than ever before, traditional passive learning model is broken with the teacher becoming the encourager, adviser, and coach, helps students be more responsible and also the learning experience is been transformed where students become more creative and more connected. The future of education is already here and any schools missing out in an unbelievable amount of opportunities will be those without or with inadequate modern technological devices. Network infrastructure is up-to-date and/or sufficient enough to properly support their end-users. The modern technology tools available for teaching and learning today in Nigerian classrooms requires adequate training for teacher's effective utilisation in order for students to get the benefits accrue to it. Modern technological tools, such as an interactive whiteboard, email, or the Internet requires proper planning for adequate integrate technology into their classrooms since it could be time consuming and misused. This in turn is capable of increasing motivation, interest and academic achievement. Therefore, this study sets out to investigate the impact of modern technology tools on students' interest in biology with reference to senior secondary schools in Plateau State, Nigeria.

## **STATEMENT OF THE PROBLEM**

In spite of the importance of modern technology in the development of interest in the study of Biology, students are taught the concept of Biology in abstraction. Based on this the researcher investigated the impact of the use of technological devices in the teaching and learning of Biology in Jos North Local Government area of Plateau State.

## **PURPOSE OF THE STUDY**

The main purpose of the study was to determine the impact of modern technological devices on interest of Senior Secondary School students in Jos North Local Government area of Plateau State. Specifically, the study sort to:

1. determine the extent of Students' Usage of Modern Technology Tools in Learning Biology in public senior Secondary Schools in Plateau State.
2. Determine the extent to which technological tools influence Students' Interest in the study of Biology in public secondary Schools in Plateau State.

## **RESEARCH QUESTIONS**

1. What is the extent Students' Usage of Modern Technology Tools in Learning Biology in public Senior Secondary Schools in Plateau State?
2. To what extent does the use of modern technological tools influence Senior Secondary Schools Students' Interest in the study of Biology.

## **METHODOLOGY**

In other to examine the impact of modern technology tools on public Senior Secondary school students' interest in Biology in Plateau State, a survey research design was adopted, Only one category of respondent and random sampling technique was used for selection of schools sampled while Stratified sampling technique was used to obtain the Biology students sample in Public Secondary schools. The sample schools were the six public Secondary schools in Jos North, Plateau State, Nigeria. Thirty (30) Biology students were selected from each school making a total of 300 hundred respondents.

The research instrument adopted for this study was a self-designed questionnaire titled “Impact of technology tools on Jos North, Plateau State Senior Secondary school students’ interest in Biology” The questionnaire was segregated into two (2) sections A and B. Section A was demographic in nature eliciting information on the personal data of the respondents such as name of school. Section B consists of four (2) parts of thirteen (13) items (6 and 6 respectively) of Modified Likert rating scale Modified Likert rating scale was used as Strongly Agreed (SA-4), Agreed(A-3), Strongly Disagreed (SD-2) and Disagreed (D-1) to get respondents views on each item.

The drafted copy of the questionnaire was validated by expert in Biology and test and measurement. The reliability of the research instrument used was determined using test-retest method of reliability test to determine its internal and external consistency(check). A reliability value of 0.758 was obtained and the instrument was considered suitable for the study.The researchers personally visited the sampled Schools and obtained permission from the schools’ authority, administered the questionnaire to the respondents and collected completed questionnaires on the spot. Data were analysed using frequency count, mean and ranks.

## **RESULTS**

### **Research Question one:**

What is the extent Students’ Usage of Modern Technology Tools in Learning Biology in Plateau State public senior Secondary Schools?



**Table 1: Extent of students' usage of Technological Tools in Learning Biology.**

S/N	ITEMS	SA	A	DS	D	N	εFX	M	RANKING
1.	I have not been using technology tools, for learning biology at all	44	79	98	79	300	688	2.29	7 <sup>TH</sup>
2.	I make the use of technology tools for learning biology in a while	55	107	85	53	300	764	2.55	4 <sup>TH</sup>
3.	I am frequent in the use of technology tools in learning biology	63	100	78	59	300	767	2.56	3 <sup>RD</sup>
4.	Technology tools can only be used for learning specific topics in biology	65	71	100	64	300	737	2.46	5 <sup>TH</sup>
5.	Technology tools for learning biology is not available in my school	94	70	88	48	300	810	2.70	1 <sup>ST</sup>
6.	My teachers do not make use of technology tools while teaching biology	81	86	56	77	300	771	2.57	2 <sup>ND</sup>
7.	Use of technology tools which plateau state school environment is unrealistic.	63	73	86	75	300	718	2.39	6 <sup>TH</sup>

Table 1 shows students' usage of technology tools in learning Biology in Jos North, Plateau State Senior Secondary schools. Ranking 1<sup>ST</sup> is lack of accessible technological tools for used technology tools for use in learning Biology, next ranking 2<sup>ND</sup> and 3<sup>RD</sup> is the frequencies at which teachers and students make use of technology in learning Biology in Jos North, Plateau State. 4<sup>TH</sup> ranking is the use of technology in learning in just a while, 5<sup>TH</sup> shows the believe that technological tools can only be used for learning some biology topics. Ranking 6<sup>TH</sup> is the view that technological tools can be used in Plateau in teaching biology. Ranking 7<sup>TH</sup> is the view that students in Jos North, senior secondary school are novice in the use of Technology totally.

## Research Question 2

To what extent does the use of modern technological tools influence Senior Secondary School Students' Interest in the study of Biology.

**Table 2: Plateau State Secondary School Students' Interest in Biology with the use of Technology Tools.**

S/N	ITEMS	SA	A	DS	D	εFX	N	M	RANKING
1.	I get more interested in learning biology using technology tools.	13	107	45	18	859	300	2.86	1 <sup>ST</sup>
2.	I get more confused while using technology tools to learn biology	24	72	119	83	633	300	2.11	4 <sup>TH</sup>
3.	Using technology tools for learning biology makes no difference	43	67	115	78	681	300	2.27	3 <sup>RD</sup>
4.	Learning biology is more encouraging without employing technology tools.	85	86	76	53	803	300	2.68	2 <sup>ND</sup>
5.	Technology tools for learning biology is time wasting	22	37	119	122	559	300	1.86	6 <sup>TH</sup>
6.	My teachers dislike the use of technological tools	31	37	109	123	576	300	1.92	5 <sup>TH</sup>

Table 2 shows Plateau State senior secondary school students find Biology more interesting with the use of technology tools with the 1<sup>ST</sup> rank and the 2<sup>ND</sup> show that they students are more encouraged in learning Biology using technology tools. Learning Biology to some makes no difference possible for lack of continuity. Teachers like using technology to teach but they are not available at the 5<sup>TH</sup> yet the challenge of using technology in teaching biology could be time consuming.

## DISCUSSION

The findings of this study revealed that majority of respondents agree that students do not frequently use technology tools in learning Biology which does not agrees with the studies of both Gikas and Grant (2013) who opined that modern technology tools are used by students to solve problems, provide solutions to the problems in the learning process and that it makes knowledge acquisition more accessible, and concepts in learning areas are understood while engaging students in the application of technology tools.

Also, some students find learning Biology more interesting with the use of technology tools, which concur with Spornjak, Puhek, & Sorgo (2010) whose research study indicated that the use of technology tools for learning increase student's engagement, interest, motivation and satisfaction in learning Biology and other science subjects. On the contrary, Cheung, Yen & Tsang (2011) stated that secondary school students don't necessarily find the learning of Biology like other subjects more interesting with the use of technology tools except for the particular technology tools which they find acceptable.

The challenge of using technology is its scarcity for the learning of Biology, that in spite of the widely advocated benefits of implementing technology-based teaching/learning activities, there are obstacles preventing teachers and students from using technology in their classrooms and thus its application in Nigerian senior secondary schools is still low. The lecture method is still gaining its popularity in our senior secondary schools today.

## CONCLUSIONS

From the findings of this study, it was concluded that few students make use of technology tools in learning Biology in high schools and these technology tools influence students' interest in learning Biology. Scarcity of technology tools are found in secondary schools.

### Recommendations.

1. Need for senior secondary school students to be encouraged in utilizing technology tools for learning Biology so as to boost their interest in the subject.
2. Relevant stakeholders in the education sector should find a lasting solution to scarcity of technology and give teacher education with constant use of technological tools for grooming of the teachers.

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**STUDENTS' PERCEPTIONS OF THE IMPACT OF TEAM TEACHING  
IMPLEMENTATION ON STUDENTS LEARNING IN TERTIARY INSTITUTIONS IN  
IMO STATE**

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***Abstract***

*This study investigates students' perceptions of the impact of team teaching implementation on students' learning in tertiary institutions in Imo State. Descriptive survey design was used. The population of the study is 668 (six hundred and sixty eight) third year degree regular students of the faculty of education IMSU and school of natural science AIFCE Owerri. The sample size used comprised 252 of which 134 students from IMSU and 118 students from AIFCE were selected using stratified random sampling technique. Four (4) research questions guided the study. A 4-point rating scale questionnaire consisting of 24 items was used to collect data from students after being validated by two expert of Measurement and Evaluation from the College. A reliability index of 0.68 was obtained using Cronbach alpha method. Data collected were analyzed using mean and standard deviation. The result generally showed that evaluation done by team teachers is effective, team teachers participated actively during team teaching, and that team teaching impacted greatly on students' learning. The result also showed that the quality of teaching done in team teaching is relatively low in tertiary institutions in Imo State. It was recommended among others that government should provide enough funds for the sustenance of team teaching in tertiary institutions in Imo State.*

**Keywords:** perception, impact, team teaching, implementation, students' learning.

**Introduction**

Tertiary Education plays a very important role in the realization of the economic and social development of any nation. Oyedele (2009) (as cited in Osuala, Onwuagboke and Chukwudebelu, 2015) observed that in today's lifelong learning frame work, tertiary education provides not only high level skilled man-power necessary for every market but also the training essential for teachers, doctors, nurses, civil servants, engineers, scientists and other important personnel. These trained individuals that help to develop every sector of the economy and make important decisions which affect entire society. For tertiary education in Nigeria to play the stated role, attention must be paid to the effective implementation of tertiary education programmes and policies. For a learner to grasp any segment of knowledge, effective instructional techniques are vital.

Team- teaching is one of the vital instructional techniques which its effective implementation helps in making student' learning permanent. This instructional technique is defined as working together of two or more teachers each with distinctive roles, sharing responsibilities for planning, presentation and evaluation of lessons for the same group of students (Esomonu, Akudolu and Ezenwosu, 2015). It is an approach, according to Main and Brye (2006) where two or more teachers

combine their talents, expertise, interest and resources to take joint responsibility for any or all aspects of teaching the same students. Team teaching involves a group of teachers continually planning, presenting and evaluating the learning activities for the same group of students (Carpenters, Crawford and Walden, 2007). Thus, it is an approach which involves true team-work between two or more qualified instructors who together make presentations to an audience.

According to Nweke (2004), team-teaching implies the cohesive grouping of teachers for the purpose of consulting or conducting a teaching assignment. According to him, the objectives of team teaching in curriculum implementation are to: utilize better talent and interest in teachers, enhance the equality of instruction and increase grouping and scheduled flexibility. Anderson and Landy (2006) highlighted some of the merits of team teaching to include the following: Evaluation done by teachers is more insightful and balanced than the one done by an individual teacher; leads students to more, academic activities than the single teacher method and improves the quality of teaching and learning as various experts approach a topic from different angles.

McDaniel and Colarrulli (1997) states that one of the core learning advantages of team teaching is that it gives students opportunities to obtain multiple perceptive on the same topic.

In team teaching, problems are defined clearly; there is time for brainstorming alternatives for actions. In practice, team-working has many different formats but in general, it is a means of organizing staff members who may represent different areas of subject expertise but who share the same group of students and common planning period to prepare for teaching (Centre for the enhancement of teaching and learning 1998) (as cited in Akpan, Usoro, Akpan and Ekpo, 2010).. Effective team teaching requires a re-orientation on the part of the individual staff and departmental administration. Quin and Kanter (as cited in Akpan et al, 2010) were of the view that since team teaching requires group of experts, there must be corresponding increase in the provision of funds to keep the teachers, effective team teaching may be impeded if the institution lacks sufficient money.

For team teaching to achieve success, it depends on three conditions, namely: If teachers possess or supported to develop appropriate skills; there is time for the implementation of team teaching and the existence of appropriate administration and management support (Nunan, 1997).

The vision of tertiary institution is to extend higher education to all qualified persons to promote academic pursuits to the highest possible standards and to encourage the advancement of learners through teaching and research. For tertiary institution to effectively achieve the afore-stated; vision and mission statements, their academic staff need to effectively adopt and utilize appropriate teaching approaches. These teaching approaches should be varied from time to time in order to meet with the changing demands of tertiary institutions, hence the implementation of the team teaching approach. Team teaching exposes students to a variety of teaching styles and approaches, which increases the potential for the team to meet the various learning styles of students. However, while team teaching may prove advantageous for many students, some may feel frustration and discontentment about more than one teacher following the adage that "Too many cooks spoil the broth." The combination of different lecturers to generate conflicting ideas may end up confusing the students instead of clarifying their ignorance (Anderson and Landy, 2006).

Teaching can be counter-productive following the adage that "Too many cooks spoil the broth". The combination of different lectures to generate conflicting ideas may end up confusing the students instead of clarifying their ignorance. (Anderson and Landy, 2006). In order to investigate the impact of implementing team in tertiary institution in Imo State, there is the need to find out from the students, how they perceive the implementation as the recipients of the teaching approach, because he wears the shoe knows where it pinches. Therefore, this study investigated students perception of the impact of team teaching implementation on students learning in tertiary institutions in Owerri, Imo State.

### **Purpose of the Study**

The purpose of this study was to investigate student' perception of the impact of team teaching implementation on students' learning in tertiary institutions in Imo State. Specifically, this study sought to find out students perception of:

1. Impact of evaluation done by teachers engaged in team teaching
2. The level of participation of team teachers in classroom activities.
3. The quality of teaching done in team teaching?
4. The impact of team teaching on students' learning

### Research Question

The following four research questions guided the study.

1. What are students' perception of the impact of evaluation done by teachers engaged in team teaching?
2. What are students' perception of the level of participation of team teachers in classroom activities?
3. What are students' perception of the quality of teaching done in team teaching?
4. What are students' perception of the impact of team teaching on their learning?

### Methods

A descriptive survey design was employed. A purposive sampling technique was used to select third year degree students from the faculty of education, Imo State University (IMSU), Owerri and school of natural science Alvan Ikoku Federal College of Education (AIFCE), Owerri. Three departments each of the faculty of education IMSU and school of natural science AIFCE have the populations of four hundred and twenty (420) and two hundred and forty-eight (248) students respectively. Out of these populations, one hundred and thirty-four (134) students and one hundred and eighteen (118) students respectively were selected from the faculty of education IMSU and school of natural science AIFCE Owerri. The sample size is two hundred and fifty-two (252) which is 47% each of the population of the faculty and school of the Tertiary Institutions under study. The researchers designed a 24-item 4-point rating type questionnaire titled Students Perception of the Impact of Team Teaching Implementation ("SPITTI"). The instrument contained four response options of strongly agreed (SA), Agree (A), Disagree (D) and strongly disagree (SD) weighed 4, 3, 2 and 1 respectively for positively skewed items and the reverse weights for negatively skewed items. Two experts from Measurement and Evaluation validated the instrument. A reliability index of 0.68 was obtained using Cronbach alpha method. Copies of the questionnaire were administered to the respondents by the researchers. The data collected were analyzed using mean standard deviation. Items having mean values of 2.5 and above were considered as having impact on the learning of the students of the institutions under study. A mean value below 2.5 was not considered.

### The Results of Data Analysis

**Research Question 1:** What are students' perception of evaluation done by teachers engaged in team teaching?

**Table 1:** Showing students' perception of evaluation done by team teachers

S/N	Item statement	SA	A	D	SD	N	X	S/D	Decision
1	Evaluation is done by team teachers who teach same topics to the same group of students		12 (48)	140 (420)	30 (60)	70 (70)	252 (598)	2.4	Not considered

2	Evaluations done by two or more teachers are more insightful and balanced	85 (340)	75 (225)	60 (120)	37 (37)	252 (722)	2.9	0.3	Considered
3	Evaluation done using assignments given to students by team teachers help students to cover enough course outlines.	86 (344)	76 (228)	60 (120)	26 (26)	252 (718)	2.8	0.2	Considered
4	Evaluation done using group presentations given to students help them involve in activity-oriented practices.	90 (360)	79 (237)	51 (102)	32 (32)	252 (731)	2.9	0.3	Considered
5	Team teachers grade students' learning using individual presentations.	29 (116)	61 (183)	77 (154)	85 (85)	252 (538)	2.1	- 0.5	Not Considered
<b>Total mean</b>							<b>13.1</b>		
<b>Grand mean</b>							<b>2.6</b>		
<b>Standard deviation</b>							<b>0.32</b>		

The result of data analysis for **table 1** revealed the following: A grand mean of 2.6 and standard deviation of 0.32 showed that evaluation done by teachers engaged in team teaching is effective. The mean values of 2.4 and 2.1 for items 1 and 5 were obtained while items 2, 3 and 4 respectively have mean values of 2.9, 2.8 and 2.9.

**Research Question 2:** What are students' perception of level of participation of team teachers in classroom activities?

**Table 2:** Showing students' perception of level of participation of team teachers in classroom activities

S/N	Item statement	SA	A	D	SD	N	X	S/D	Decision
6	Team teachers show cooperative attitude to themselves during teaching..	53 (212)	84 (252)	70 (140)	45 (45)	252 (649)	2.6	0	0 considered
7	Students-toteacher relationship is cordial during team teaching.	74 (296)	63 (189)	60 (120)	55 (55)	252 (660)	2.6	0	0 Considered
8	Team teachers give various tests during teaching.	80 (320)	87 (261)	45 (90)	40 (40)	252 (711)	2.8	0.2	0.04 Considered
9	Team teachers involve students in various assignments	78 (312)	60 (180)	50 (100)	64 (64)	252 (656)	2.6	0	0 Considered

<b>10</b>	Team teachers respond to students' questions during teaching.	72 (288)	70 (210)	55 (110)	55 (55)	252 (663)	2.6	0	Considered
Total mean							13.2		
Grand mean							2.6		
Standard deviation							0.10		

The result of data analysis for **table 2** revealed the mean values of 2.6, 2.6, 2.8, 2.6 and 2.6 respectively for items 6, 7, 8, 9 and 10. A grand mean of 2.6 and a standard deviation of 0.10 were shown. This result indicates that team teachers participate actively in classroom activities.

**Research Question 3:** What are students' perception of the quality of teaching done in team teaching?

**Table 3:** Showing students' perception of the quality of teaching done in team teaching?

S/N	Item statement	SA	A	D	SD	N	X	S/D	Decision
<b>11</b>	Teaching of students by two or more teachers lead students to more academic activities	n 80 nx(320)	65 (195)	60 (120)	47 (47)	252 (682)	2.7	0.3	Considered
<b>12</b>	Team teachers exchange ideas during teaching	46 (120)	47 (141)	70 (140)	105 (105)	252 (506)	2.0	-0.4	Not Considered
<b>13</b>	Team teachers are assigned to teach courses of their specialization	85 (340)	77 (231)	50 (100)	40 (40)	252 (711)	2.8	0.4	Considered
<b>14</b>	My school has sufficient funds to sustain team teaching approach which requires two or more experts	12 (48)	140 (420)	30 (60)	70 (70)	252 (598)	2.4	0	Not Considered
<b>15</b>	My school has sufficient qualified staff for the sustenance of team teaching.	71 (284)	89 (267)	52 (104)	40 (40)	252 (698)	2.8	0.4	Considered
<b>16</b>	Team teaching is monitored in my school.	50 (200)	47 (141)	70 (140)	85 (85)	252 (566)	2.2	0.2	Not considered
<b>17</b>	Our school has conducive classroom environment for team teaching.	39 (156)	52 (156)	71 (142)	90 (90)	252 (544)	2.1	0.4	Not considered
<b>18</b>	Team teaching improve the quality of teaching and learning as various experts approach a topic from different angles	45 (180)	50 (150)	72 (144)	85 (85)	252 (559)	2.2	-0.2	Not considered
<b>19</b>	Team teachers attend classes together and teach same topic	45 (180)	51 (153)	70 (140)	86 (86)	252 (559)	2.2	0.2	Not Considered



<b>Total mean</b>	<b>21.4</b>
<b>Grand mean</b>	<b>2.4</b>
<b>Standard deviation</b>	<b>0.29</b>

The result of data analysis for **table 3** revealed the grand mean of 2.4 and a standard deviation of 0.29 and this showed that *the quality of teaching done in team teaching is relatively low*. The mean values of 2.7, 2.8 and 2.8 respectively for items 11, 13 and 15 were obtained. Items 12, 14, 16, 17, and 18 respectively have mean values of 2.4, 2.2, 2.1 and 2.2.

**Research Question 4:** What are students' perception of the impact of team teaching on their learning?

**Table 4:** Showing students' perception of the impact of team teaching on their learning?

<b>S/N</b>	<b>Item statement</b>	<b>SA</b>	<b>A</b>	<b>D</b>	<b>SD</b>	<b>N</b>	<b>X</b>	<b>S/D</b>	<b>Decision</b>
<b>20</b>	Team teachers generate ideas that help to clarify students' ignorance	70 (280)	85 (255)	50 (100)	47 (47)	252 (682)	2.7	0.1	considered
<b>21</b>	Students are helped to apply high level of cognitive skills when two or more teachers give them difficult aspects of the course outlines as assignment	85 (340)	77 (231)	61 (122)	29 (29)	252 (722)	2.9	0.3	Considered
<b>22</b>	Team teachers involve students in practical-oriented activities which made learning permanent	50 (200)	52 (156)	80 (160)	70 (70)	252 (586)	2.3	- 0.3	Not considered
<b>23</b>	Corrections given to individual assignments by team teachers make them to be more confident of themselves.	61 (244)	50 (150)	80 (160)	61 (61)	252 (615)	2.4	- 0.2	Not considered
<b>24</b>	Both students group presentations and team teachers' feedback lead to students competence.in their area of specialization.	69 (276)	71 (213)	60 (120)	52 (52)	252 (661)	2.6	0	Considered
<b>Total mean</b>							<b>12.1</b>		
<b>Grand mean</b>							<b>2.6</b>		
<b>Standard deviation</b>							<b>0.21</b>		

The result of data analysis for **table 4** showed the mean values of 2.7, 2.9, and 2.6 respectively for items 20, 21 and 24 while items 22 and 23 have mean values of 2.3 and 2.4. The result further showed the grand mean of 2.6 and standard deviation of 0.21 indicating that team teaching impact greatly on students learning.

### Discussion of Findings

The result in table 1 showing a grand mean of 2.6 and standard deviation of 0.32 revealed that evaluation done by team teachers has great impact on the effective implementation of team teaching

in tertiary institutions in Imo State. The result revealed that students agreed that evaluation done by team teachers are insightful and balanced, evaluation done using assignments help the student to cover enough course outline and that evaluation done using group presentation help the students involved in activity-oriented practices as shown in items 2, 3, and 4 with mean values of 2.9, 2.8 and 2.9 respectively. The result of item 2 is in line with one of the merits of team teaching as highlighted by Anderson and Landy (2006) that evaluation done by two or more teachers is insightful and balanced than the one done by an individual teacher. The results of items 3 and 4 indicated that team teachers evaluation of students using assignments help them to cover enough course outline and that group presentations involve students in activity-oriented practices. This showed that team teachers use comprehensive assessment technique in evaluating students. This result is in line with the standard for continuous assessment which maintained that continuous assessment should involve the use of variety of modes of evaluation for the purposes of guiding and improving learning performances of students. (Federal Ministry of Education, science and Technology (1995). The students disagreed that grading is done using individual presentation. The result is in line with the opinion of Onyeka and Dara (2016) that any assessment that falls short of providing a full picture of the learner could be misleading and therefore any decision taken based on such information is defective. This shows that team teachers do not teach topics together and evaluation of students is done separately. The result showing that team teachers do not grade students' learning using individual presentation may be because of too much workload on individual teachers. The result of data analysis in table 2 showing the grand mean of 2.6 and standard deviation of 0.10 signified that team teachers participate actively in the classroom activities. This is revealed in items 6, 7, 8, 9 and 10 with mean values of 2.6, 2.6, 2.8, 2.6 and 2.6 respectively which are within the grand mean of 2.6. This suggests that students agreed that team teacher show co-operative attitude to themselves, there is cordial relationship between the team teachers and students and that team teachers respond to students' questions during teaching. This result shows that team teachers create enabling environment to themselves and the students, a condition that contribute to active participation of both the teachers and the students in classroom activities. The mean values of 2,8 and 2,6 of items 8 and 9 respectively indicated that students were involved in various assignments and tests during team teaching. This result is in line with the National Policy on Education (2004) which entails carrying out assessment during the course of instruction so that students can receive feedback.

The result of data analysis in table 3 indicating the grand mean of 2.4 and standard deviation of 0.29 revealed that students disagreed that team teaching improves the quality of teaching. The mean values of 2, 2.4, 2.2, 2.1, 2.2 and 2.2 for items 12, 14, 16, 17, 18 and 19 respectively are below the grand mean of 2.4. This shows that students disagreed that: team teachers exchange ideas during team teaching, their schools have sufficient fund to sustain team teaching, their school monitor team teaching, their schools have conducive classroom environment for team teaching, various experts approach a topic from different angles, team teachers attend classes and teach same topic. The results of items 14, 16 and 17 showed that the schools have insufficient funds for providing materials and equipment to sustain team teaching. This result is in line with the view of Akpan, Usoro, Akpan & Ekpo (2010) that since team teaching requires group of experts, there must be a corresponding increase in the provision of funds to keep the teachers, effective team teaching may be impeded if the institution lacks sufficient money. This is why Nunan (1997) was of the view that for team teaching to achieve success, depends on the existences of appropriate administrative and management support. The result also showing that team teachers do not exchange ideas during teaching and that they neither go to class together nor teach the same topic may be as a result of time factor which Akpan *et al* (2010) stated that for team teaching to achieve success, depends on time of implementation. This indicates that team teachers plan within themselves who will teach which topics and when to teach them. This result is against the statement of McDaniel and Colarulli (1997) that one of the core advantages of team teaching is that it gives students opportunity to obtain multiple perspectives on the same topic. The result also showed in items 11 and 15 that students agreed that they are led to more academic activities when two or more teachers teach and that their

school has sufficient staff for sustenance of team teaching. This results suggests that students are taught by the qualified teachers that led them to more academic work.

The result of data analysis in table 4 showing the grand mean of 2.6 and standard deviation of 0.21 indicate that students agreed that team teaching improve their learning. The mean values of 2.7, 2.9 and 2.6 respectively for items 20, 21 and 24, are above the grand mean of 2.6. This result suggests that: team teachers generate ideas that help students to clarify their ignorance, high level cognitive skills are applied when two or more teachers give students difficult aspects of course outlines as assignment, give group presentation to students, and that team teachers' feedback lead to students' competence in their area of specialization. Giving students difficult aspects of course outlines as assignment showed that students were led to apply high level cognitive skill which Nwana (2007) and Onuekwusi and Agoha (2015) observed as most useful in both critical analysis and divergent thoughts and activities. The mean values of 2.3 and 2.4 of items 22 and 23 are below the grand mean of 2.6. This indicates that students disagreed that team teachers involve students in individual practical work and assignments. This result showed that team teachers neither involve students in individual practical works nor assignment and as a result, denied the students the opportunity for initiative which is one of the attributes of creativity. This may be as a result of high teacher-student ratio which makes team teachers to use neither individual practical work nor assignment for assessment and feedback. This result is in line with the finding of Dara and Agoha (2018) that teachers neither mark individual assignment and give feedback on them nor give individual feedback after presentation.

### Recommendations

The result of the findings has the following recommendations

- i. Imo state tertiary institutions should provide sufficient fund for the sustenance team teaching.
- ii. School environment should be made conducive for effective teaching and learning.
- iii. Team teaching should be effectively monitored by the institutions and government

### Conclusion

It is the desire of every head of institutions that team teaching be feature of their school to meet the changing demands of tertiary institutions. To meet these demands, effective implementation of team teaching is to be sustained. Team teachers are actively participating in teaching and evaluation carried out using comprehensive assessment techniques for improving the quality of students' learning. These efforts are impeded by the administrative and management insufficient support.

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## **ANALYSIS OF AVAILABILITY OF INFORMATION AND COMMUNICATION TECHNOLOGY EQUIPMENT FOR THE TEACHING AND LEARNING OF BIOLOGY IN SENIOR SECONDARY IN JOS-NORTH, PLATEAU STATE**

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### **Abstract**

This study analyzed the availability of Information and Communication Technology (ICT) equipment in teaching and learning Biology in some selected public and private schools in Jos North Local Government Area of Plateau State so as to investigate the effect on the teaching and learning of Biology in secondary schools in Jos-North. A checklist that contains sixteen (16) ICT equipment was adopted for the study using on the survey design. The study purposively sampled twenty secondary schools that claimed to be ICT compliant out of the 202 secondary schools in Jos-North. The descriptive survey was adopted in analyzing the data collected for answering the two research questions in the study, while the data was grouped into three different categories according to the available number of ICT equipment in the sampled schools. Hence the results revealed that there is a significant difference among the schools with more and functional ICT equipment, those who have few and those that rarely have for students' use in the study area. The study also showed that higher number of schools in the study area do not have enough ICT equipment, for effective teaching and learning of Biology subject. However, the level of ICT equipment in secondary schools is at a minimum level. Conclusively, the government, school owners and Parent Teachers Associations should endeavour to provide ICT equipment, improve the training of teachers in utilizing ICT equipment through seminar, workshop and in-service training so that teaching and learning standard will improve drastically in order to achieve the objectives of National Policy on Education.

**KEYWORDS:** Information and Communication Technology (ICT), Effective Teaching /Learning Process

### **Introduction**

Information and Communication Technology (ICT) is an accepted umbrella name for diverse sets of technology and technological tools used to communicate, disseminates, store and manage information. The uses of ICT in schools by members of staff and students have become a necessity as it can be used to improve the quality of teaching and learning. Information and Communication Technology (ICT) are often spoken of in a particular context such as ICT in education, health care, or libraries. The Federal Ministry of Education (FME) of Nigeria had created her ICT department and has since been collaborating with several government agencies and other stakeholders in the private sector to initiate ICT driven projects and programmes to affect all levels of educational sector in Nigeria (Osakwe, 2012). Like every issue of development in the country, educational sector in Nigeria is struggling to access the needed technology for effective ICT driven system as a measure to ascertain academic excellence.

In this age of information explosion, one's skill in processing and distribution of data using computer hardware and software, telecommunications, and digital electronics will largely determine one's value in the work force. Computer literacy will likely have such impact on career opportunities today just as the ordinary or conventional literacy had in the past. Educational technologists have cited many reasons why education system based on ICT can effectively result in positive pedagogic outcomes than one based only on conventional techniques popularly known as talk and chalk. Throughout the evolution of ICT, it has been observed that societies that have access to ICT tools and also leverage on the availability of the ICT resources or artifacts for teaching and learning have advanced their education and development (Osakwe, 2012).

The 1990s was the decade of computer communications and information access, particularly with the popularity and accessibility of internet-based services such as electronic mail and the world wide web (www). At the same time the CD-ROM became the standard for distributing packaged

software (replacing the floppy disk, popularly known as drive 'A' and quantified as 3.5). As a result educators became more focused on the use of the technology to improve students' performance. Any discussion about the use of computer systems in schools is built upon an understanding of the link between schools, learning and computer technology. When the potential use of computers in education was first mooted, the predominant conception was that students would be taught by computers. In a sense it was considered that the computer would take over the teacher's job in the same way as a robot computer may take over a welder's job.

The effect of technology in teaching and learning is rapidly becoming one of the most important and widely discussed issues in contemporary education policy. Most experts in the field of education generally and in educational technology specifically, agreed that, when properly used, Information and Communication Technology (ICT) hold great promise to improve teaching and learning in addition to shaping work force opportunities for students.

Biology as a science subject is defined as the study of living things which include plants and animals. It is a fascinating study that ranges from microscopic-cellular molecules to the biosphere, encompassing the earth's surface and its living organisms (Sarogini, 2010). Biology used to be one of the core subjects that was mandatory for all secondary school students until it was reviewed in the year 2015. Despite that, most of the students still offer Biology in secondary schools in Nigeria as it remains a pre-requisite for the study of many courses relevant to humanity which include the following; Medicine, Pharmacy, Biochemistry, Anatomy, Physiology, Botany, Zoology, Microbiology, Cell Biology, Ecology, Entomology Immunology, Molecular Biology, Evolutionary, Genetics and population dynamic among others. Biology can be conveniently taught in a laboratory which is a place designed and equipped with materials for teaching and learning. It is obvious that most secondary schools lack physical laboratories and where they exist, there are inadequate or lack of equipment and other relevant instructional materials that are not even computer based.

In science the use of many senses appeal more to the learners and makes learning more meaningful. The use of video tapped as an ICT device appeals to the sense of sight and hearing respectively. ICT Instructional materials are usually self-explanatory and save the energy the teacher would have used in talking.

The West African Examination Council syllabus (2014-2019) states the objectives of teaching Biology as a subject in senior secondary schools as understanding of the structure and functions of living organisms as well as appreciation of nature; acquisition of adequate laboratory and field skills in order to carry out and evaluate experiments and projects in Biology; acquisition of necessary scientific skills for example observing, classifying and interpreting biological data; relevant knowledge in Biology, needed for future advanced studies in biological science; acquisition of scientific attitudes for problem solving; ability to apply biological principles in everyday life in matters that affect personal, social, environmental, community health and economic problems and awareness of the existence of interrelationships between biology and other scientific disciplines.

The above stated objectives could be achieved in students offering Biology at the end of the three-year course through the use of Information and Communication Technology (ICT) which has such advantages in teaching and learning process. However, this hinges strongly on the availability of ICT equipment, ability and capability of the available teachers to incorporate teaching strategies which uses ICT-Driven instructional aids in achieving the objectives of lesson at the classroom level.

The pattern of teaching and learning process today is expected to shift from the conventional method to a more dynamic and flexible one which is learner-centred (Ezekoka & Okoli, 2012).

This learner-centred approach makes students to influence the content, activities, materials and pace of learning, which places them in the centre of the learning process and enhances independent learning (Collins & O'Brien (2003). However, despite the glaring relevance of ICT in education, coupled with the huge capital investment of both Federal and State governments through ICT driven project known as school net and donations from Non-Governmental Organizations to Secondary schools in Nigeria, the ICT equipment seem to be a thing of mirage in Nigerian secondary schools to improve students' academic performance in general and Biology in particular.

However, the non-availability of these equipment has equally affected the teachers' prowess in the use of these gadgets. Beetheng and Sim (2008) asserted that, there is still a long way to go before secondary school teachers in developing countries like Nigeria will be able to take advantage of the opportunity provided by the 21st century technology also known as New Kind of Science (NKS) and this was substantiated by Adomi and Kpangban (2010) who reported that 75 % of teachers in Nigerian secondary schools sometimes seems to be reluctant due to their background inexperience regarding the use of ICT equipment in education.

A component of ICT in some form or the other, and to different extents, is now an integral part of the teacher education curriculum for all students, either at the diploma level (D.Ed.) or at the degree level (B.Ed.). Even master degree programme in education leading to M.Ed. degree have also started introducing a component of ICT in the curriculum. At the degree level an entire paper on ICT titled "Educational Technology and Computer education" is offered to the students. So most of the teacher training institutions are equipped with an "education technology laboratories" and a computer laboratory with some or all of the following items of essential ICT hardware and software as required by the National Council of Teachers Education (NCTE) guidelines and regulations.

Examples of such gadgets that are supposed to be in the Education Technology laboratories include Television, CD/VCD player, Audio video cassettes, Projection screen, Camera, Multimedia PC systems with monitors, hard disk drives, floppy, Drivers, UPS, Printers, Networking, Interactive board among others.

ICT simplifies the part of teaching as a visual presentation. We learn 80% of the learning through visual. So, the visual presentations of a particular Biology topic could be easily understood by the student. Pro- ICT people further argue that availability of ICT equipment and their use in school is crucial to equip students with the digital literacy skills needed for the information age, as suggested by Manuel Castells (Castells, 2010). These technologies can also be effective to improve understanding of difficult to grasp concepts, through the use of multi-modal and media representations, (Selinger, 2010).

Some of the academic achievement of the availability of ICT equipment in the teaching of Biology include faster learning in which the students still learn up to twice as much in the half time that they would in the Biology classroom teaching. This is because the course progress as fast as the students can without worry for other student or an instruction. Consistent instruction is also a plus because every instructor has his or her own style, which may not be the best for students at all times. Some days, the instructor is on top form and delivers a great class. Other day he or she may be bored, tired or simply unmotivated but with ICT, the course is software driven and each student receives the same high quality content. Students' interests are simulated in teaching and learning process when the teaching is ICT driven. There is the need to generate, arouse, motivate and maintain students' interest and if the learner's interest is properly built, learning can take place more effectively. As the availability of ICT equipment has the potentials if effectively used for regulating the place of information flows among different class of learners under the same classroom in the teaching of Biology. ICT helps address individual differences in the classroom.

Also, globally, educational systems are under great pressure to adopt innovative methodologies and to integrate Information and Communication Technologies (ICTs) in the Biology teaching and learning process. Therefore, to prepare students with the knowledge and skills they need in the 21<sup>st</sup> century, there is need to update knowledge. Today a verity of ICTs can facilitate not only delivery of instruction but also Biology learning process itself. Exercising sound reasoning in understanding and making complex choices, understanding the interconnections among systems problem identification, formulation and solution, ability to frame, analyze and solve problems all require Critical thinking and systems thinking which is made simple through the use of ICT equipment. ICT instructional aid if properly used allow for a flow and transmission of idea from the Biology teacher to the students and likewise from the students to the Biology teachers or from one group to another. The learner will be able to see, touch, smell what is been talked about by the Biology teacher and be curious to ask questions that would be very helpful for effective evaluation (formative) of the teacher and instructions on subject matter which all amount to effective communication.

Moreover, the need for actual classroom is not really necessary because through ICT learning there is no actual classroom, no teacher or no textbooks, but it gives the impression of studying in a classroom. ICT means no travel, no schedule conflicts, no equipment issues, consistent instruction, higher retention and less money than instructor-led-training which leads to incredible saving of time and money.

In most secondary schools, the conventional instructional delivery approach of teaching is in vogue. This has constantly led to poor performance of students in the Senior Secondary School Certificate Examination. The secondary schools in Jos North area of Plateau State are no exception to this unfortunate circumstance. The downward review of cut-off marks of JAMB for admission into tertiary institutions especially universities from 180 at as 2016 to 120 in 2017 is a pointer to the fact that students' academic performance is not encouraging and researchers need to find out why and the way forward. There could be many reasons responsible for these students' poor performances, but certainly one of these reasons could be the teaching style or method which is conventionally done. That is, the use of talk and chalk method of teaching.

Biology is developing more rapidly today than in the past and so the skills and techniques of imparting useful biological knowledge through the traditional method of teaching should give way to newer or modern educational techniques that require the use of ICT. This study, therefore investigates "The Analysis of Availability of ICT Equipment for the Teaching and Learning of Biology in Senior Secondary in Jos North, Plateau State".

### **Objectives of the Study**

Therefore, in specific terms, this study is intended to achieve the following objectives:

- vii. To analyze the available Information and Communication Technology (ICT) Equipment in senior secondary schools in Jos North.
- viii. To investigate the extents to which Information and Communication Technology (ICT) Equipment has influenced the teaching and learning of Biology in secondary schools in Jos North.

### **Research Questions**

This study specifically seeks to provide answers to the following research questions:

- i. To what extent are the ICT equipment available in the schools that claimed to be ICT compliant?
- ii. To what extent does the availability of ICT equipment affects the teaching and learning Biology in Senior Secondary schools in Jos North, Plateau State?

### **Methodology**



The population of the study consisted of 182 private established secondary schools and 22 government established senior secondary schools making the total of 202 Senior secondary schools in Jos North Local Government Area of Plateau State. The sample of this study consisted of Twenty (20) Senior secondary schools in Jos North area of Plateau State which was selected using purposive sampling technique. The sample comprises of both Government and Private established secondary schools in the study area and with more than ten years of establishment who claimed to be ICT compliant. This was done to check the availability of ICT equipment in the selected schools in the study area. To achieve the objective of the study, a survey method involving a checklist was used as the measuring instrument. The checklist cannot be administered to a group of people simultaneously, rather used by the researcher to record a particular information of each school independently. In this research, checklist is used to obtain quantitative information from the Principals, Head of Departments (HODs) and Biology teachers of the selected secondary schools on the availability of ICT equipment for the teaching and learning of Biology. As a result, a total of 20 checklist were used for this study which were selected using purposive sampling Technique by the researcher. Then the researcher was given access to the school ICT room to take stock of the various ICT equipment in the school and the previous record of the students in the Senior Secondary Certificate Examination (SSCE) Biology grades. The researcher was personally taken round the school to record using the prepared checklist.

After data collected from all the sampled Secondary schools, all items of the survey checklist were analyzed using descriptive statistics to compare the availability of ICT equipment and the Biology grades in the Senior Secondary Certificate Examination (SSCE). All the data collected using the survey checklist was grouped into three (3)

### **Results**

Research Question One: To what extent are the ICT equipment available in the schools that claimed to be ICT compliant?

**Group One:** These are the secondary schools that have ICT equipment at the maximum level. These are the secondary schools with at least one projector, a desktop or Laptop to each student, good internet access but only one out of the three schools has an interactive board

**Group Two:** These are the eight secondary schools that have ICT equipment at average level. Some of the schools in this groups have fewer Laptops of which the students take turns when it comes to us. The internet access is not regular during class lessons but readily available for tests. Mostly students in these schools have to be grouped into two, three or more before they can access the computer and hence its time consuming and the teacher may not meet up with time.

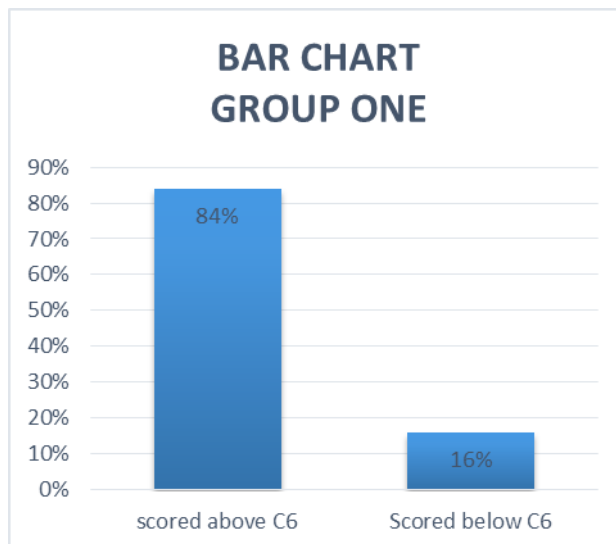
**Group Three:** These are the remaining nine secondary schools that have non-functional ICT equipment just for decoration. There was no internet access at all. This category has possibly only one desktop for which is being used by only the school secretary mostly administrative purposes but not for teaching and learning of Biology. Students of this group have no access to computers.

**Research Question two:** To what extent does the availability of ICT equipment affects the teaching and learning Biology in Senior Secondary schools in Jos North, Plateau State?

**Table 1:** Group one

S/N O	GROUP ONE	PERCENTAGE (%) IN (SSCE) BIOLOGY
1	Students who scored above C6	84
2	Students who scored below C6	16

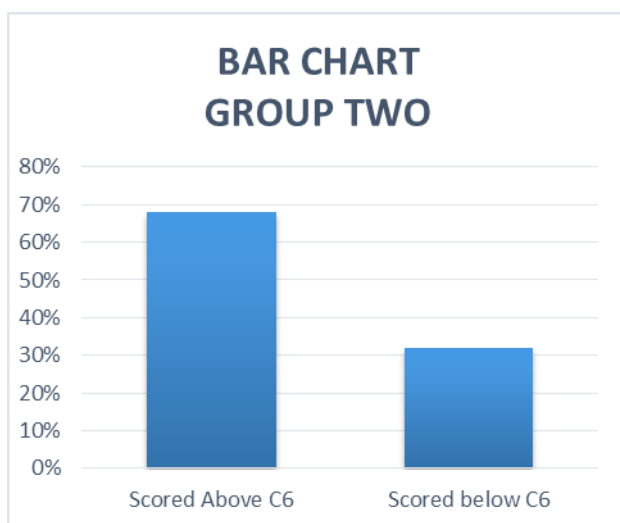
Table 1 above shows that in group one, 84% of the students in the group scored at a minimum of C6, while 16% scored below C6. The performance of the Students in Biology in their SSCE examination is encouraging because of the level of the ICT facilities available in the schools and the integration of the ICT facilities in the teaching and learning of Biology. it is represented in Bar chart and Pie chart in the figure below.



**Table 2:** Group Two

S/NO	GROUP TWO	PERCENTAGE (%) IN (SSCE) BIOLOGY
1	Students who scored above C6	68
2	Students who scored below C6	32

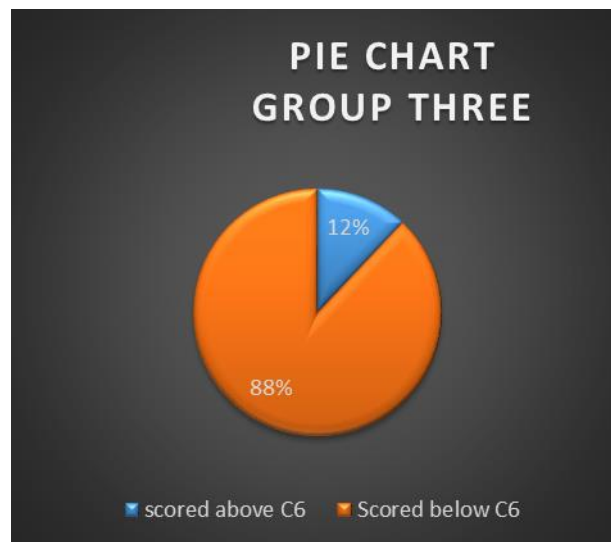
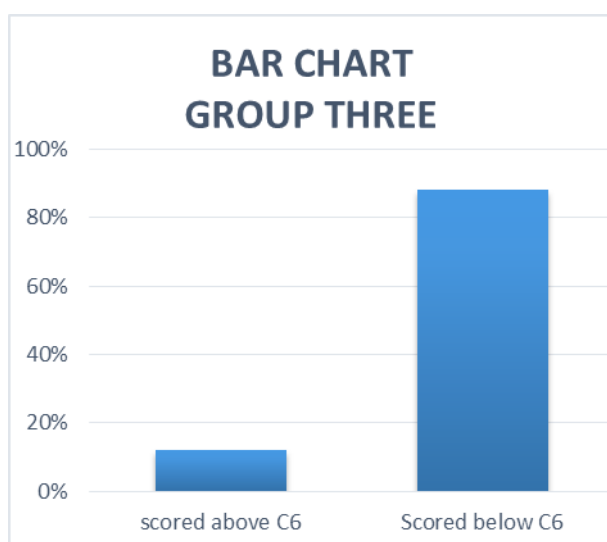
Table 2 above shows that in group two, 68% of the students in the group scored at a minimum of C6, while 32% scored below C6. The performance of the Students in Biology in their SSCE examination is at an average level because the level of ICT equipment available in the schools is not up to group one above and the level of integration of the ICT facilities in the teaching and learning of Biology. It is represented in Bar chart and Pie chart in the figure below.



**Table 3:** Group Three

S/NO	GROUP THREE	PERCENTAGE (%) IN (SSCE) BIOLOGY
1	Students who scored above C6	12
2	Students who scored below C6	88

Table 3 above shows that in group three, 12% of the students in the group scored at a minimum of C6, while 88% scored below C6. The performance of the Students in Biology in their SSCE examination is very poor because of the poor level of the ICT facilities available in the schools and the lack of integration of the ICT equipment's in the teaching and learning of Biology. probably if there was good ICT facilities in the schools in this group the performance would have been better. It is represented in Bar chart and Pie chart in the figure below.



It is therefore established from the aforementioned three groups that the availability of ICT equipment affects the teaching and learning Biology in Senior Secondary schools in Jos North, Plateau State. The more ICT equipment, the better the performance.

The research was able to come up with the following summary of findings as follows:

Majority of the schools visited by the researcher with survey checklist indicated the extent to which the availability of both desktop and laptop computers in the schools covered by the study was at the minimum level. As a result, the availability of computers in senior secondary schools in Jos North Local Government of Plateau state for teaching and learning Biology was at minimum level. However, the extent to which the availability of computers for administrative purpose were found at good level especially in private established secondary schools.

Only a few secondary schools have a well-organized computer laboratory with availability of ICT equipment at average level. Although all schools covered by the study in some extent have a computer laboratory rooms for students, but mostly non-functional, the management of computer laboratory in most schools was too poor, and many computers are covered with dusts, hence damaged.

### **Conclusion**

Based on the findings of this study, the following conclusions were drawn. These conclusions serve as a basis for recommendation in the form of guidelines to secondary school leaders and Plateau State Ministry of Education to equip, improve and make available ICT equipment in Jos North for the sake of improving teaching and learning Biology and other subjects.

It was indicated that ICT can make a very profound and remarkable impact on the quality and quantity of teaching, learning when they are effectively integrated in teaching and learning process. As a result both teachers and students are deprived of Information and Communication Technology facilities recommended and commonly used for teaching-learning purpose. Hence, biology teachers are most times demotivated for not having the opportunity to maximally contribute a lot in bringing professional growth, improving the teaching and learning process in strengthening students' performance in a bid to achieve quality education.

Majority of the school managements did not consider ICT related issues within their day to day activities; the reason I said that many computers in the school are not functioning well because of poor management and supervision, irregular arrangement of facilities in students' computer laboratory with poor control and inventory system. Also majority of the schools did not consider about purchasing of ICT equipment or did not made efforts to gain ICT facilities to their schools from donors, NGOs by creating different mechanisms such as developing projects etc, and the government on its own part also failed to provide enough ICT equipment in secondary schools in the study area.

Considering the finding of the study, it is possible to specifically conclude that shortage of ICT equipment, lack of finance and financial support from government and other stakeholders, absence of training for teachers on the use of ICT, lack of well-furnished laboratory rooms, absence of school based ICT policy, absence of internet connection, lack of maintenance to ICT equipment, absence of technical assistant, lack of interest by principals to equip ICT laboratories with facilities in teaching-learning purpose, lack of motivation by principals to use ICT for teaching-learning purpose are major problems inhibiting the usage of ICT equipment for teaching learning Biology in the study area and ultimately hindering the improvement of learning which is corroborated by Kulik's (2010) meta-analysis study revealed that, on average, students who used ICT-based instruction scored higher than students without computers. The students also learned more in less time and liked their classes more when ICT-based instruction was included.

### **Recommendations**

Based on the findings of the study, the following recommendations in the form of guidelines to concerned stakeholders are postulated.

- i. ICT must be effectively integrated in the schools for effective teaching and learning. School managements need to be committed to effectively implement ICT program in their schools.

Educational reform, decentralization and school improvement may all benefit from integration of ICT to school system in general and for teaching and learning purpose in particular, which supports the improvement of schools as learning organizations in the way expected by Ministry of Education.

- ii. The culture of maintenance should be prioritized at all levels because some of the computers were purchased for the supervision team of the ministry of Education to award approval of the running of the school and the systems were not accessible by the teachers and students.. Some equipment that are supposed to be repaired should be repaired and where there is need for a change, it should be done.
- iii. The State Ministry of Education and the state government should show more interest in supplying Information and Communication Technology (ICT) equipment to all secondary schools in the study area. This could be done through improved funding by parents association, Non-governmental Organization (NGOs) to make these equipment available for use
- iv. Schools should hire technical assistant to effectively manage the available ICT equipment. As well as schools should train their personnel to do the maintenance rather than depend on commercial technicians.

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## USE OF MODERN TECHNOLOGIES IN TEACHING SCIENCE, TECHNOLOGY, ENGINEERING AND MATHEMATICS (STEM) IN NIGERIAN UNIVERSITIES

By

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### **Abstract**

This paper discusses the importance of modern technologies on Science, Technology, Engineering and Mathematics (STEM) instructional practices in university education and the role modern technologies plays in the development of university education focusing on what STEM education could gain from modern technologies and what modern technologies could do. The method applied in this paper was descriptive as it discusses and explains the functions of modern technologies that promote effective teaching and meaningful learning. Descriptive analysis is also applied to explain the basic features in the process of instructional practices using modern technologies. Modern technologies in Nigerian universities have the potential to transform STEM education, and make it accessible and exciting for students. University lecturers and students have access to Internet, cell phones, smart phone, video, games, among others for e-learning. Modern technologies have positive and negative impacts on STEM delivery in Nigerian universities. However, modern technologies help to solve the most difficult pedagogical challenges faced by STEM teachers. They provide symbolic, graphical, and dynamic representations of STEM subjects during instruction by making the abstract world more accessible through experiential learning. Hence, complex ideas can be represented on screen as computational objects for equitable and robust understandings. Lecturers are supposed to use modern technologies in teaching for conceptual understanding and equitable access to legitimate STEM knowledge.

**Keywords:** Modern technologies, STEM education, university education, teaching and learning.

### **Introduction**

Science, Technology, Engineering and Mathematics (STEM) subjects are expected to enhance innovative digital technology while modern technologies are supposed to enhance effective teaching and meaningful learning for sustainable development. Honey, Pearson, & Schweingruber (2014) allude that in the classrooms, computer software applications, along with word processing software, are the most widely available applications of digital technology using the internet. Teaching students' database and spreadsheet programmes promote organizational skills and modelling software promotes the understanding of STEM concepts.

Ndinechi and Okafor (2016) posit that STEM education in universities make students learn to become problem solvers, innovators, creators and collaborators and removes the traditional barriers created between the four disciplines, by integrating them into one cohesive teaching and learning paradigm.

Modern technologies refer to many forms of electronic communications, which include the Internet, which is accessible through both computers and mobile phones, and instant messaging services, such as WhatsApp, Face book, telegram, instagram, twitter, Skype, zoom, among others.

Digital technologies provide symbolic, graphical, and dynamic representations of STEM subjects that make them accessible to design, exploration and testing by university students (Davies, Kent, Laurillard, Mavrikis, Noss, Pratt & Price, 2013). For all STEM subjects they make the abstract world more accessible through experiential learning, because complex ideas can be represented on screen as computational objects which students can manipulates.

Furthermore, using modern technologies enhance and sustain learning beyond content delivery in STEM education so that students develop a broad mix of skills (Kärkkäinen & Vincent-Lancrin, 2013). The authors further explain that teaching and learning approaches spark high order thinking skills and creativity, enhance students' engagement, strengthen communication, and build collaboration among teachers and students as well as make STEM teaching and learning more effective, more relevant, and more enjoyable.

Science, Technology, Engineering and Mathematics (STEM) education is an aspect of teaching and learning that bridges the four disciplines (Sarac, 2018). While Technology and Engineering are design-based STEM that foresees the integration of knowledge and skills related to effective teaching and meaningful learning of Science subjects and Mathematics (Guzey, Harwell, & Moore, 2014). Science, Technology, Engineering and Mathematics (STEM) in university education makes students to gain knowledge and skills by tackling problems from multi-disciplinary point of view and provide opportunities for specialization in these four fields. Dugger (2010) observes that STEM is an educational approach that is providing both teachers and students with the ability to communicate in an interdisciplinary way, to practice team work, to reason critically, investigate through research, to produce and to solve problems. Use of modern technologies in university education encourages the application of smart boards, instructional technologies, computer-based and computer-assisted-instruction (CAI), dynamic geometry software, mobile learning and project based learning (Sarac, 2018).

### **Problem Statement**

Modern technologies help in improving pedagogy practices in Science, Technology, Engineering and Mathematics (STEM) subjects in university education. Unfortunately, most teachers in these subjects area faced with challenges on how to use modern technology for effective teaching and meaningful learning. Other challenges faced by Nigerian universities include inadequate modern technologies equipment for teaching and learning in STEM education, fluctuation of internet network and epileptic nature of electricity in Nigeria. However, the technical know-how, proper awareness of the importance, positive and negative impacts of modern technologies as well as effective use of scarce resources for effective teaching and meaningful learning would give optimum performance in Nigerian universities.

### **Research Questions**

The following questions guides the discussion in this paper:

4. To what extend do modern technologies support pedagogical practices in science, technology, engineering and mathematics (STEM) education in Nigerian Universities?
5. How do modern technologies help in facilitating learning beyond content delivery in Science, Technology, Engineering and Mathematics (STEM) education in Nigerian Universities?
6. How can modern Technologies be encouraged and used to help develop, spread, accelerate, sustain and enhance STEM education so that students develop a broad mix of skills?

### **Methodology**

The methodology applied in this research was descriptive as it discusses and describes the impact of modern technologies on STEM university education and explains the functions and challenges faced in the use of modern technologies in teaching STEM subjects in Nigerian universities. Descriptive analysis is applied to explain the basic features of modern technologies and STEM subjects.

### **Modern Technologies in Science and Technology Education**

The modern technologies make teaching and learning process easier and less time consuming as well as improve the learning and interactivity of students in Nigerian universities. Nigerian universities use modern technologies in the following ways:

**1. Use of internet connection and global connectivity:** An internet refers to a global computer network providing information and communication facilities, consisting of interconnected networks using standard protocol – World Wide Web (www). The internet provides different online services.

Some examples of the internet services include: (i) Web – a collection of billions of webpages that can be viewed with a web browser; (ii) Email – the most common method of sending and receiving messages online. (iii) Social media – websites and applications that allow people to share information, comments, photos and videos; (iv) Online gaming – games that allow people to play with and against each other over the internet. This can be part of online marketing; (v) Software updates – operating system and application updates can be typically downloaded from the internet. The use of internet gives the teachers and students the impressions that teaching and learning process is easier and less time consuming. It also facilitates and improves teaching and learning process in STEM subjects.

**2. Use of projectors and audio- visual aids:** A projector is a device or apparatus with the system of lenses for projecting slides or film onto a screen or other surfaces using an intense light focus the image. It is a machine or optical instrument that project images. They <sup>include</sup>: CRT (Cathode Ray Tube), DLP (Digital Light Processing) and LCD (Liquid Crystal Display). Projectors and audio-visual aids strongly to students during teaching and learning process, that is the reason that make most university lecturers in the world to rely on use projectors in presenting their lectures and power point presentations. It makes their instructional practices interactive and interesting (Raja & Nagasubramani, 2018). Therefore, a modern technology within the university systems motivates, and improves teachers-students interaction and generates students' interest in learning.

**3. Digital footprint:** Digital footprint is the information about a particular individuals that exit on the internet as a result of their online activities. It is one's set of digital activities, actions and communications that leave data trace on the internet or on a computer or other digital device and can identify the user. However, in this context digital footprints are all the global connectivity which teachers and students use and the different fora that are available for problem solving and working assignments.

**4. Electronic-learning (E-learning) or Mobile- learning (M-learning):** Many people now take up online courses for studies and certifications without attending any classroom or using face to face contact. This type of learning is called Electronic-learning (E-learning) or Mobile- learning (M-learning). Electronic-learning (e-learning) or mobile-learning (m-learning) is defined as learning through multiple contexts, across social and content interactions, using different electronic devices (Frohberg, Goth & Schwabe, 2009). This is a form of electronic learning or distance education where the mobile-learners can use mobile device or educational technology in any locations at their time convenience, provided there is network and internet service.

Students receive instructions from their teachers online using mobile devices such as smartphones, iPads, netbooks and tablets. Assignments, tests, correction of students' projects/theses done online and thesis defense can be done on landline, Skype, zoom, through emails, among others.

### **Importance of Modern Technologies on University Education**

Science, Technology, Engineering, and Mathematics (STEM) subject in university education is important to university lecturers and their students because of its importance to the development of Nigerian universities. STEM subjects in Nigerian university education has foundational value because it develops the general skills of making sense of communications about science and mathematics, solving problems and interpreting data (Davies et al., 2013). This is done by engaging students in understanding complex concepts and developing the high-level skills of abstraction and modeling, investigation and experimenting, data gathering and analysis, testing and problem solving. The importance of modern technologies in university education can be categories into four. They:

**(i) Are part of the curriculum:** Science, Technology, Engineering and Mathematics (STEM) subjects are part of the subjects offer in the universities and they are effectively taught and learn through modern technologies.

**(ii) Are instructional delivery system:** Modern technologies are used for effective teaching and meaningful learning of STEM subjects.



**(iii) Help in instructional practices:** Modern technologies aid effective teaching and meaningful learning of STEM subjects.

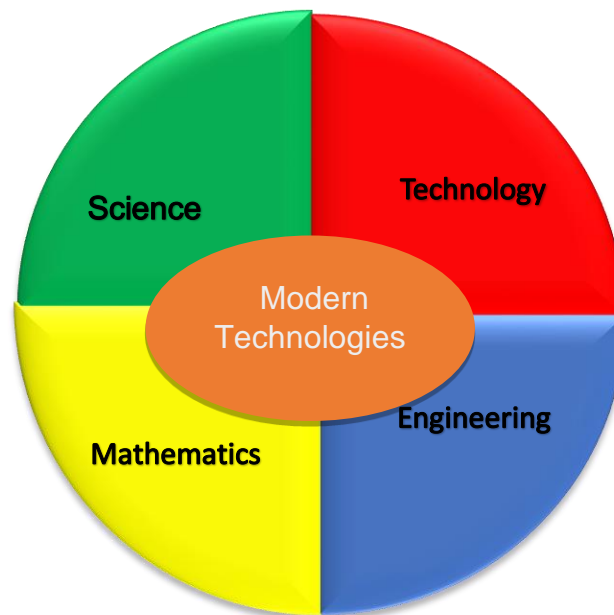


Figure 1. The impact and relationship between modern technologies and STEM (Schoenfeld, 2011p. 6).

Figure 1 shows the impact and the relationship between modern technologies and STEM. Knowledge and skills develop by modern technologies on STEM in the skills required for the development of scientific concepts which in turn modify and generate further practice. In this way the student gradually gains better understanding and control over aspects of the physical world and its formal conceptual representations. Learning this kind of expertise is not easy and to be successful.

Science, Technology, Engineering and Mathematics (STEM) university lecturers must design appropriate tasks that target the students' needs, motivate them by engendering a sense of ownership and self-efficacy (Bosan, 2018), and provide feedback and support mechanisms that keep students on-task, and help them to reflect on their level of their understanding in order to move forward.

### **Impact of Modern Technologies on University Education**

In university education, modern technologies have the capacity to increase access to education, improve its relevance to current workforce and high quality demand by the labour market. Modern technologies impact with respect to knowledge acquisition and assimilation by both lecturers and students. However, there are positive and negative impacts of modern technologies on STEM education.

### **The Positive impact of modern technologies on STEM**

Modern technologies have impact on university education in the following ways:

**1. Promote effective instructional practices:** Modern technologies tools such a digital cameras, projectors, mind training Software's, computers, PowerPoint presentation, 3-D visualization tools, among others, have become important resource materials for STEM teachers in their classroom instructional practices. Concept understanding, equitable and legitimate knowledge in STEM subjects in Nigerian universities, modern technologies positively impact on both lecturers and students by enhancing the following:

**(a) Creative Learning:**Modern technologies enhance the manipulation of existing knowledge in order to create new ones that are productive.

**(b)Active Learning:** Modern technologies promote students' engagement as they select learning materials at their own pace and engage themselves in meaningful learning. For instance, students select the courses they will be able to handle in a semester. These opportunities allow sufficient time for the students to grapple with a problem and to engage in critical thinking (Schoenfeld, 2017) as well as allow them to share multiple problem-solutions strategies (Bosan, 2018) that enhance meaningful learning.

**(c) Integrative Learning:** They enhance integrative approach to instructional practices thereby eliminating synthetic difference in theory and practice.

**(d) Collaboration and Cooperative Learning:** Modern technologies collaborative teaching and cooperation learning among teachers and students regardless of level of educational attainment. This gives the teachers and students the opportunity to work with people from different culture. Working together in groups enhances their communication skills and global awareness. It also leads to cooperation among students within and beyond school level and thereby expand the existing interactive relationship between teachers and students.

**(e) Evaluative Learning:** Modern technologies in teaching and learning are student-centered and provide tangible feedback. It allows the students to learn through discovery and learning is enhancing through the new instructional practices. These are also tools for computation and analysis of student's results from assessments that determine their performance.

**(2) Enhanced Globalization:** Globalization is the transfer, adaptation, and development of value, knowledge, technology and behavioural norms across countries and societies in different parts of the world. The phenomena and characteristics associated to globalization are growth of global network, global transfer and interflow in technological, economic, social, political, cultural and learning areas, international alliances and competitions, international collaboration and exchange, global village, multi-cultural integration, and use of international standards and benchmarks. Therefore, teachers and students from different part of the world interact in teaching and learning through video, emails, Skype, among others. Students now receive assignment, tests from their lecturers online. They also defend their theses online through Skype, landline and phones. Teachers and students of STEM subjects can browse information through Google scholar search, some also help students to learn foreign languages online and translation of any document can be made to any standard language registered online.

**(3) Unlimited barriers in teaching and learning:** Modern technologies have introduced online studies everywhere in the world. Some students and their teachers do not have to be physically present in the classroom to receive instructions open and distant learning and other online education has become a common phenomenon in the education system in Nigeria. The NOUN, NTI, among others has fantastic STEM courses with the emergence of modern technologies.

### **Negative impacts of Modern Technologies on STEM Education Delivery**

The use of modern technologies on STEM subjects also has some negative impact. They include:

**(a) Tremendous decline in writing skills:** Both young and old embrace online chatting full of abbreviations and shortcut spellings nowadays. This has made a drastic decline in writing skills in students. Total dependence and reliance in digital communication make STEM students to neglect effort in writing skills. Students no longer care about correct spellings, how to construct sentences correcting and how to make coercive writing.

**(b) Negative Focus:** Text messages as SMS has become part of students' life. Students spend their reasonable time, playing with their cell phone, iPad, iPhone day and night and even during lectures. With introduction of online connectivity there is lack of focus and concentration in academic activities. They prefer watching sports and extra-curricular and activities instead participating in them. These behaviours distract their academic activities. For example, teachers and students mostly use computer in e-learning, aptitude test, computer-based-test (CBT) as well as other types of computer-assisted- instruction (CAI) and high-stake assessments.

**(c) Encourage Examinations Misconduct:** The use of graphic calculators, mini cameras, smart watches and similar equipment usually aid students to cheating in examinations. It is easier for

students to browse and write down formulas and information during examination with least chances of being caught.

(d) Messages are sent to students, answers are stored and retired. It has reduce originality among students.

### **Opportunities and Challenges of Modern Technologies**

Apart from the impact of modern technologies on STEM university education, there are opportunities and challenges of modern technologies on STEM subjects.

The opportunities of modern technologies to STEM subjects are: they make students excited during the teaching and learning process; students are kept busy and have freedom to work at their own pace; students are enable to learn new technologies skills that can be used in workplace on graduation and they reduce the cost of printing and photocopying of documents.

The challenges of modern technologies to STEM subjects include the decline in students' imagination and thinking ability, time consuming from teacher's point of view and installation of modern technologies is expensive. The most commonly cited challenges are lack of time; lack of access; lack of resources; lack of expertise and lack of support. Another challenge is reliability of modern technologies and tools.

### **Conclusion**

The paper explains that modern technologies have positive and negative impacts on STEM education in Nigerian universities. Therefore, teachers and students should take the advantage of the positive impact of modern technologies and eliminate the negative effects. This will make Nigerian university achieve excellence in STEM education. For all STEM subjects they make the abstract world more accessible through experiential learning because complex ideas can be represented on the screen as computational objects which university students can manipulate.

### **The Way Forward**

For effective use of modern technologies in STEM education, the way forward/suggestions are as follows:

3. Nigerian universities need to convene a technology planning team comprising of administrators, teachers, technology coordinators, students, parents and other stakeholders in education to determine the educational goals for students and types of technology that will support efforts to meet the goals. The team should also develop a vision of how technology can improve teaching and learning in STEM subjects in Nigerian universities.

4. Science, Technology, Engineering and Mathematics students cannot be expected to benefit from modern technologies if their lecturers are neither familiar nor comfortable with them. Lecturers need to have experience with the technologies. Hence, it is important to provide professional development to teachers to help them not only to learn how to use new technologies but also on how to provide effective instructions and meaningful learning to students with activities using technology in the classroom.

5. Reasonable class periods and more allowance for team/collaborative teaching should be built in the daily schedule of teachers. Students may need enough time to find, explore and synthesize materials. Thus more time should be built into daily schedule allowing teachers time to collaborate and work with their students.

6. With a variety of theories suggesting a potentially powerful effect of media and the growing empirical evidence for negative impact, parents should take care to limit exposure of their wards to detrimental technology.

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**POLITICAL AND ECONOMIC FACTORS IMPEDING EDUCATIONAL  
DEVELOPMENT: THE CASE OF THE KOMA PEOPLE OF ADAMAWA STATE,  
NIGERIA**

By

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### **Abstract**

The study investigated the political and economic factors militating against the educational development of Koma people of Jada Local Government Area of Adamawa State, Nigeria. The study answered three research questions and tested three hypotheses. A 21-item questionnaire collected data from resident and non-resident indigenes of Koma District. Descriptive statistics of mean and standard deviation were used to answer the research questions. The Z-test tested the hypotheses at 0.05 level of significance. The study found that political factors responsible for the slow pace of educational development of Koma District were prolonged neglect by successive governments in providing social amenities, poor political representation in governance and bias in appointments, among others. Economic factors responsible for the slow educational development of Koma District were lack of adequate natural resources, high rate of unemployment, neglect by successive governments in resource allocation, and high poverty rate among the Koma. The study found that provision of social amenities, increased funding, increased quota for the election of Koma indigenes into political positions, paying of political attention by way of legislation on the development of the Koma people, and declaration of an educational emergency for the development of the Koma people were among the strategies found to enhance the educational development of the Koma people, if adopted. It was found by the study that there was no significant difference between the mean responses of resident and non-resident indigenes on the political and economic factors responsible for the slow educational development of Koma District, as well as on strategies to adopt to enhance the educational development of Koma District. Therefore, the three null hypotheses, were upheld. The study suggested among others that government needed to declare a state of emergency in the education sector for the Koma people. Members representing the Koma/Jada constituency needed to maintain constant contact with the people of their constituency in order to keep the Koma people abreast of government policies and the act of governance, and that there was need for increased participation of the private sector in the provision of education and other social amenities for the Koma people.

### **KEY WORDS**

Political factors   Economic factors   Educational Development   Koma District

### **Introduction**

Education is widely regarded as the route to economic prosperity, the key to scientific and technological advancement, the means to combat unemployment, and the foundation of social equity. According to Adedeji (2012), "In its broad term, education is any process by which an individual gains knowledge or insight, or develops attitudes or skills", adding that education refers to "as a process of transmitting cultural values and other information from generation to generation."

The Encarta Dictionary (2008) defined development as change, growth, or improvement over a period of time. Consequently, educational development refers to those changes, progresses, improvements, advancement brought about in a given society as a result of education they acquire. Changes or improvement could be in terms of living standard, expansion of educational and economic facilities, attainment of reasonable literacy level, better living condition, availability of health and medical facilities. Educational development is synonymous to economic growth in that educated societies produce more than uneducated societies.

Education is widely regarded as the route to economic prosperity, the key to scientific and technological advancement, the means to combat unemployment, and the foundation of social equity (Asodike, 2016). Consequently, Adenike (2012) identified five factors that influence education. These factors are the historical factors, political factors and economic factors. Others are the sociological factors and the geographical factors. According to Adenike, the historical factors relate to the culture and tradition of a people. The economic factors deal with the economic growth of a nation as in the era of the oil boom in Nigeria and growth in GDP. Political factors are concerned

with the act of governance vis-à-vis the establishment of schools. Sociological factors are those factors that arise from social demand for education. The geographical factors relate to the vast nature of a region or country like Nigeria.

The plight of the people of Koma had been an issue of controversy until the visit of Colonel Yohanna Madaki, then the military Governor of the defunct Gongola state. He took a bold step to unearth the mystery by paying an unscheduled visit to the people who were said to be living in a stone-age condition. The Koma people were believed to be lagging behind in all aspects of development: The familiar story was that Koma people lacked almost all social amenities that could make life meaningful. These amenities included access roads, health facilities and schools. Consequently, the living standard of the people of Koma was low.

Three decades after the so-called discovery of the Koma people by former governor, and subsequent inauguration of the Task Force Committee on resettlement of the Koma people by his successor, Wing Commander David Jonah Jang in 1986, the Koma District still appears to be backward in all aspects of development. The District lacks virtually all social amenities that could make life meaningful to the people (Minority Right Agenda, 2008). It is understood that development comes through education. Education for the Koma people, is very vital. However, government's effort at making education and other social amenities available to the people appears to be stagnant, thus raising concern for the plight of the people of Koma. It does appear that this section of the country is being neglected. In cases where social amenities like schools are provided, administrators of such schools face serious challenges such as inadequate funding, poor motivation and inadequate supply of instructional facilities. The Koma people of Jada Local Government Area of Adamawa State are caught up in this challenge. Consequently, Koma District has remained educationally less developed. Therefore, the fundamental problem of the study was posed by the following questions: What factors, if any, are responsible for the slow pace of educational development of Koma District? What appropriate strategies well adopted would enhance the educational development of Koma District?

### **Purpose of the Study**

The purpose of the study was to:

- iii. Ascertain the political factors that affect the educational development of Koma District.
- iv. Determine the economic factors that affect the educational development of Koma District;
- v. Determine the strategies to adopt to enhance the educational development of Koma District.

### **Research Questions**

The following research questions were stated to which answers were sought:

- v. What are the political factors that affect the educational development of Koma District?
- vi. Are there economic factors that affect the educational development of Koma District?
- vii. What are the strategies to adopt to enhance the educational development of Koma District?

### **Research Hypotheses**

The following hypotheses were stated and were tested at 0.05 level of significance:

- Ho<sub>1</sub> There is no significance difference between the mean scores of the responses of resident and non-resident indigenes of Koma District on the political factors that affect the educational development of Koma District.
- Ho<sub>2</sub> There is no significance difference between the mean scores of the responses of resident and non-resident indigenes of Koma District on the economic factors that affect the educational development of Koma District.
- Ho<sub>3</sub> There is no significance difference between the mean score of the responses of resident and non-resident indigenes of Koma District on the strategies to adopt to enhance the educational development of Koma District.

### **Review of Relevant Literature**

The development of education in any given society is hampered by many factors. These factors can be identified as social, political, economic, ethnic or cultural factors. While the urban

areas have abundance of educational facilities to some extent, the rural areas such as Koma District, lack these facilities (Aluede, 2006). Aluede added that where schools are available in rural areas, “teachers either resist or refuse transfer to those rural areas for lack of social amenities”. Ezewu and Tahir (1997) gave a clearer explanation of the common situation in rural and riverine areas with regard to educational development where infrastructure was highly inadequate. Facilities such as markets, health centres and recreational centres, which affect settlements, are not available in the rural areas.

Politics, according to Kevin and Joseph (2011), refers to “the art of power, of management of human affairs and governance in society.” The authors also viewed politics as the science of exerting power and influence over issues affecting the well-being of the people, and allocation of available resources to the various sections of society. Buttressing this point, Igbineweka (2011) viewed politics is an act whereby someone uses his/her power or authority to influence the decision of others to his/her advantage. Authority in this context means the power or right a person has to give orders to people. This encompasses the activities in getting and using power in public life, and being able to influence decision that affect a country or society.

Political considerations have affected education in many rural areas in Nigeria. According to Aluede (2006), due to political considerations, “rural areas witnessed lack of establishment of schools. Where schools are available, teachers either resist or refuse transfer to those rural areas for lack of social amenities”. Ezewu and Tahir (1997) gave a clearer explanation of the common situation in rural and riverine areas with regard to educational development. There has been highly inadequate quantity and quality of infrastructure. Facilities such as markets, health and recreational centres, which affect settlements, are not available in the rural areas. Aluede further stated that the implication of this for education is that the rural areas stand disadvantaged in educational provision, supervision and educational data needed by researchers.

Adeyinka in Igbineweka (2011) asserted that the question as to who should assume responsibility for and control of education has yet been satisfactorily answered, even in highly developed countries of the world, because there are still conflicts in opinions as to what should be appropriate roles of the various agencies of education - federal, state, local government and the private sector. In this connection, Adeyinka listed the 12 problems retarding the pace of educational development in Nigeria as:

1. Conflicts between federal, state and local Government
2. Prevalence of multiple system of education
3. Diversification of the education system
4. Unstable curriculum and subject syllabuses
5. The problem of relating the curricular to national man-power needs.
6. Unstable staff
7. The poor state of nation's economy and the financing of education
8. Politicisation of education
9. Procurement and servicing of equipment
10. Inadequate classroom accommodation
11. Poorly equipped libraries, laboratories and subject rooms
12. Scarcity and prohibitive cost of books.

Among the factors retarding educational development as enumerated above, are political factors. Political factors have played a vital role in slowing the pace of educational development not only in Koma District but in many societies in Nigeria. Adeyinka in Igbineweka (2011), observed that in an attempt to catch up with their counter parts, many States in Nigeria, particularly the new ones, indulge in the opening and running of many educational institutions, even when they are least prepared to do so. This results in lowering of standards and in various educational projects collapsing mid-way. In Koma, it is the lack of establishing many schools that was one key factor that had brought about the slow pace of educational development. The first primary school established in 1965 remained the only school for over ten years, catering for the educational need

of Koma youth. An additional nine primary schools were established between 1975 and 1980. All these schools benefited only the Koma living on the plain.

Development for the Koma people, simply connotes change or growth. It proceeds gradually and cumulatively, through a kind of unfolding of the internal or latent potentiality. Rodney (2005:1) perceived development from two levels: these are levels of the individual and social groups. At the individual level, development implies increased skills and capacity, greater freedom, creativity, self-discipline, responsibility and material well-being. At the level of social groups, development implies an increasing capacity to regulate both internal and external relationship. Furthermore, Akinpelu (2000: 80) identified three stages of meaning which development has undergone. The first is its reference to the quantitative provision of some paraphernalia of development such as utilities and infrastructure; to the tools and materials of development, such as distribution of land and wealth, provision of credit, seeds and tools, and access to knowledge and skills for use. The second stage is its use to characterize solely economic growth in terms of per capita income, while the third stage is where the target of development process is the human person. Development at this stage is concerned with the process of changing the personality, equipping it with the necessary skills, knowledge and attitudes to conceive design and undertake self-development.

The concept of economy has been summarised by Eneasator (1996) to mean the totality of the socio-political and economic factors that interact and operate in several ways to determine the level of national income which influence the quality of life in any given society. Educational economics analyse both what determines or creates education and what impact education has on individuals and societies. Historically at World Bank a great deal of emphasis has been placed on determining outcomes to educational investment and the creation of human capital. Education is positively related to economic growth. Indeed, a number of international studies have been conducted to establish this relationship. For instance, Bowman and Anderson (1963) measured literacy rates and gross national product (GNP) in 63 countries and concluded that a 40% literacy rate was a necessary condition for income per head to exceed \$300 in 1955, or 90% literacy rate for the income per head to exceed \$500.

The implication is that any country striving to increase its GNP must first try to raise its literacy level. Another study was done by Kaser (1966) who studied the GNP of 12 developed countries using five educational indicators, namely, enrolment rate for three levels of education, students' enrolment ratio, pupil teacher ratio, and total expenditure per student and teachers' salaries as a proportion of GNP per head. The conclusion was that higher GNP per head was associated with higher enrolment ratios particularly at the secondary and tertiary levels. Consequently, many countries the world over understand that education is positively related to economic growth.

In order to enhance the educational development of a people, funding is necessary. In Koma, during the military rule of Ibrahim Babangida, late colonel Yohanna Madaki earmarked one million naira, a substantial amount at that time, for the take-off of Koma resettlement scheme which came into oblivion after his transfer from Gongola State to Benue State in 1987 (Task Force Committee on Resettlement of Koma People, 1987).

To finance education, a number of models are needed. Such models include 1) Complete private sector involvement incorporating individuals, corporate bodies and organisations; 2) Joint partnership financing involving both the Government and private sector; and 3) Sole Government financing. In Nigeria a variety of models have been tried (Ogbonnaya, 2010). The early education sector was dominated by private sector involvement but at the moment, the joint partnership model is being adopted, because there is practical realisation that no single economic sector can finance education alone. The federal government, in its national policy on education, recognises education as an expensive social service requiring adequate financial provision from the federal, state and local governments, as well as the local community, individuals and organisations (FRN, 2004).

The relationship of economics with education is in the area of demand for education which is reflected in the provision of educational institutions and facilities. The creation or expansion of education facilities however, depends on the viability of the economy; where the economy is not



buoyant, it is unlikely that the demand for education will be met. Another relationship between education and economics is in the aspect of resource allocation. Resources are scarce and so its allocation to education must follow efficient criteria. Scarce resources should be invested in the area of maximum returns and most efficient way to ensure minimum running cost and minimum wastage. Since education is never planned in isolation, but in relation to other sectors of the economy, it then implies that whatever affects these sectors also affect education (Ogbonnaya, 2010). Education positively relates to economic growth by improving literacy level of the labour force and by helping in the acquisition of relevant skills and expertise.

## Methodology

Descriptive survey research design was used for the study in which a 21-item structured questionnaire, designed by the researchers, was used to collect data from a sample of 675 respondents, made up of 360 resident indigenes and 315 non-resident indigents. The instrument was treated on the Likert scale. The Area of the research was Koma District of Jada Local Government Area of Adamawa state. The Area is bounded to the north by Verre District of Fufore Local Government Area, to the West by Mapeo District of Jada Local Government Area and to the South-East by the People's Republic of Cameroon. The landscape is partially plain and partially mountainous or hilly with deep gorges with several streams which tributaries terminate into River Walla down-hill. The population of Koma District is 50095 people (Okpara, 2009). The District is predominantly inhabited by people of Koma origin who formed about 80%. However, there are also other ethnic groups that form the minority but are very influential, such are the Chamba, the Verre, the Fulani, and the Vomni. The Vomni who though share all cultural characteristics with the Koma people yet maintain that they are an entirely different ethnic group, so they are treated so.

Experts from the academia undertook content and face validation of the instrument which was later trial tested on 30 respondents. Test re-test method was used to estimate the coefficient of stability of the instrument using the Pearson Product Moment Correlation Coefficient, which stood at 0.87. The researcher personally collected data for the study. He was however, assisted by two research assistants. Mean and standard deviation were used to analyse the data collected for answering the research questions. Z-test test the hypotheses at 0.05 level of significance. Decision was based on the true limits of real numbers in which any mean score of respondents which was 3.50 and above was considered "Agree"; a mean score between 2.50 and 3.49 was considered "Undecided". A mean score of less than 2.50 was considered "Disagree". For the z-Test, the decision rule was to reject the null hypotheses if the calculated value (z-cal) exceeded the critical value (z-crit); otherwise uphold the null hypotheses.

## Results and Analysis

Data collected were analysed in tables based on the research questions and hypotheses.

### 4.1 Research Question 1

What are the political factors that affect the educational development of Koma District?

This research question is answered by the data in Table 1

**Table 1: Mean and Standard Deviation of the Responses of Resident and Non-Resident Indigenes on the Political Factors that Affect the Educational Development of Koma District**

S/N	Items	Res. Ind. N <sub>RI</sub> =250		Non-Res. Ind. N <sub>NRI</sub> =225		Grand Mean $\bar{X}_G$	Remarks
		$\bar{X}_{RI}$	$\bar{B}_{RI}$	$\bar{X}_{NRI}$	$\bar{B}_{NRI}$		
1	Prolonged neglect by successive governments in providing social amenities	3.78	1.03	4.01	0.90	3.89	Agreed
2	Poor political representation in governance	4.01	1.71	3.52	1.23	3.78	Agreed
3	Neglect in appointments for the few educated Koma indigenes	3.92	1.02	4.02	1.01	3.98	Agreed
4	Bias in appointments	3.53	2.01	3.94	0.91	3.72	Agreed
5	Lack of good road network linking Koma with other communities	3.62	1.71	3.72	2.01	3.67	Agreed
6	Political manipulation in elections	4.03	0.92	3.81	1.91	3.93	Agreed
7	Lack of political power	3.54	2.02	4.00	0.95	3.76	Agreed
8	Infrequent visits by successive governments	3.72	1.73	3.82	1.05	3.77	Agreed
Table Grand Mean		3.77		3.86		3.81	Agreed

## KEY

Res. Ind.	=	Resident Indigenes
Non-Res. Ind.	=	Non-Resident Indigenes
N <sub>RI</sub>	=	Number of Resident Indigenes
N <sub>NRI</sub>	=	Number for Non-Resident Indigenes
$\bar{X}_{RI}$	=	Mean for Resident Indigenes
$\bar{X}_{NRI}$	=	Mean for Non-Resident Indigenes
$\bar{B}_{RI}$	=	Standard Deviation for Resident Indigenes
$\bar{B}_{NRI}$	=	Standard Deviation for Non-Resident Indigenes
$\bar{X}_G$	=	Grand mean of Resident and Non-Resident Indigenes

Table 1 presents the results that answered research question one. The mean scores of resident and non-resident indigenes ranged between 3.52 and 4.03. Their standard deviation scores stood between 0.90 and 2.02. This result indicated that the response scores of the respondents are closer to the mean. The grand mean of the table stood at 3.81. Using the decision rule, the result showed that both resident and non-resident indigenes agreed with all eight items on the table as being the political factors that affect the educational development of Koma District

## Research Question 2

Are there economic factors that affect the educational development of Koma District?  
 Table 2 provided data that answered this research question.

**Table 2: Mean and Standard Deviation of the Responses of Resident and Non-Resident Indigenes on the Economic Factors that Affect the Educational Development of Koma District**

S/N	Items	Res. Ind. N <sub>RI</sub> =250		Non-Res. Ind. N <sub>NRI</sub> =225		Grand Mean $\bar{x}_G$	Remarks
		$\bar{x}_{RI}$	$\bar{E}_{RI}$	$\bar{x}_{NRI}$	$\bar{E}_{NRI}$		
1	Lack of adequate natural resources	3.77	1.01	3.90	1.17	3.83	Agreed
2	Inadequate human resources for societal development	3.92	0.09	3.67	1.20	3.80	Agreed
3	Inadequate social infrastructure	4.01	0.27	3.93	1.02	3.97	Agreed
4	Neglect by successive governments in resource allocation	4.00	0.91	3.88	1.21	3.94	Agreed
5	High rate of unemployment	3.93	1.21	3.71	1.09	3.83	Agreed
6	High poverty rate among the Koma	3.81	1.15	3.65	2.01	3.73	Agreed
Table Grand Mean		3.91		3.79		3.85	Agreed

The data in Table 2 show the results that answered research question 3. The mean scores of respondents, i.e., resident and non-resident indigenes ranged between 3.65 and 4.01. Their standard deviation scores ranged between 0.09 and 2.01, and indication that the responses of the respondents are closer to the mean. The grand mean score of the table is 3.85. This result shows that respondents agrees with all the six items on the table as being the economic factors responsible for the slow pace of educational development of Koma District.

### Research Question 3

What are the strategies to adopt to enhance the educational development of Koma District?

Data in Table 3 answered this research question.

**Table 3: Mean and Standard Deviation of the Responses of Resident and Non-Resident Indigenes on the Strategies to Adopt to Enhance the Educational Development of Koma District**

S/N	Items	Res. Ind. N <sub>RI</sub> =250		Non-Res. Ind. N <sub>NRI</sub> =225		Grand Mean $\bar{x}_G$	Remarks
		$\bar{x}_{RI}$	$\bar{E}_{RI}$	$\bar{x}_{NRI}$	$\bar{E}_{NRI}$		
1	Provision of social amenities	3.99	0.86	3.77	0.93	3.89	
2	Political attention by way of legislation on the development of the Koma people	4.01	0.91	4.00	0.91	4.01	Agreed
3	Increased funding	3.83	1.09	3.73	2.01	3.78	Agreed
4	Increased admissions of the Koma into educational institutions	3.91	1.02	3.93	1.03	3.92	Agreed
5	Increased quota for the election of Koma indigenes into political positions	3.87	2.01	3.99	1.00	3.93	Agreed
6	Increase in constituency allocations for the development of the Koma people	3.77	0.96	3.83	2.03	3.79	Agreed
7	Declaration of an educational emergency for the development of the Koma people	4.03	0.92	3.92	1.21	3.98	Agreed

Table Grand Mean	3.92	3.88	3.90	Agreed
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Table 3 presents results on the strategies to adopt to enhance the educational development of Koma District. The mean scores of residents and non-residents ranged between 3.73 and 4.03, with their standard deviation scores that ranged between 0.83 and 2.03, indicating that respondents' views were not far from the mean. The grand mean score of the table stood at 3.90. This result shows that respondents agreed that all seven items on the table were the strategies to adopt to enhance the educational development of Koma District.

### Hypothesis 1

There is no significance difference between the mean scores of the responses of resident and non-resident indigenes of Koma District on the political factors.

Data that tested this hypothesis are presently in Table 4.

**Table 4: z-Test of Difference Between the Mean Scores of Resident and Non-Resident Indigenes of Koma on the Political Factors that Affect the Educational Development of Koma District**

Respondent Category	Mean	SD	N	df	SE	z-cal	z-crit	DEC
Resident Indigenes	3.77	0.16	250	473	0.08	1.32	1.96	Accept
Non-Res. Indigenes	3.86	1.20	225					

Table 4 is the result obtained when hypothesis one was tested at a 0.05 level of significance. The calculated value of z (z-cal) is 1.32 against the z critical (z-crit) of 1.96. Since z-cal is lower than z-crit, the result shows that there is no significant difference between the mean responses of resident and non-resident indigenes on the political factors that affect the educational development of Koma District. The null hypothesis,  $H_{01}$ , is therefore, upheld.

### Hypothesis 2

There is no significance difference between the mean scores of the responses of resident and non-resident indigenes of Koma District on the economic factors that affect the educational development of Koma District.

This hypothesis was tested by the data in Table 5

**Table 5: z-Test of Difference Between the Mean Scores of Resident and Non-Resident Indigenes of Koma on the Economic Factors Responsible for the Slow Educational Development of Koma District**

Respondent Category	Mean	SD	N	df	SE	z-cal	z-crit	DEC
Resident Indigenes	3.91	1.06	250	473	0.15	1.09	1.96	Accept
Non-Res. Indigenes	3.79	0.90	225					

The data of Table 5 provide the result when hypothesis three was tested at a 0.05 level of significance. The calculated z (z-cal) stood at 1.09. The critical value of z, i.e., z-crit was 1.96. Since z-cal was lower than z-crit, the result shows that there was no significant difference between the mean responses of resident and non-resident indigenes on the economic factors that affect the educational development of Koma District. The null hypothesis,  $H_{03}$ , was therefore, upheld.

### Hypothesis 3

There is no significance difference between the mean score of the responses of resident and non-resident indigenes of Koma District on the strategies to adopt to enhance the educational development of Koma District

The data presented in Table 6 tested this hypothesis.

**Table 6: z-Test of Difference Between the Mean Scores of Resident and Non-Resident Indigenes of Koma on the Strategies to Adopt to Enhance the Educational Development of Koma District.**

Respondent Category	Mean	SD	N	df	SE	z-cal	z-crit	DEC
Resident Indigenes	3.92	0.17	250	473	0.09	1.26	1.96	Accept
Non-Res. Indigenes	3.88	1.00	225					

In Table 6 are data obtained when hypothesis five was tested at a 0.05 level of significance. In this result, z-cal was 1.26 against the z-crit of 1.96. From this result, it could be seen that z-cal was lower than t-crit. This result shows that there was no significant difference between the mean responses of resident and non-resident indigenes on the strategies to adopt to enhance the educational development of Koma District. Therefore, the null hypothesis,  $H_{06}$ , is upheld.

### Findings of the Study

The analysis of the results has yielded the following findings:

3. Political factors responsible for the slow pace of educational development of Koma District are prolonged neglect by successive governments in providing social amenities, poor political representation in governance, bias in appointments, political manipulation in elections, and infrequent visits by successive governments, among others.
4. Economic factors responsible for the slow educational development of Koma District are lack of adequate natural resources, inadequate social infrastructure, high rate of unemployment, neglect by successive governments in resource allocation, and high poverty rate among the Koma.
5. Provision of social amenities, increased funding, increased quota for the election of Koma indigenes into political positions, paying of political attention by way of legislation on the development of the Koma people, and declaration of an educational emergency for the development of the Koma people were among the strategies found to enhance the educational development of the Koma people, if adopted.
6. There was no significant difference between the mean responses of resident and non-resident indigenes on the political factors responsible for the slow educational development of Koma District. The null hypothesis,  $H_{01}$ , was therefore, upheld.
7. There was no significant difference between the mean responses of resident and non-resident indigenes on the economic factors responsible for the slow educational development of Koma District. The null hypothesis,  $H_{02}$ , is therefore, upheld.
8. No significant difference between the mean responses of resident and non-resident indigenes on the strategies to adopt to enhance the educational development of Koma District. Therefore, the null hypothesis,  $H_{03}$ , is upheld.

### Discussion of Findings

The study found in Table 1 the political factors responsible for the slow pace of educational development of Koma District to include are prolonged neglect by successive governments in providing social amenities, poor political representation in governance, bias in appointments, political manipulation in elections, and infrequent visits by successive governments. This study is supported by the Daily Trust Newspaper (2015, November 7<sup>th</sup>), which reported among other things that successive Government after Madaki failed to continue with genuine agenda to bring civilization to the people as the mobilisation of people to embrace modern civilization started and ended with the late military governor. The finding is also supported by Aluede (2006) who stated

that “On the contrary, rural areas witnessed lack of establishment of schools. Where schools are available, teachers either resist or refuse transfer to those rural areas for lack of social amenities”. Ezewu and Tahir (1997) gave a clearer explanation of the common situation in rural and riverine areas with regards to educational development. There has been highly inadequate quantity and quality of infrastructure. Facilities such as markets, health centres and recreational centres, which affect settlements, are not available in the rural areas. Aluede further stated that the implication of this for education is that the rural areas stand disadvantaged in educational provision, supervision and educational data needed by researchers. This finding is also supported by Julie’s (2011) work which found that overzealous political power seekers circumvent the electoral process and even make it impossible for the electorate to vote the candidates of their choice. The political culture was found to be undemocratic and this was being transmitted from one regime to another through the various agents of political socialization. The welfare and needs of the governed were found to be undermined by the political class who rise to power.

The study found in Table 2 that economic factors responsible for the slow educational development of Koma District included lack of adequate natural resources, inadequate social infrastructure, high rate of unemployment, neglect by successive governments in resource allocation, and high poverty rate among the Koma. This finding agrees with Jacob and Sarki (2012) whose work found that there was constant change in educational policies and insufficient facilities and equipment, were among the factors that hindered the successful implementation of the primary school curriculum. The finding is further supported by Akinpelu (2000: 80) who identified three stages of meaning which development has undergone. The first is its reference to the quantitative provision of some paraphernalia of development such as utilities and infrastructure; to the tools and materials of development, such as distribution of land and wealth, provision of credit, seeds and tools, and access to knowledge and skills for use. The second stage is its use to characterize solely economic growth in terms of per capital income, while the third stage is where the target of development process is the human person: him or her. Development at this stage is concerned with the process of changing the personality, equipping it with the necessary skills, knowledge and attitudes to conceive design and carry out his or her self-development. The work of Julie (2011) also supports this finding in which overzealous political power seekers circumvent the electoral process and even make it impossible for the electorate to vote the candidates of their choice. The political culture was found to be undemocratic and this was being transmitted from one regime to another through the various agents of political socialization. The welfare and needs of the governed were found to be undermined by the political class who rise to power.

Finding in Table 3 revealed that provision of social amenities, increased funding, increased quota for the election of Koma indigenes into political positions, paying of political attention by way of legislation on the development of the Koma people, and declaration of an educational emergency for the development of the Koma people were among the strategies found to enhance the educational development of the Koma people, if adopted. This finding is supported by Rodney (2005:1) who perceived development from two levels: these are levels of the individual and social groups. At the individual level, development implies increased skills and capacity, greater freedom, creativity, self-discipline, responsibility and material well-being. At the level of social groups, development implies an increasing capacity to regulate both internal and external relationship. In order words, In order to deal with the educational backwardness of the Koma people, there is the need to give them equal opportunity of education, providing them functional skills that will make them useful members of the society. Again, Akinpelu (2000: 80) identified three stages of meaning which development has undergone. The first is its reference to the quantitative provision of some paraphernalia of development such as utilities and infrastructure; to the tools and materials of development, such as distribution of land and wealth, provision of credit, seeds and tools, and access to knowledge and skills for use. The second stage is its use to characterize solely economic growth in terms of per capital income, while the third stage is where the target of development process is the human person: him or her. Development at this stage is concerned with the process of changing the personality, equipping it with the necessary skills, knowledge and attitudes to conceive design

and carry out his or her self-development. Consequently, in the words of Bennet (1997) held that that vocational and general secondary education has high relationship with economic growth. Peaslee (1967) buttressed that no country has ever achieved significant economic growth without first enrolling 10% of the total population in primary schools.

The study found that significant differences did not exist between the mean scores of the responses of indigenes and non-indigenes on the political and economic factors that contributed to the slow pace of educational development of the Koma people. This finding is however, opposed by the work of Ogungboye (2012) who found that culture and economic status have significant influence on politicians' attitude towards the education of rural dwellers, especially women.

## Conclusion

Based on the findings of the study, the following conclusions were drawn. Political factors which included neglect by successive governments in providing social amenities, poor political representation in governance, bias in appointments, political manipulation in elections, are responsible for the slow pace of educational development of Koma District. Economic factors among which are lack of adequate natural resources, inadequate social infrastructure, high rate of unemployment, are responsible for the slow educational development of Koma District are neglect by successive governments in resource allocation, and high poverty rate among the Koma. Strategies such as provision of social amenities, increased funding, increased quota for the election of Koma indigenes into political positions, can enhance the educational development of the Koma people, if adopted. The study also concluded that since no significant differences existed between the mean scores of the responses of resident and non-resident indigenes of Koma District, on the political and economic factors responsible for the slow pace of educational development of Koma District as well as the strategies to enhance the educational development of the Koma people, respondents were unanimous on the five variables. This led to upholding the five null hypotheses.

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

- iv. Koma District needs to be more politically involved in governance at the local, state and federal levels.
- v. A state of emergency needs to be declared in the education sector for the Koma people.
- vi. There is need for increased participation of the private sector in the provision of education and other social amenities for the Koma people.
- vii. Government needs to provide special scholarship awards to indigenes of Koma to pursue education at various levels.
- viii. Resident and non-resident indigenes of Koma need to rise to the challenge of developing their communities in order to enhance their living conditions.
- ix. Members representing the Koma/Jada constituency needs to maintain constant contact with the people of their constituency in order to keep the Koma people abreast of government policies and the act of governance.
- x. Government needs to visit and assess the educational development of the Koma people, with a view to increasing the provision of assistance where necessary.
- xi. Koma people and their traditional rulers need to work hand in hand to embrace modernity in this age of information and globalization.

It was hoped that the data provided by the study would be found useful by non-resident indigenes in their effort to develop their area. Traditional rulers and politicians as well as non-governmental organizations would find the information provided by the study useful in enhancing their effort to reach out and develop Koma District. The organized private sector and religious organizations and international agencies would find the data provided by the study useful in that they would be able to provide scholarships to indigenes and build schools and places of worship for the Koma people. This way, the educational development of the Koma people would be enhanced.

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## **EFFECTS OF COMPUTER ANIMATION STRATEGY ON SECONDARY SCHOOLS STUDENT PERFORMANCE IN TRIGONOMETRY IN ZAMFARA STATE, NIGERIA**

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### **Abstract**

*This study sought to determine the effect of computer animation strategy on secondary school students' performance in trigonometry in Zamfara state, Nigeria. Two research questions and two hypotheses guided the study. Pretest, post test quasi-experimental research design was adopted for the study. The study was conducted in Kaura Education Zone of Zamfara State. Two hundred senior secondary school one (SSSI) students out of a total population of 4960 SSSI in the zone were drawn from 2 intact classes across 2 randomly sampled schools. Instrument used for data collection was Trigonometry Performance Test (TPT). The instrument was validated by three research experts, and TPT yielded a stability co-efficient of 0.73 obtained through test - retest approach. Research questions were answered using mean and standard deviation. Hypotheses were tested using analysis of Covariance (ANCOVA). Major findings of the study showed that experimental group, that those were exposed to the computer animation strategies; it performed better than the control group. It was recommended among other things that computer animation strategy should be used in teaching Mathematics and Trigonometry in particular in secondary schools.*

**Keywords:** Computer Animation, Strategy, Performance, Trigonometry.

### **INTRODUCTION**

Mathematics is the bedrock of science and technology and thus without the knowledge of mathematics, scientific and technological development will be difficult to achieve. According to Kratvitz (2013), Mathematics promotes science and technological development as well as facilitates the training of reasonable, thoughtful and productive citizens. Mathematics is one of the core subjects which students must pass in order to pursue their careers in higher institutions. It is a subject that helps in describing various phenomena using the concept of shapes, sizes, quantity and order (Odogwu, 2001). In recognition of its importance, mathematics is made compulsory at the primary and secondary school levels in Nigeria.

Despite numerous methods/strategies or approaches used in teaching mathematics and trigonometry in particular, reports are stills ranging in concerning persistent upward trend in students' poor performance on the subject. This is evidenced in literature(WAEC& NECO Chief examiners' reports 2010-2013. The reports from the WAEC Chief Examiners (2015) over a period of time have shown the poor performance of students in mathematics and trigonometry in particular, despite the improvement in teaching methods and learning strategies. In order to find out the causes of the low performance of students in the subject, many research works have been carried out to investigate the use of computer animation to improve the teaching and learning of mathematics. Nneji and Alio (2017) investigated effects use of computer animations strategy on secondary school students' achievement and retention in algebra in Enugu state. The finding showed that students taught with the computer animations strategy achieved higher and retained more algebra than their counter parts in the control group. Studies byEtukudo (2002) and Iji (2005) also showed that instructional strategies employed by teachers improved students' interest and achievement.

Also according to Uloko and Usman (2008), there is significant relationship between quality of training, quality of instruction and students' achievement. Thus mathematics educators expend a lot of efforts in research in a bid to improve the quality of instructions. Performance can be defined as the gain in the knowledge of students as a result of taking part in learning activity or program.

According to Mayer and Moreno (2002), animation is a form of pictorial presentation. It is also defined as computer generated motion pictures showing association between drawn figures. Things which correspond to this idea are motion, pleasure and stimulation. WhileTrigonometry, is the study of triangles in relation to their sides and angles. It is widely applied in many discipline, in particular trigonometric functions have come to play great roles in science. Gender is a psychological terms describing behaviors and attributes of an individual on the basis of being born as either male or female students and show no difference in the performance (Salman & Ameen, 2014).

## **STATEMENT OF THE PROBLEM**

A lot of studies have shown that an effective teaching approach increases students' performance in learning tasks. (Olunloye,2010, Olosude,2013; Abakpa&Igwue,2013) However, students' performance in mathematics especially trigonometry particular is poorly attempt both on internal and external examinations. This was carried out to determine if the adoption of computer animation strategy as an instructional strategy by mathematics teacher would improve the SS 1 student's performance in trigonometry.

## **PURPOSE OF THE STUDY**

The purpose of this study was to determine the effects of computer animations strategy on secondary schoolstudents' performance in trigonometry in Zamfara state. Specifically, thestudy aimed at finding out the effects of computer animations strategy on secondary school one (SSS I) students' performance in trigonometry.

## **RESEARCH QUESTIONS**

To guide the study two research questions were constructed:

- viii. What is the difference between the mean performance scores of SS I students in trigonometry class taught using computer animations strategy and those exposed to lecture method?
- ix. What is difference between the mean performance scores of SS I male and female students in trigonometry class taught using computer animations strategy and lecture method?

## **RESEARCH HYPOTHESES**

Also to guide this study two null hypotheses were formulated and tested at 05 level of significance:

5. There is no significant difference between the mean performance scores of students taught trigonometry using computer animation strategy and those taught without.
6. There is no significant difference between the mean performance score of male and female students taught trigonometry using computer animation strategy and those taught without.

## METHODOLOGY

The study employed a quasi-experimental design of pre-test post-test control group design. Intact classes were used to avoid disrupting school programmes for experimental purpose. A sample of 200 out of 4960 SSI students from two of 14 senior secondary schools in Kaura Namoda Educational Zone was used. Stratified random sampling method was adopted in order to fulfill the criteria for selection. The population was subdivided into strata: males and Females schools. Thereafter, a simple random sampling was used to select two schools. From each of school selected, a class with two or more stream was further selected for the study. Since intact classes were used, the entire students of each selected class were used for the study. The research instrument was Trigonometry Performance Test (TPT) constructed by the researchers. Initially, TPT consisting of 50 multiple choice items of four options were given to three experts, two in mathematics education and one from computer Science Department of the Ahmadu Bello University Zaria for validation. Their corrections and suggestion resulted in the final draft of 40 multiple choice items. The topics taught during the study comprised: (i) Pythagoras theorem (ii) Trigonometry ratio (iii) special Angles (iv) angle of elevation and depression.

The items were trial tested on twenty students in a school different from those used for the study. A test – retest method was used to ascertain the reliability of the instrument. Reliability coefficient was established, using Pearson product moment correlation coefficient. Its value was 0.73 and this indicates that the instrument was valid and reliable.

TPT were administered as pre test and post test. Two teachers were engaged to teach for four weeks using the prepared lesson plans. One of the teacher taught the experimental group, while the other teacher taught the control group. The re-organized version of TPT was administered as post-test in both control and experimental school. The teachers administered the test to their students at the end of treatment. The scripts were marked by the researcher so minimize difference in scoring. The researchers computed mean and standard deviation to answer the research questions. While Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance.

## RESULTS

In order to answer the research questions on performance, the mean and standard deviation of the pre-test and post-test of student's performance in trigonometry based on the variable of teaching strategy (computer animations versus lecture method).

**Table 1:** Means and standard deviation of the pre-test and post-test of performance test in trigonometry

GROUP	NUMBER	PRE-TEST		POST TEST	
		MEAN	SD	MEAN	SD
Experimental	100	8.62	3.20	12.00	4.03
Control	100	7.20	2.96	6.76	2.25
<b>Total</b>	<b>200</b>	<b>15.82</b>	<b>6.16</b>	<b>18.76</b>	<b>6.28</b>

The result of table 1 presents the means score and standard deviation of both the pre -test and post-test performance of the students in the experimental and control groups. The mean scores of pre -test of the experimental group was 8.62 and a standard deviation of 3.20 in pretest, while control group had a mean and standard deviation of 7.20 and 2.96 respectively. In post test of (TPT), the mean score and standard deviation of experimental group were 12.0 and 4.03 respectively. While mean score and standard deviation of control group were 6.76 and 2.25 respectively. This result shows that the students in the experimental group improved upon their Trigonometry Performance Scores than the students in control group as shown by their higher difference in the mean scores.

## Research Hypothesis 1

There is no significant differences between the mean performance scores of students taught trigonometry using computer animation strategy and those taught without. To test this hypothesis, ANCOVA statistics was computed as shown in Table 2

**Table 2:** Summary of ANCOVA of post-test scores of the difference of the means of two groups

SOURCE	SS	DF	MS	F-CAL	SIG
Corrected model	2931.170	2	512.561	93.821	.000
Intercept	126169.252	1	126169.262	205.111	.000
Pre test	171.640	1	171.640	31.456	.000
Method	2688.220	1	2658.220	132.176	.000
Gender	216.000	1	216.000	10.111	.146
Method x gender	1.391	1	1.391	0.78	.615
Error	51187.493	1.93	20.423		
Total	14863.000	200			
Corrected total	2722.693	199			
a R squared = .361 (adjusted R squared = .354)					

Table 2 shows that the main effect, teaching strategy,  $F(1, 199) = 0.000$ ,  $P < 0.05$  is statistically significant with F- Critical value = 0.000 . Hence the hypothesis is rejected. This means that the students taught computer animation strategy significantly achieved higher scores than the students taught lecture method.

Also from table 1 the mean of the experimental group that was taught using computer animation strategy was higher with (12.00) with standard deviation of 4.03, while the mean of the control group taught lecture method was (6.76) with standard deviation of 2.25. This indicates that the difference was in favor of the experimental group that learned by using computer animation strategy. Which means that the use of computer animations strategy had the effect on the performance of the SS I students in trigonometry compare to the lecture method.

### Research hypothesis 2

There is no significant difference between the mean performance scores of male and female students taught trigonometry using computer animation strategy and those taught without

Table (2) also shows that there is no significant difference on the gender variable (male and female) among students taught with computer animations strategy and those taught with lecture method, which ( $f = (1, 199) = 0.146$ ,  $P > 0.05$ ). the second null hypothesis that says there is no significant difference between mean performance scores of male and female student taught trigonometry using computer animations strategy and those exposed to lecture method is therefore retained.

### DISCUSSION OF THE FINDING

This study investigated the effect of computer animations strategy on senior secondary school students' performance in trigonometry. In this study computer animations strategy was found to be more effective in enhancing students' performance than lecture method of teaching, and the findings from this study showed that there was a significance difference between the performance mean scores of senior secondary school (SS I) students taught trigonometric concepts using computer animations strategy and those taught using lecture methods. The finding agrees with the finding of Nneji & Lio (2017) who observed that students exposed to computer animations strategy achieved higher and retained more algebra concepts than their counterparts in lecture method.

The finding from this study also showed that there was no difference between the performances scores of male and female SS I students taught trigonometric concept using computer animations and lecture method. This showed that both computer animations and lecture method are not gender sensitive in the teaching of trigonometric concept. This finding is supported by the work of other researchers on the performance scores of male and female students with respect to treatment given to the students (Salman & Ameen, 2014; Attah&Guwan, 2015).

These findings confirmed that when male and female students are exposed to mathematics, specifically trigonometry, using different methods of teaching, their performance will not differ significantly.

## CONCLUSION

The results of the study analyzed indicated that generally computer animations strategy represents an effective teaching method in teaching trigonometry and mathematics in general. However, it shows that both the two teaching methods were not gender sensitive in teaching trigonometry concepts.

## RECOMMENDATIONS

In light of the results of this study, the researchers recommend the following:

- vi. The need for specialized training program and resources for mathematics teachers to use computer animation strategy in teaching trigonometry and mathematics in general.
- vii. Proprietors of schools provide learning materials especially, computers and internet services in the schools.

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**EFFECT OF OUTDOOR LABORATORY METHOD ON GEOGRAPHY  
ACHIEVEMENT OF SENIOR SECONDARY SCHOOL STUDENTS IN JOS NORTH  
LOCAL GOVERNMENT AREA, PLATEAU STATE.**

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**Abstract**

The study investigated the effects of outdoor laboratory method on the achievement of senior secondary school students in Geography in the study area. A sample of 180 students was used for the study. The pure experimental design was employed in conducting the study. Four research questions and three hypotheses were answered and tested using the results obtained from students' answers on the instrument (Geography Achievement Test – GAT). Mean, standard deviation and t-test of independent samples were the statistical tools used to analyse the data for the study. Results of the analysis indicated significant difference between the experimental and control groups in favour of the experimental group. The results further revealed no difference in the Geography achievement of public and private schools, as well as of male and female students in the experimental group. It was therefore concluded from the results of the study that outdoor laboratory is an effective method for teaching Geography in senior secondary schools in the study area and possibly elsewhere in Nigeria. Based on this outcome, it was recommended among others that curriculum planners and Geography teachers should include and adopt outdoor laboratory teaching method in the curriculum and teaching of Geography respectively.

**INTRODUCTION**

Science is a great enterprise which nations depend on to advance technologically. Geography is one of the science subjects taught in senior secondary schools and tertiary institutions in Nigeria. It is concerned with the scientific study of natural features and phenomena of the earth's surface. Geography as a science is geared towards teaching the interrelationship among phenomenon on the earth surface and those in the atmosphere (Nigeria Educational Research and Development Council (NERDC) 2007; Abdulkarim, 2010). Geography is sub divided into human, physical, regional and map reading. These divisions of Geography require diverse teaching methods to ensure effective learning by students.

Outdoor laboratory is one of the methods Geographers can explore to effectively deliver the Geography curriculum at all levels of learning. Outdoor laboratory is believed by experts in education, particularly experts in Geography and environment education, to have the power to bring phenomena of the environment to the classroom because it encourages knowing by seeing. This enhances learning because students are taken to the environment to see what is in the textbooks, which led to better understanding of Geography. This means that one way to make sure students learn Geography effectively is for Geography teachers to apply outdoor laboratory in their teaching.

Outdoor laboratory refers to organized learning that takes place outside and not within the confines of the classroom, using natural features as laboratory for experiment which involves the

use of all senses. It takes place primarily but not exclusively, through exposure to the natural environment. Thus, the classroom is a great avenue for learning, but stepping into the natural environment as an outdoor laboratory supplements the traditional lecture in a real and unique way. This is essential as the environment provides a wide range of opportunities for students to have real life experience outside the classroom. With the outdoor laboratory method, teaching can be more interesting, fun, effective, spontaneous, inspiring and student centered in nature. It provides unique way of relating the deep learning inside the classroom and the real world. Geography as a science is activity based and the suggested method for teaching it is practical in nature (Otagbo, 2010). Otagbo emphasizes that the methods adopted in the teaching of Geography are determinant of student's achievement. This study experiment the effectiveness of outdoor in relation to senior secondary school student's achievement in Geography.

### **PROBLEM OF THE STUDY**

Despite the relevance of Geography as a science subject to a nation's technological development and economic progress, the subject has suffered set back. This has been seen in the poor achievement of geography senior secondary school students over the years. The chief examiner's reports of West African Examination Council (WAEC) for the past ten years (2007-2016) indicated that students achievements has been consistently poor (Dakur, 2018). Various reasons are attributed to this poor achievement among which include teaching methods, lack of interest on the part of the students, voluminous nature of the subject (Obeka, 2010; Abdulkarim, 2010). Often times, as pointed out by the authors, teachers who are not sufficiently competent are employed to deliver lessons in the classroom, such lessons are usually delivered by expository instructional method, which consist mainly of teacher dominated talks. This practice is most probably responsible for student's poor achievement in Geography's public examination such as WAEC and NECO. The researchers are therefore motivated to investigate the extent to which outdoor laboratory could provide an experimental solution to the phenomena of students' failure in Geography.

## PURPOSE OF THE STUDY

The purpose of the study was to investigate the effects of outdoor laboratory method on Geography achievement of senior secondary school students in Jos North Local Government, Plateau State, Nigeria. This was accomplished through determining the following specific objectives:

- viii. The pretest Geography achievement mean scores of the experimental and control groups.
- ix. The posttest Geography achievement mean scores of the experimental and control group.
- x. The posttest Geography achievement mean scores of male and female students in the experimental group.
- xi. The posttest Geography achievement mean scores of private and public school students in the experimental Group.

## RESEARCH QUESTIONS

Four research questions were answered during the study. These include the following:

- x. What is the pretest Geography achievement mean scores of the experimental and control groups?
- xi. What is the posttest Geography achievement mean scores of the experimental and control groups?
- xii. What is the posttest Geography achievement mean scores of male and female students in the experimental group?
- xiii. What is the posttest Geography achievement mean scores of private and public school students in the experimental group.

## RESEARCH HYPOTHESES

The following three hypotheses were tested at 0.05 level of significance:

- xii. There is no significant difference between the experimental and control group on posttest geography achievement mean scores.
- xiii. There is no significant difference between male and female students in the experimental group on posttest Geography achievement mean scores.
- xiv. There is no significant difference between public and private school in the experimental groups on posttest Geography achievement mean scores

## METHODOLOGY

The pure experimental research design, specifically the pretest – posttest control group research design was adopted for the study. Thus, two groups, experimental and control groups were used, where the experimental group was taught using outdoor laboratory method and the control group, lecture method.

The population of the study consisted of all senior secondary school (SSI) students in Jos North Local Government Area of Plateau State. The total number of SS1 Students in Jos North was 1,590, distributed in private and public schools. The students from public schools were 534 and 1,056 in private schools.

The stratified sampling method was used to select 180 students who were used for the study. Thus, one school each from private and public schools was selected and used for the study using the stratified sampling method. All the SS1 students in the selected private and public schools were randomly assigned to the experimental and control groups. This process gave rise to 81 students in the experimental group and 99 in the control group. The process also gave rise to 39 boys and 42 girls in the experimental group and 43 boys and 56 girls in the control group respectively. The sample was made up of 101 students in private school and 79 in public school, consisting of 42 in the private 39 in the public schools for the experimental group, and 59 in the private and 40 in the public schools for the control group.

The data for the study was obtained through the use of a Geography Achievement Test (GAT) containing twenty items in the form of multiple choice supply test with alternative responses



A-D. Three Geography topics were used for the study, namely: Weather, Climate and Rock types. The choice of these topics was informed by student's difficulty in comprehension, evidenced by their failure to correctly answer questions on the topics. (WAEC Chief examiner's reports 2015, 2016 & 2017), resulting from teachers' inability to apply the appropriate teaching method. The experiment lasted for seven weeks during the normal geography periods in the two sampled schools. Each lesson lasted 40 minutes. The experimental group was taught using outdoor laboratory method while the control group was taught using the traditional lecture method. Pretest was administered at the commencement of the experiment to both groups, while posttest was administered after the experiment. Each of the tests, lasted one hour and each item test was scored two marks for correct answer.

The statistical techniques employed in analyzing the data were mean, standard deviation and t-test of independent samples. The mean and standard deviation were used to answer the research questions, while the t-test was used to test the hypotheses.

## RESULTS

Four research questions were answered and three hypotheses tested as follows:

**Research Question One:** What is the pretest Geography achievement mean score of the experimental and control groups.

The pretest Geography achievement mean scores of the experimental and control groups were used to answer the research questions.

**Table 1: Pretest Achievement Mean Scores of the Experimental and Control Groups**

Group	Pretest N	$\bar{X}$	SD	$\bar{X}$ diff.
Experimental	81	32.06	21.02	1.54
Control	99	30.52	10.04	

Table 1 shows that the pretest achievement mean score for the experimental group ( $\bar{X} = 32.06$ ) is slightly more than the pretest mean score of the control group ( $\bar{X} = 30.52$ ) with mean difference ( $\bar{X}$  diff = 1.54). This means that the pretest achievement mean scores for the experimental and control groups were almost the same.

**Research Question Two:** What is the posttest Geography achievement mean scores of the experimental and control groups?

**Table 2: Posttest Geography Achievement Mean Scores of the Experimental and Control Groups**

Group	Posttest N	$\bar{X}$	SD	$\bar{X}$ diff.
Experimental	81	80.04	23.13	31.88
Control	99	48.16	22.11	

The data in Table 2 show that the posttest achievement mean scores of the experimental group ( $\bar{X} = 80.04$ ) is higher than the posttest mean scores of the control group ( $\bar{X} = 48.16$ ) with mean difference ( $\bar{X} = 31.88$ ). This means that the outdoor laboratory method improves students' understanding of Geography.

**Research Question Three:** What is the posttest Geography achievement mean scores of male and female students in the experimental group?

The posttest Geography achievement of the experimental group were used to answer this research question.

**Table 3: Posttest Geography Achievement Mean Scores of Male and Female Students**

Group	Gender	N	$\bar{X}$	SD	$\bar{X}$ diff.
Experimental	Male	39	82.85	20.85	3.17
Experimental	Female	42	79.68	25.14	

The data in Table 3 show that male students in the experimental group had slightly higher Geography achievement mean score ( $\bar{X} = 82.85$ ) compared to the mean score of female students ( $\bar{X} = 79.68$ ), with mean difference ( $\bar{X}$ diff = 3.17). This means that outdoor laboratory method influenced the achievement mean scores of male students more than their female counterparts.

**Research Question Four:**What is the posttest Geography achievement mean scores of private and public school students in the experimental group?

The posttest Geography Achievement scores of students in the experimental group were used to answer this research questions.

**Table 4: Posttest Geography Achievement Mean Scores of the Experimental Group based on School Type.**

Group	School Type	N	$\bar{X}$	SD	$\bar{X}$ diff.
Experimental	Public	36	79.82	3.14	0.19
Experimental	Private	45	80.01	3.80	

The data in Table 4 indicate that the posttest Geography achievement mean score of students in public schools ( $\bar{X} = 79.82$ ) is almost equal to that of the mean score of students in private school ( $\bar{X} = 80.01$ ) giving a mean difference ( $\bar{X}$ diff = 0.19). This shows that the outdoor laboratory method did not have any differential effects on the public and private school students on Geography achievement mean scores.

**Hypothesis One:**There is no significant difference between the experimental and control groups on posttest geography achievement mean scores.

**Table 5: Summary Table for t-Test of Difference between Experimental and Control Group on Posttest Geography Achievement Mean Scores.**

Group	N	$\bar{X}$	SD	$\bar{X}$ diff.	t	P-Value
Experimental	81	80.04	23.13	31.88	9.46	.000
Control	99	48.16	22.11			

The data in Table 5 shows that the results of t-test independent groups indicate a significant difference between the experimental and control groups on posttest geography achievement mean scores. Thus,  $t=9.46$ ,  $p=.000$  ( $p < .05$ ) provides sufficient evidence for the rejection of the null hypothesis. It was therefore concluded that there was a significant difference between the experimental and control groups on posttest Geography achievement mean scores.

**Hypothesis Two:**There is no significant difference between male and female students in the experimental groups on posttest geography achievement mean scores.

**Table 6: Summary Table for t-Test of Difference between Male and Female Students on Posttest Geography Achievement Mean Scores.**

Group	Gender	N	$\bar{X}$	SD	$\bar{X}$ diff.	t	P-Value
Experimental	Male	39	82.85	20.99	5.87	1.21	.231
Control	Female	42	79.68	25.14			

The data in Table 6 show that the results of t-test of independent samples prove insignificant difference between male and female student on posttest Geography achievement mean scores. The result  $t=1.21$ ,  $p=.231$  ( $p > .05$ ) give sufficient basis for the acceptance of the null hypothesis. It was therefore concluded that there was no significant difference between male and female students in the experimental group on posttest Geography achievement mean scores.

**Hypothesis Three:** There is no significant difference between public and private schools in the experimental groups on posttest Geography achievement mean scores.

**Table 7: Summary for t-Test of Difference between Public and Private School in Experimental Group on Posttest Geography Achievement Mean Scores**

Group	School Type	N	$\bar{X}$	SD	$\bar{X}$ diff.	t	P-Value
Experimental	Public	79	79.82	3.14	0.19	.091	.927
Control	Private	101	80.01	3.80			

The result of t-test of independent sample as shown in Table 7 show no significant difference between public and private school students on posttest Geography achievement mean scores. Thus,  $t=.091$ ,  $p=.927$  ( $p > .05$ ) provided sufficient ground for the acceptance of the null hypothesis. Therefore, it was concluded that there was no significant difference between public and private school students on posttest Geography achievement mean scores.

## CONCLUSION AND RECOMMENDATIONS

Based on the results of the study, it was concluded that outdoor laboratory is an effective method of teaching Geography in senior secondary schools in the study area and possibly elsewhere in Nigeria and beyond. Consequently, the following recommendations were made.

1. Geography teachers should adopt and use outdoor laboratory teaching method as it is an effective method for improving learning in the subject.
2. Both federal and state ministries of education in the country should enforce and monitor the application of outdoor laboratory teaching at the secondary school levels, while adequate funding should be provided to ensure its effectiveness.
3. Curriculum planners in the country should include outdoor laboratory teaching method in the Geography curriculum for senior secondary schools in Nigeria.
4. In-service training programmes in the form of seminars and workshops should be organized for geography teachers by ministries of education.
5. Teachers training institutes should also include outdoor laboratory teaching method in their curriculum.
6. Outdoor laboratory teaching method is gender friendly because it aided learning among the male and female student hence it is recommended for both gender groups as an effective method of teaching Geography.

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**EFFECTS OF FLOW CHARTS AND PROJECTED PICTURES ON JUNIOR SECONDARY TWO STUDENTS' ACHIEVEMENT IN BASIC SCIENCE AND TECHNOLOGY IN BARKIN LADI, PLATEAU STATE, NIGERIA**

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### ABSTRACT

This paper investigated the effects of flow charts and projected pictures on junior secondary two students' achievement in Basic Science and Technology in Barkin Ladi, Plateau State, Nigeria. The study adopted the pre-test, post-test quasi experimental control group design. A total of 120 Junior secondary two students from two schools out of a population of 1690 students in 28 schools participated in the study. The two schools used were randomly assigned to an experimental group and a control group. The students were used in their intact class settings and as such were not sampled. A Basic Science and Technology Achievement Test (BSATAT) with a reliability index of 0.72 was used to collect data from students. Two research questions were raised and two hypotheses formulated to guide the study. The experimental group was taught Basic Science and Technology concepts for four weeks using flow charts and projected pictures while the control group was taught the same concepts for the same length of time using the lecture method. Research questions were answered using mean and standard deviation while the hypotheses were tested using Analysis of Covariance (ANCOVA) at 0.05 level of significance. Results of the study showed that students taught using flow charts and projected pictures achieved significantly higher than students taught using the lecture method. Gender was found to have no significant influence on students' achievement in Basic science and Technology. It was concluded that the use of flow charts and projected pictures was more effective in enhancing students' achievement in Basic science and Technology than the lecture method. It was recommended that teachers should incorporate the use of flow charts and projected pictures into Basic Science and Technology classrooms to enhance students' achievement in the subject.

**Keywords:** Achievement, Basic Science and Technology, Flow charts, Projected Pictures.

### Introduction

Science and technology have always been recognized as critical factors in the process of national development. Through its application, the resources of nations have been transformed into goods and services the world over. Abdul-kadir (2011) remarked that the current development in science and technology has greatly affected the lives of everyone so much so that, to be ignorant of the basic knowledge of this development is to live an empty, meaningless and probably unrealistic life. To Nsofor (2001), for any nation to attain the status of self-reliance, science must be an important component of that nation irrespective of race, creed or gender. Science is defined as the systematic body of knowledge obtained by methods or techniques based on observation and experimentation as its authority. It seeks to explain natural phenomena using enquiry processes or activities. The branches of science include biology, physics, chemistry, and can be broadly classified into natural and applied sciences (Aigbomian, 2002).

Technology refers to the application of knowledge, skills, tools and materials, methods, and processes in the production of goods and services or in the accomplishment of objectives, such as, scientific investigations. Egbogah (as cited in Nwaobasi 2011) sees technology as the primary engine of economic growth which provides the key to unlocking the country's potentials. Technology plays a significant role in wealth creation, economic growth, transformation of society and enhancement of quality of life of humans. It brings together tools to promote development, for use and exchange of information. Technology influences the way individuals think, learn and communicate; how they interact with one another and also impacts their daily lives (Wikipedia, nd). Other important features of technology include making tasks easier and helping in solving the problems of humans. The National Policy of education (FRN, 2013) presents technology education as that form of education which equips individuals with appropriate skills, abilities, competencies as equipment for the individual to live in and contribute to the development of the society.

In recognition of the relevance of science and technology, the federal government of Nigeria prescribed Basic Science and Technology as one of the core subjects taught at the Basic level of education in Nigeria. It is a foundational course for the future study of all the other science and technology-based subjects at the senior secondary and tertiary levels. Its objectives include to enable learners develop interest in science and technology; acquire basic knowledge and skills in science and technology, apply their scientific and technological knowledge and skills to meet societal needs; become prepared for further studies in Science and technology (FRN, 2007).

Despite the relevance of basic science and technology as a foundational course for the sciences and national development, research report by Katniyon and Mundi (2011) reveals that students' achievement in Basic Science and technology has been consistently poor. The implication is that obtaining the required workforce to take the nation to the next level in science and technology development might be a mirage. Moreover, Nigeria would continue to lag behind in the global scene as far as technological advancement is concerned.

The teaching and learning of all science subjects in general and Basic Science in particular require a lot of instructional media which are channels of communication through which messages, information, ideas and knowledge are conveyed or disseminated to learners (National Teachers' Institute [NTI], 2011). Projected instructional pictures are used to display moving or still pictures as well as opaque materials. A variety of materials such as book pages, objects, coins, postcards or any other flat materials that are non-transparent are projected and its effectiveness depend on the quality of the projected image. This media could help to reduce the abstract nature of the concepts and enhance students' achievement and retention of Basic Science concepts. Projected instructional pictures do not seem to be available in many schools, where they are available; they are grossly inadequate in supply. The scarcity of instructional media in many schools today has resulted in ineffective teaching of science and technology subjects leading to poor achievement of students both in internal and public examinations. Factors responsible for students' poor achievement in science, technology and mathematics are poor laboratory facilities, inability of science teachers to put across ideas clearly to the students and inadequate quantity of instructional resources, such as pictures, charts; technologies and facilities in schools, as against, consistent increase in the number of schools and students' enrolment (Eniayeju, 2007).

Projected instructional Pictures are those channels of communication which promote the effectiveness of instruction and help the teacher to communicate ideas effectively to his students (Ali, 2012). These Pictures are alternative channels of communication which a Basic science and Technology teacher can use to concretize abstract concepts during his teaching. Projected pictures aim at grasping or stimulating students' attention, sprouting and arousing their interest, supporting their learning with living examples and visual elaboration, which make classroom learning environment enjoyable (Isola, 2010). They assist in achieving stated behavioural objectives when evaluation is carried out at the end of the lesson or programme in testing knowledge and ability, and help both male and female students to retain knowledge for longer periods (Awolaju, 2015).

Gender has been an issue of concern in science and technology education research. It is one of the factors interacting with achievement in STEM education. Some of the factors responsible for the observed differences in the achievement of males and females according to Dabo (2019) are sex-role stereotyping, masculine image of science and its related subjects and female socialization process. Studies by Gotom, Ozoji and Odigiri (2020) and Igidi (2019) showed no significant differences between the mean achievement scores of male and female students in Basic Science and Technology. On the contrary, Ifeakor (2005) and Obekpa (2013) observed gender differences in the achievement of students in science. The issue of gender and science achievement have been seen to be inconclusive and as such requires more empirical studies.

### **Statement of the Problem**

The persistent poor achievement of students in Basic Science and Technology in Nigeria at the Junior Secondary School level of education is a matter of serious concern to all educationist and other stakeholders. The Basic Education Certificate Examinations results from 2018 showed that students' achievement in Basic Science and Technology was poor (Gotom, Ozoji & Odigiri, 2020). This may be because of the abstract nature of some science concepts. Another widely accepted factor responsible for underachievement in Basic Science and Technology is the use of ineffective teaching methods in science and technology classrooms. If the persistent low achievement of students in Basic Science and Technology is left unchecked, the 60: 40 ratio mandate by the government on United Tertiary Matriculation Examinations for university admissions in the nations' universities cannot be achieved.

The implication is that getting students to pursue science and technology-based courses and careers, such as, Medicine, Pharmacy, Engineering, Bio-technology would be difficult. There is therefore, an urgent need for a paradigm shift in the ways science and technology subjects are taught in schools. One way to achieve this is through the incorporation of innovative technologies/aids into science and technology classrooms, such as, flow charts and projected instructional aids. The problem of this study therefore, was to find out if the use of flow charts and projected pictures in teaching science and technology concepts could enhance students' achievement outcomes in Basic Science and Technology.

### **Purpose of the Study**

The purpose of this study was to investigate the effects of flow charts and projected pictures on JS two students' achievement in Basic Science and technology in Barkin Ladi, Plateau State, Nigeria. Specifically, the objectives of the study were to:

13. Find out the mean difference between the mean achievement scores of JS 2 students taught Basic Science and Technology using flow charts and projected pictures and their counterparts taught using the lecture method.
14. Find out the mean difference between the mean achievement scores of JS 2 male and female students taught Basic Science and Technology using flow charts and projected pictures.
15. Find out the effects of flow charts and projected pictures on JS 2 students' achievement in Basic science and technology.
16. Determine whether gender would have any influence on JS 2 students' achievement in Basic Science and Technology.

### **Research Questions**

The following research questions were raised to guide the study:

7. What is the mean difference between the post-test mean achievement scores of JS 2 students taught Basic Science using flow charts and Projected pictures and their counterparts taught without projected instructional pictures?
8. What is the mean difference between the post-test mean achievement scores of JS 2 male and female students taught Basic Science and Technology using flow charts and projected pictures and those taught with the lecture method.

### Hypotheses

The following hypotheses were tested at 0.05 level of significance:

- i. There is no significant difference between the mean achievement scores of JS2 students taught Basic Science with flow charts and projected pictures and those taught using the lecture method.
- ii. There is no significant difference between the mean achievement scores of JS2 male and female students taught Basic science using flow charts and projected pictures.

### Method

The study adopted the pre-test, post-test quasi experimental control group research design. The population for the study comprised 1690 Junior secondary two students (JS 2) in the study area. A total of 120 Basic science students constituted the sample for the study. The simple random sampling technique was used to select two schools with a population of 1690 JS 2 students in Barkin Ladi local government area in the State. The schools chosen were randomly assigned to an experimental and a control group, respectively. In each of the schools selected, an intact class made up of 60 students was used. The instrument for data collection was a Basic Science and Technology Achievement Test (BSTAT). The instrument comprised two sections, namely, sections A and B. Section A sought information on the demographic variables of the participants, such as, name of school, name of student and gender. Section B was a 40-item multiple choice objective questions with options A – D adopted from past BECE questions. Each correct answer was allocated two and a half marks while each wrong answer attracted a zero score.

The BSTAT was validated by two experts, one from Test and Measurement in the Department of Educational Foundation and the other from the Department of Science and Technology Education, all in the Faculty of Education, University of Jos. The reliability index of the BSTAT established as 0.72 using the Cronbach alpha method. Mean and standard deviation were used to answer the research questions while ANCOVA was used to test the hypotheses at 0.05 level of significance. The BSTAT was administered to the experimental and control groups as pre-test. Thereafter, the experimental group was taught the concepts of nutrition, family and health for four weeks by one of the researchers using flow charts and projected pictures. The control group was taught the same concepts for the same period of time by one of the researchers using the lecture method. After the teaching exercise both groups of students were exposed to a post-test on BSTAT.

### Results

#### Research Question 1

What is the mean difference between the post-test mean achievement scores of JS two students taught Basic Science and Technology using flowcharts and projected pictures and those taught with the lecture method?

**Table 1: Basic Science and Technology Post-test Mean Achievement Scores of JS Two Students taught with Flowcharts and Projected Pictures and those taught Using Lecture Method.**

Groups	N	$\bar{X}$	SD	Mean difference
Experimental	60	53.93	7.99	9.43
Control	60	44.50	8.43	



Table 1 shows Basic Science and Technology post-test mean achievement scores of JS two students taught with flow charts and projected pictures and those taught using lecture method. Students taught using flowcharts and projected picture had a post-test mean score of 53.93 and standard deviation score of 7.99, while the those in control group had a post-test mean achievement score of 44.50 and standard deviation of 8.43. The mean difference between the post-test mean achievement scores of the experimental and control groups is 9.43.

### Research Questions 2

What is the mean difference between the post-test mean achievement scores of JS Two male and female students taught using flowcharts and projected pictures.

**Table 2: Post-test Mean Achievement Scores of JS 2 Male and Female Students taught with Flow charts and Projected Pictures**

Groups	N	Mean	SD.	Mean Diff.
Male	30	54.70	7.91	1.53
Female	30	53.17	8.12	

Table 2 shows the Basic Science and Technology post-test mean achievement scores of JS two male and female students in the experimental group as 54.70 and 53.17, respectively, with standard deviations 7.91 and 8.12. The mean difference between the post-test mean achievement scores of the experimental and control groups is 1.53.

### Hypothesis 1

There is no significant difference between the Basic Science and Technology post-test mean achievement scores of JS two students taught with flow charts and projected pictures and those taught using the lecture method.

**Table 5: Summary of Analysis of Covariance of Basic Science and Technology post-test achievement mean scores of JSS two students taught with flow charts and projected pictures and those taught using lecture method.**

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Squared	Eta
Corrected Model	1791.006 <sup>a</sup>	3	597.002	110.709	.000	.693	
Intercept	9771.949	1	9771.949	1812.125	.000	.925	
Groups	3.28.019	1	328.019	60.828	.000	.293	
Gender	.030	1	.030	.003	.953	.000	
Test	1354.159	1	1354.159	251.117	.000	.631	
groups * test	533.802	1	533.802	98.989	.000	.402	
Error	792.703	118	5.393				
Total	11115.000	120					
Corrected Total	2583.709	121					

a. R Squared = .693 (Adjusted R Squared = .687)

Table 1 shows the summary of Analysis of Covariance of post-test mean Basic Science and Technology achievement scores of JSS two students taught with flow charts and projected pictures and those taught using lecture method. This result indicates that ( $F_{(1, 120)} = 60.83, p = 0.00$ ). The p-value 0.000 is less than 0.05 level of significance. Therefore, there is effect of post-test achievement mean scores of JS two students taught with flow charts and projected pictures and those taught using lecture method. Hence, the null hypothesis was rejected showing a statistically significant effect.

**Hypothesis 2:** There is no significant difference between the Basic Science and Technology post-test mean achievement scores of JS two male and female students taught with flow charts and

projected pictures. This Gender result indicates that ( $F_{(1, 151)} = .003$ ,  $p = .953$ ). The p-value 0.953 is greater than 0.05 level of significance. Therefore, there was no significant difference between Basic Science and Technology mean achievement scores of JS two male and female students taught using flow charts and projected pictures.

### Discussion

The findings of this study showed that students taught with flow charts and projected pictures achieved significantly better than the students taught using the lecture method. The significant difference could be as a result of the ability of the flow charts and projected pictures which must have provide both aural and visual representations of experimental procedures. This could also be due to the fact that projected pictures have the potential to make students learn more because fun and entertainment are natural ways through which students learn, therefore, improving the achievement in Basic Science and Technology. The fore-going findings are in line with the previous research findings by Okwara, Anyagh and Ikyaan (2017), Awolaju (2015), Abdu-Raheem (2012), Abakpa (2011), Musa and Agwagah (2006) which indicated that students achieved significantly better when taught with projected instructional pictures than without projected instructional Pictures. The result is also in line with the finding of National Reading Panel (2000) which showed that use of graphic organizers was one of the seven most effective instruction strategies for learning.

The results of this study further showed that gender had no significant influence on students' achievement in Basic science and Technology. Therefore, the use of flow charts and projected instructional combined still and motion pictures which captured students' attention and helped them to learn meaningfully and achieve well in the subject.

However, the result of this study is at variance with the findings of previous researchers, such as, Abdu-Raheem (2012) and Ariyo (2014 as cited in Okwara et al.2017) who observed that gender, had significant effect on students' achievement in favour of males. However, the findings of this study are in agreement with that of Peter (2014) and Sunday (2014) each of which found no significant difference in academic achievement of male and female students in science.

### Conclusion

It was concluded that the use of flow charts and projected pictures was more effective in enhancing students' achievement in Basic science and Technology than the lecture method.

### Recommendations

Based on the findings of this study the following recommendations were made:

9. Basic science and Technology teachers should incorporate the use of flow charts and projected pictures into the teaching of Basic science and Technology especially for topics that are abstract and difficult.
10. Projected instructional pictures should be used to promote gender-equality in science and technology classrooms and to make sciences interesting to girls..

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**EFFECTS OF LABORATORY AND LECTURE METHODS OF TEACHING ON  
SENIOR SECONDARY TWO STUDENTS' ACHIEVEMENT IN PHYSICS IN  
CENTRAL ZONE OF PLATEAU STATE, NIGERIA**

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**Abstract**

The study was carried out to determine the effects of laboratory and lecture methods of teaching on senior secondary two students' achievement in Physics in Central Zone of Plateau State, Nigeria. The study used a survey research designed and quasi-experimental research design, pretest-posttest control group specifically was used for quasi-experimental because the experiment was conducted with students in their intact classes. All 3237 SSII physics students from the zone made up the population for the study from 583 registered secondary schools, i.e. 106 public and 477 private. The sample for the study was made up of 300 Senior Secondary two (SS2) students from twelve (12) selected Senior Secondary Schools in the central zone of Plateau state (six each for experimental and control group were selected using simple random sampling technique). The sample comprised of 158 male and 142 female, the experimental group has 89 males and 76 females while control group has 69 males and 66 females. This clearly showed that the sample consisted 165 students' in the experimental group while 135 students' for the control group. The data for the study was collected using three instruments: Physics Achievement Test (PAT) was used for pretest and posttest; Physics Equipment Check List for availability (PECLA) and Physics Laboratory Equipment Utilization Questionnaire (PLEUQ). The PAT was made up of twenty multiple choice

objective items on electricity, simple harmonic motion and waves. PECLA has 35 list or number of some common laboratory facilities which were checked from each school laboratory by the researcher as to whether available or not. PLEUQ has two sections: the general information such as gender, school type and the other section was based on the utilization of 35 list of facilities as to whether they used them very-often, often, not so often or not at all. The three instruments were validated by two expert in the department of physics and one expert in test measurement and Evaluation University of Jos. PAT and PLEUQ were pilot-tested and the reliability coefficient for internal consistency was established using Cronbach Alpha method, while PECLA used kalpha method and the SPSS version 22 was used for its computation and were respectively found to be 0.64, 0.78, 0.83. To guide the study, two research questions were raised and answered, also, three research hypotheses were raised and tested at 0.05 level of significance. The data collected was analyzed using mean, standard deviation and t-test statistics. The findings from the study revealed, among others, that students taught with laboratory method achieved better than those taught with lecture method.

**Key words:** Effects, Utilization, Physics, Laboratory Method, Lecture method, Students' Achievement, Nigeria.

### **Introduction**

The importance of physics in national development cannot be overemphasized. Physics according to Laurie (2012) is a science that deals with the structure of matter and the interactions between the fundamental constituents of the observable universe. Is concerned with all aspects of nature on both the macroscopic and submicroscopic levels. Physics is very significant to understanding the world around us, the world inside us, and the world beyond us, American Physical Society (APS, 2013). From this definitions, it is clear that every matter has particles, and where there is interactions of particles, certainly there must be energy. Therefore, matter according to Andrew (2019) is any substance which has mass and occupies space. All physical objects are composed of matter, in the form of atoms, which are in turn composed of protons, neutrons, and electrons. Teaching of physics involves more than writing formulas on a chalkboard. It involves helping students to see the world in a new way. It involves crafting a learning environment where students are able to explore and understand how the physical world works, and to connect complex scientific concepts to their daily lives (Physics Teacher Education Coalition, 2011). It also helps in building student confidence in their ability to solve challenging problems, and empowering them to build a better future for themselves and others

A study carried out by Aina (2013) revealed that, inadequacy of qualified science teachers, inadequate of instructional materials, subject nature, low student interest and inadequacy in terms of motivation among others causes low enrolment in science in Nigeria. Amunga, Amadalo and Musera (2011) study revealed that there are disparities in enrolment and achievement among the different school categories and gender disparities as well. Boys' schools have had a steady lead in the enrolment and achievement on physics during the five years. With the decreasing number of enrollment of students in science in Nigerian secondary schools, there is a need to finds a suitable teaching method that will be suitable and most appropriate for effective learning to take place. And it will in turn encourage many to have interest in sciences. Apart from conventional way of teaching physics in a class room, laboratories are wonderful settings for teaching and learning science. They provide students with opportunities to think about, discuss, and solve real problems. Several studies among others revealed that students' taught with laboratory method of teaching physics achieved higher than those taught with conventional method. For example, Amadalo, Ocholla and Memba (2012) revealed that experimental group which is those taught with the laboratory method outperformed the control group on all the research objectives. Ashiq, Muhammad and Azra (2011) confirmed that there is a significant effect of guided, unguided and combination of scientific inquiry on the students' achievement than traditional physics teaching method. Bello (2012) found out that physics laboratory is a critical variable in determining the quality of output from secondary schools. Laboratory experiments are characteristics features of science teaching at all levels of education (Adane & Adams, 2011). Nowadays, it is rare to find any science course without a substantial

component of laboratory activity in teaching institutions. During such laboratory experiments, students are provided with specimens or work guide (manual) and some sort of equipment's which help them to investigate scientific problems in order to understand theories and principles of science subjects.

Many researches carried out in physics education in particular and science in general showed achievement of male and female at different level, for instance, a study investigated by Josiah (2012) revealed that students exposed to practical Physics knowledge achieved higher in Physics than students who were not exposed to practical Physics knowledge. Furthermore, there was no significant difference in the mean PhysAT scores of male and female students exposed to practical Physics knowledge. It is evident, from the findings of this study that, where there is availability and effective utilization of laboratory facilities then, the knowledge of practical Physics will have a positive effect on students' achievement in Physics. Ensaf (2013) showed that the experimental group students' which were taught with laboratory method achievement was higher than that of the control group students with conventional method. Ojediran, Oludipe and Ehindero (2013) indicated that there was significant difference in the achievement in Physics of low performing students exposed to laboratory-based instructional intervention (LBII) and those exposed to conventional teaching method (CTM). Uduak, Nkwo and Nsungu (2014) The study showed that students significantly achieved better in Multiple-choice test type than in the restricted essay and the extended essay test types, irrespective of gender.

Oluwatelure (2015) result obtained revealed that there was a significant sex difference in the performance of students in physics. A significant difference was also observed in the attitude of male and female students. A positive relationship was observed in the attitude and performance students in science. A positive relationship was also observed between attitude towards science and scientific attitudes of the respondents conclusively, sex of learners is an important factor that must be considered in the teaching and learning of science. Fatoba and Aladejana (2014) findings showed that, Gender was found to have no effect on Students' Attitude but there was slight difference in Attitude of the students in favour of females. Njoku (2007) reported that boys perform better than girls in science, Technical and Mathematical subjects.

### **Aim and objective**

The aim and objective of this was specifically to;

- iii. determine the effects of teaching methods on secondary students' achievement in physics, in central zone of Plateau State, Nigeria
- iv. ascertain the effects of gender on students' academic achievement

### **RESEARCH QUESTIONS**

1. To what extent do students taught with laboratory method achieve better than those taught with conventional method?
2. To what extent do the mean achievement scores of male and female students differ in the experimental group?

### **HYPOTHESES**

4. There is no significant difference between achievement mean scores of students taught with laboratory method and those taught with lecture method
5. There is no significant difference in the achievement mean scores of boys and girls in regards to availability and utilization of laboratory materials
6. There is no significant difference between the total achievement mean scores of male and female students in the experimental group

### **METHOD**

The study used a survey research designed and quasi-experimental research designed, pretest-posttest control group specifically was used for quasi-experimental because the experiment was conducted with students in their intact classes. All 3237 SSII physics students from the zone made up the population for the study from 583 registered secondary schools, 106 public and 477 private. The sample for the study was made up of 300 Senior Secondary two (SS2) students from twelve (12) selected Senior Secondary Schools in the central zone of Plateau state (six each for

experimental and control group were selected using simple random sampling techniques). The sample comprised of 158 male and 142 female, the experimental group has 89 males and 76 females while control group has 69 males and 66 females. This clearly showed that the sample consisted 165 students' in the experimental group while 135 students' for the control group. The data for the study was collected using three instruments: Physics Achievement Test (PAT) was used for pretest and posttest; Physics Equipment Check List for availability (PECLA) and Physics Laboratory Equipment Utilization Questionnaire (PLEUQ). The PAT was made up of twenty multiple choice objective items on electricity, simple harmonic motion and waves. PECLA has 35 list or number of some common laboratory facilities which were checked from each school laboratory by the researcher as to whether available or not. PLEUQ has two sections: the general information such as gender, school type and the other section was based on the utilization of 35 list of facilities as to whether they used them very-often, often, not so often or not at all. The three instruments were validated by two expert in the department of physics and one expert in test measurement and Evaluation University of Jos. PAT and PLEUQ were pilot-tested and the reliability coefficient for internal consistency was established using Cronbach Alpha method, while PECLA used macro kalpha method and the SPSS version 22 was used for its computation and were respectively found to be 0.64, 0.78, 0.83.

Before the treatment was administered, the researcher visited each of the selected schools to seek for permission for the study to be conducted. Two research assistants with B.sc (Ed.) in physics with minimum of four years teaching experience were selected and were trained for a period of two weeks on the procedure for administering instruments/treatment. They were well equipped on how to go about the administering the three instruments, PAT was administered to the students in the form of pretest and then the students' were taught for a period of six weeks after which posttest was given to obtained posttest scores. Both the experimental and control groups were taught the same physics topics but using laboratory and conventional method respectively. The data collected was analyzed using descriptive statistics for the research questions and t-test of independent at 0.05 level of significance was used to test the hypotheses

## Research Questions

- vii. To what extent do students taught with laboratory method achieve better than those taught with conventional method?

Table 1: Showing mean scores of students base on methods of teaching

S/N	Method	N	Mean	SD
1	Laboratory	165	60.78	12.57
2	Lecture	135	55.58	7.98

Table1 reveals that students taught with laboratory method have a higher mean scores of 60.78 than those taught with the conventional method which is 55.58. These showed that the gained mean scores between the two methods is 5.2

- viii. There is no significant difference in the achievement mean scores of boys and girls in regards to availability and utilization of laboratory materials

Table 2: Mean difference base on gender in the experimental group

Group	Test	Sex	N	Mean	SD
1	Pretest	Male	89	60.31	12.79
		Female	76	52.46	13.22
2	Posttest	Male	89	77.77	11.08
		Female	76	68.69	12.27

Table 2 shows that when the students were pre-tested, male students have a total mean scores of 60.31 and the females have 52.46, this shows that the males have a better mean scores than their females counterpart. Also, during posttest, males has a total mean scores of 77.77 while female have 68.69, this means that the male score better than the female. However, the mean difference between

male posttest and pre-test, and female posttest and pre-test respectively are  $(77.77-60.31) = 17.46$  and  $(68.69-52.46) = 16.23$ . It is clear that students achieved better when are exposed to treatment.

## Hypotheses

1. There is no significant difference between achievement of students taught with laboratory method and those taught with lecture method

Table 3: t-test of significant difference of methods of teaching

S/N	Method	N	Mean	SD	t-cal	t-table	Df	$\alpha$ level
1	Laboratory	165	60.78	12.57	4.350	1.962	292	0.05
2	Lecture	135	55.58	7.98				

Table 3 shows that t-calculated value of statistics of 4.350 is greater than the t-table value of 1.962 at 0.05 level of significance. The null hypothesis is therefore rejected, meaning there is significant difference in the achievement when students taught with laboratory and lecture methods

2. There is no significant difference in the achievement of boys and girls for schools that have available and utilized laboratory materials.

Table 4: t-independent Test of Significant Difference in Gender

Gender	N	Mean	SD	Df	$\alpha$ level	t-cal	t-crit
Male	158	58.37	12.003	298	0.05	1.414	1.962
Female	142	56.49	11.001				

Table 4 showed that males and females has mean 58.37 and 56.49 respectively. Also their standard deviation respective is 12.003 and 11.001 hence, t-critical has a greater value of 1.962 than t-calculated which has 1.414 at 0.05 level of significance with a degree of freedom of 298.

The total achievement mean scores of male and female students in the experimental group will not differ significantly

3. There is no significant difference between the total achievement mean scores of male and female students in the experimental group

Table 5: t-independent test of significant difference in pre-test based on Gender

S/N	Group	Test	Sex	N	Mean	SD	t-cal	t-table	df	$\alpha$ -level
1	Experimental	Pretest	Male	89	60.31	12.79				
		pretest	Female	76	52.46	13.22	3.879	1.962	163	0.05

Table 6: t-independent test of significant difference in post-test based on Gender

S/N	Group	Test	Sex	N	Mean	SD	t-cal	t-table	df	$\alpha$ -level
1	Experimental	Posttest	Male	89	77.77	11.08				
		posttest	Female	76	68.69	12.27	4.954	1.962	163	0.05

Table 5 and 6 revealed that t- calculated respectively are 3.879, 4.954 which are greater than t-critical which is 1.962 in both cases. The null hypothesis is therefore rejected, meaning there is significant difference in the achievement of male and female students in their pre-test scores. Also, there is significant difference in their posttest scores

## Discussion and Conclusion

The purpose of this study was to find out the Effects of Laboratory and Lecture Methods of Teaching on Senior Secondary II Physics students' Achievement in central Zone of Plateau State, Nigeria. To answer the research question one, the mean of students taught with laboratory and lecture methods were computed, hence table 1 reveals that students taught with laboratory method have a higher mean scores of 60.78 than those taught with the conventional method which is 55.58. These showed that the gained mean scores between the two methods is 5.2

To answer research question 2, from table 2 shows that when the students were pre-tested, male students have a total mean scores of 60.31 and the female have 52.46, this shows that the male have a better mean scores than their females counterpart. Also, during posttest, male have a total



mean scores of 77.77 while female have 68.69, this means that the male score better than the female. However, the mean difference between male posttest and pre-test, and female posttest and pre-test respectively are  $(77.77-60.31) = 17.46$  and  $(68.69-52.46) = 16.23$ . It is clear that students achieved better when are exposed to treatment than the normal

To answer hypothesis 1, table 3 shows that t-calculated value of statistics of 4.350 is greater than the t-table value of 1.962 at 0.05 level of significance. The null hypothesis is therefore rejected, meaning there is significant difference in the achievement when students taught with laboratory and lecture methods. This is in line with Josiah (2012) research work which revealed that students exposed to practical Physics knowledge achieved higher in Physics than students who were not exposed to practical Physics knowledge and also Ojediran, Oludipe and Ehindero (2013) results of their study which indicated that there was significant difference in the achievement in Physics of low performing students exposed to laboratory-based instructional intervention (LBII) and those exposed to conventional teaching method (CTM).

To answer hypothesis 2, the three hundred (300) students' were separated based on their gender, hence their corresponding achievement were compared in terms of mean score. Table 4 showed that males and females has mean 58.37 and 56.49 respectively. Also their standard deviation respective is 12.003 and 11.001 hence, t-critical has a greater value of 1.962 than t-calculated which has 1.414 at 0.05 level of significance with a degree of freedom of 298. The total achievement mean scores of male and female students in the experimental group will not differ significantly

To answer the hypothesis 3, table 5 and 6 revealed that t- calculated respectively are 3.879, 4.954 which are greater than t-critical which is 1.962 in both cases. The null hypothesis is therefore rejected, meaning there is significant difference in the achievement of male and female students in their pre-test scores. Also, there is significant difference in their posttest scores. This is also in line with the following findings (Oluwatelure, 2015; Fatoba & Aladejana, 2014; Amunga, Amadalo & Musera, 2011) which revealed that there was a significant sex difference in the performance of students in physics.

### Recommendations Based on the Findings

- 1 Standard should be followed appropriately when new school is to establish to make sure that all the needed laboratory facilities are all in place and well functional
11. The physics curriculum planners should lay emphasis on the laboratory method of teaching physics
12. Government should help to supply some physics laboratory facilities to the registered secondary schools
13. Female students should be encouraged by given special attention during teaching and learning of physics that will helps built their confidence

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## **CHALLENGES OF PEACE, SECURITY AND EDUCATION IN THE NORTH-EAST GEO-POLITICAL ZONE OF NIGERIA**

By

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### **Abstract**

The paper assessed the challenges of peace and security in the North-East Geo-political Zone of Nigeria. Insecurity in the Zone, fueled by elements such as Boko-Haram and Maitatsine, have led to the killing, maiming and displacement of ethnic nationalities. Politico-economic factors which deal with the activities of the political class and the act of governance are found to fuel insecurity. The political class has been sponsoring youth gangs who perpetrate violence before, during, and after elections. Ethnic and regional factors are potential causes of insecurity in Nigeria. The North-South dichotomy has persisted since independence and politicians have used it as a factor to divide the people. Ethnicity and regionalism manifest themselves in areas of appointments to employment positions and admissions. Religion has been used to create insecurity in Nigeria. In many cases, the trend is blamed on religious leaders who use incisive, provocative and unwarranted statements to create social disturbance that breaches the peace and creates unrest. The effect of insecurity on education has been enormous. Besides the general insecurity to lives and property, there have been distortion in academic calendar. Hostage taking as in the case of the Chibok school girls, has adverse effect upon the educational development of the girls. More so, invading a school in the process of hostage taking has only made the school environment unsafe for teaching and learning. Other effects are drop in school enrolment, closure of schools, loss in students' memory and destruction learning facilities. Insecurity also creates psychological trauma in serious students and parents. Parents will have to live with the trauma of losing their children to insurgents in broad daylight. To curb terrorism and other social and economic vices, the paper suggest for the urgent need to tackle the problem through functional vocational education and de-radicalization of the youth who are vulnerable to manipulation and susceptible to the doctrines of extremism that threaten peace and security in the North-East.

**KEY WORDS:** Peace, security, Boko Haram, fueling factors, effect, religion, ethnicity, vocational education

### **Introduction**

The North-East Geo-political Zone of Nigeria has six States, namely, Adamawa, Bauchi, Borno, Gombe, Taraba and Yobe State. The latitude of Nigeria is 10°N and 8°E. The climatic conditions of Nigeria vary from place to place across the country. In the north of the country, the climatic condition is arid. In the south of the country, the climatic condition is an equatorial type of climate. The North-East zone lies between latitude 9° -14°E and longitude 11° -14°N (Abdullahi & Musa, 2004, Nigeria Latitude and Longitude, 2012). Appendix I shows the map of the North-East Geo-political Zone.

Security is a serious issue both in national and international discourse. In Nigeria, the security situation is unstable, even after over 50 years of nationhood (Akinyinka, 2013). Ogunsina (1992) acknowledged that crime and violence which create insecurity in Nigeria are increasing at an alarming rate. These, according to Akinyinka, have manifested themselves in cases of armed “robbery, smuggling, kidnapping, drug trafficking and abuse, burglary, cold murder and other forms of organized crimes”, making citizens to live without peace and tranquility. Buttressing this point, Dodo (2014) held that miscreants and hoodlums have perpetrated criminal acts in Nigeria, manifested in broad daylight in the form of robbery, hired assassination, looting of government treasuries and kidnappings, leading to religious and ethnic violence.

In the North-East Geo-political Zone of Nigeria, peace has eluded citizens. The term “peace” which means a violence-free period in a people’s history where there is tranquil existence (Hornby, 2010), has come to mean something different. In the North-East Geo-political Zone, the emergence of a religious sect, known as Boko Harm, in the State of Borno created serious security challenges (Umar & Manabete, 2015). The activities of the Boko Haram element created a general atmosphere of insecurity in the last several years. As way back as 2009, the sect has killed, maimed, and seized ancestral lands of citizens in Borno State. These religious criminals extended their activities to Adamawa State and killed and displaced citizens, taking over their ethnic lands and property.

Another dangerous group which has perpetrated several criminal activities in Nigeria for several years is the Maitatsine cult. The activities of this group is closely linked to the Boko Haram insurgency. The Maitatsine insurgency began in 1980 (Aluko, 1984), spread to Maiduguri in 1981 and then to Yola in 1984. The pioneer of this deadly gang was a Cameroonian, one Mohammed Marwa, also known as Maitatsine (Mustapha & Mohammed, 2011). The activities of this criminal gang, like the Boko Haram sect, were to kill, maim, displace citizens and then loot their homes.

Terrorist exploit people’s beliefs, to spread religious extremism. By deliberately distorting doctrines, extremists have taken advantage of people with limited knowledge and education and have bound religion to extremism. They incite people to overthrow secular governments to establish a theocratic state. They deny the concepts of modern secular living and incite their followers to engage in “holy war” which they believe when they die in the process die, gain what they perceive to be a path to heaven. Their behavior is guided by their wrap understanding of religious laws and defy constituted authorities. In many instances, some of them don’t possess the basic tenets of the religion, but rather exhibit pure criminality. In the process of carrying out their deadly activities, extremist groups have injured and killed those they describe as “infidels”. Their actions have disrupted normal ways of life of many citizens by bringing down social and economic development. In the process, many youth have been manipulated and sometimes coerced into terrorism.

Faced with this complex problem of extremism and terrorism, government has always used military tactics as a solution to the problem without success (Mustapha & Mohammed, 2011). Terrorism and extremism germinate in complex domestic and international environment. They are rooted in political economic and cultural factors. The fight against terrorism and extremism is a global challenge. Over the years, different countries have adopted different measures of preventing and combating terrorism and extremism, based on their respective historical and cultural traditions, their level of education and employability of their citizens (Jia & Xingyin, 2019). In order to find a lasting solution to the problem, there is the need to fully address the root cause of extremism by educating and de-radicalizing those influenced by religious extremism. Eradicating the breeding ground for recruiting through vocational training that can help trainees acquire better education and vocational skills that can help them secure jobs and earn good income.

The paper examines the challenges and the factors that fuel insecurity in Nigeria. It looks at the conditions that promote peace and security. The paper looks at the effects of insecurity on education, especially in the North-East Geo-political Zone. Finally, the paper outlines ways to tackle the security situation in the North-East towards a meaningful rehabilitation for the internally displaced persons.

### **Factors that Cause Insecurity in North-East Zone**

There are several challenges to peace and security in Nigeria. First, there are the factors that fuel insecurity. Umar and Manabete (2015) identified politico-economic factors which deal with the activities of the political class and the act of governance. The authors viewed that democracy should provide election dividends. However, for over one decade, the activities of the political class have been quite disturbing. In many instances, the political class uses religion to amass wealth (Ifamase, 1999; Aliero, 1999), engineer election violence that leaves many dead, and as well engages in ballot box snatching ((The Punch, 2015, April 14; The Punch, 2015, April 20). A case in point was the postelection violence in Taraba State which led government to declaring a dusk to dawn curfew (Vanguard, 2015, April 13).

The political class has been sponsoring youth gangs who perpetrate violence before, during, and after elections (Kwami, Yaduma & Onuh, 2014). In the North-East Geo-political Zone, there is the 'Yan Kalare group in Gombe. There is also the Sarasuka cult group in Bauchi ((Eme & Anthony, 2011). Politicians use these groups to deal with perceived political enemies, rig elections and snatch ballot boxes. These armed groups, under the pretext of safe-guarding their votes, sometimes carry about dangerous weapons strapped on their bodies. They are usually instructed by their political god-fathers to cause chaos if it is foreseen that the outcome of elections would not be in favor of the political god-fathers.

Another factor that fuels insecurity in Nigeria has been identified as the proliferation of small arms and ammunitions. In the words of Hughes (2001), at the end of the cold war, many parts of the world, including Nigeria, was in possession of small arms and light weapons (SALWs). The United Nations revealed that up to 500 million SALWs were in circulation (Alimba, 2008). Over the years, these SALWs have found themselves in the hands of private individuals and organizations who, in many cases use them to kill, maim and displace citizens for political, economic and religious gains (Muagah & Batcher, 2002; Umar & Manabete, 2015).

Ethnic and regional factors have been identified as potential causes of insecurity in Nigeria. For instance, the North-South dichotomy has persisted since independence and politicians have used it as a factor to divide the people. Ethnicity and regionalism manifest themselves in areas of appointments to employment positions and admissions, especially into tertiary education (Dode, 2005). Ethnic clashes in other parts of Nigeria include attack by 500 gunmen on the village of Shonong in Riyom Local Government Area of Plateau State in the night (Vanguard, 215, May 17), the killing of 96 people by Fulani herdsmen in Benue State (The Punch, 2015, May 27), and the displacement of over 2000 people in Ekiti State due to an ethnic clash between Hausa-Fulani and commercial drivers (The Punch, 2015, May 25)

Ethnic clashes in several parts of the North-East of Nigeria have created security challenges in several places. There is the long standing Tiv-Jukun conflict in Taraba state, which began as far back as 1959, which has unfortunately remained a long standing issue (Egwu, 1998; Mustapha & Mohammed, 2011). Mustapha & Mohammed held that the souring relationship between the Tiv and Jukun was mainly predicated on ecological and political changes, particularly in Wukari Area and generally in the Benue Valley.

Religion has played a serious role in creating insecurity in Nigeria. The North East of Nigeria is a key battlefield in the fight against terrorism and extremism. This region has been plagued by religious extremism and terrorism, which pose a serious threat to the lives of the people in the region. For the past decade, religious extremist have been pedaling a false narrative of a theocratic state. In the process, they have carried out a series of terrorist activities such as bombings, assassinations arson and riots. Their instrument of hate is by exploiting religious beliefs among

people with limited education and employment opportunities by deliberately distorting religious doctrines. They incite followers to engage in a “holy war” and die in order to gain what they believe to be life in heaven. Terrorism has destroyed normal life and social and economic life and work in the whole region and surrounding states. Influenced and controlled by religious extremists, many youth who appear to be the most vulnerable group have been instigated and sometimes coerced to engage in terrorist activities (Dodo, 1014). Necessary intervention measures must be taken to cast off the shackles of religious extremism, and get them back to normal life.

In many cases, the trend is blamed on religious leaders who use incisive, provocative and unwarranted statements to create social disturbance that breaches the peace and creates unrest (Gila & Yaro, 2003). The authors added that the religious leaders undertake this scheming consciously with a view to achieving some religious-cum-political ambitions. Terrorism and religious extremism are the common enemies of humanity and the fight against it is a shared responsibility of government and every individual in the society.

Poverty and unemployment is also viewed as a potential source of insecurity in Nigeria. Onibokun and Kumuyi in Zanna (2012) saw poverty as the deprivation of entitlements through lack of access to economic and social resources and to political consultations and participation as well. It is some form of difficulty experienced in trying to make ends meet (Olameye in Zanna, 2012). Unemployment is defined as a forced condition of idleness imposed upon wage earners who are able and willing to carry out jobs but who are unable to find one (Encarta in Zanna, 2012). Unemployed persons are defined by the International Labour Organization (World Bank in Zanna, 2012), as those persons of the economically active population who are without work but who are available and seeking for work. Where able bodied men lack jobs to do there is the tendency for them to take to crime and other social vices.

Poverty is a direct consequence of unemployment (Aregbshola, 2008). In essence, poverty is viewed to be closely linked to unemployment (Muhammad, 2012). Muhammad held that unemployment engenders poverty. Studies, such as the one by Daniels (2003), support this position which suggests that there is a strong correlation between unemployment and crimes. Where unemployment rate goes up, crime increases, and where unemployment rate goes down, crime decreases. Unemployment is a very serious issue in Nigeria, especially among the youth which stands at 43%, where the young are three times more likely to be unemployed than adults (Kamate, 2018). One of the reasons for increasing unemployment rate in Nigeria is the lack of education and appropriate skills for available jobs. A World Bank report (World Bank, 2018) shows that some 30 percent of Nigerian youth have not completed more than primary education. This high rate of youth unemployment means it is imperative for government to adopt far reaching methods to provide education and jobs for the young populace.

The United Nations Plan to Prevent Violent Extremism has identified poverty and unemployment opportunities, low level of education as driving force behind violent extremism. It therefore emphasis on providing educational and economic opportunities; and to support young people in gaining access to learning and vocational resources (UNESCO, 2015). To counter this problem of extremism and terrorism in the North East there is need to align with the plans of the Sustainable Development Goals (SDG) which aims at promoting lifelong learning opportunities for all, and to encourage individual to leave violent extremist groups by developing programs that gives them access to earn a living.

Terrorism and the activities of terror groups have created serious security problems in Nigeria. Terrorism is taken here to mean a “premeditated attack against non-belligerent targets, an activity aimed at intimidating the opponent either through covert, unconstitutional or unlawful warfare, or the use of illegal weapons and methods...” (Igwe, 2002). Terrorism can also be defined as “a tactical employment of violence and intimidation to coerce a government or community into acceding to specific political demands” (Obboh & Aisedion, 2008). Terrorism is a potential ill for societal unrest Agena (2012) identified terrorism to be of two types: political terrorism and criminal terrorism. Political terrorism, according to Agena, deals with socio-economic and political differences, struggles and injustices directed against a state. Cole (2009) and Umar and Manabete

(2015) pointed out that top politicians and business moguls are behind most political terrorist activities. Criminal terrorism, on the other hand, is simply an extension of criminal behavior. In the words of Agena, the trend deals with the use of terror or threat of terror to rob innocent and unsuspecting part of the population, of their valuables, under the guise of fighting a course, This is usually manifested in lootings, kidnappings and highway attacks.

The Boko Haram sect has been identified as a terror group. This group has created serious security problem for the North-East Geo-political Zone. Boko Haram, which means “Western education is sinful” (Mustapha & Mohammed, 2011), started in the North-Eastern State of Borno in 2009 under the leadership of one Mohammed Yusuf. The ultimate aim of the Boko Haram sect is to eradicate in all their forms and ramifications, all religions and entrench Shariah law in Northern Nigeria (Kwami, Yaduma & Onuh, 2014). In the words of Adegbenjo (2013, the sect is opposed to Western education, Western culture and modern science. The sect’s activities involve attacking schools, filling stations, police stations, prison yards (in some cases, freeing prison inmates and destroying military bases), churches and mosques (Kwami, Yaduma & Unoh, 2014).

Over the last several years, the Boko Haram sect has killed, maimed, terrorized and displaced free citizens from their ancestral homes. The sect’s activities spread to the neighboring States of Adamawa and Yobe where villagers, under the watchful eye of the Nigerian military, were killed, and some wounded, terrorized and driven from their ancestral homes ((Umar & Manabete, 2015).

### **Conditions that Promote Peace and Security**

There are certain conditions that promote peace and security. These conditions are firmly anchored on the fundamental rights of citizens, as stated in the 1999 Constitution of the Federal Republic of Nigeria. These fundamental rights are: 1) Right to life; 2) Right to liberty; 3) Right to freedom of thought, conscience and religion; and 4) Right to freedom of movement, among others. These fundamental rights entail that to produce a peaceful and a secure society, these rights must be respected by all and sundry. Right, according to Eduvie (2003) means the “liberty (protected by law), of acting or abstaining from acting in a certain manner.” Buttressing this point, Wakil (2003) said that “To say that a person has a right of whatever kind, is normally to imply that other persons have a duty not to interfere with his exercise of that right.” In effect, every citizen of Nigeria should have the right to live and work anywhere and then practice any religion of his or her choice. Therefore, there is need for religious tolerance in a pluralistic society like Nigeria.

After Nigeria’s return to democratic governance, there is still much that should be desired from the political class. From 1999 to date, Nigeria has witnessed various upheavals ranging from political thugery to cult activities, manifested in areas like election rigging, ballot box snatching and terror activities (Umar & Manabete 2015).

A survey visit by the researcher to the internally displaced person’s (IDP) camps in Adamawa, Borno and Yobe States revealed that existing conditions in the camps are deplorable. The camps which are situated in schools and other government buildings appeared to be dilapidated. Structures are weak and sagging. Most roofs of buildings are leaky. Water is in short supply. Some of the IDPs have to use nearby streams to wash their clothes and in some cases bathe in them. Sometimes the same stream water is used for both drinking and cooking. Sanitary facilities appear to be in short supply. In most cases open defecation in nearby bushes appear to be more of the order than practice for many of the IDPs. Similarly, health facilities are in short supply and both adults and children appear to be suffering from one ailment or the other. In most cases diseases such as malaria, typhoid and diarrhea are common. Above all, malnutrition appears to be the other of the day. Most hit by this development are children and women who have lost their husbands as a result of the insurgency. Psychosocially, the IDPs appear to be traumatized and look with aspersions how their condition could one day be altered, seeing there appears not to be any light at the end of the tunnel.

Government and government agencies, donor agencies, including international donor agencies, educational institutions and private individuals had lent a hand of support to the internally displaced persons (IDPs). A survey visit by the researcher to the IDP camps showed that the Federal



Government of Nigeria, through its terror victims support fund, had made effort to ameliorate some of the sufferings of the IDPs. The Federal Government, through the National Emergency Management Agency (NEMA), had provided money for the upkeep of the IDPs. It had also provided items like food, mattresses, blankets, cooking utensils, buckets and other valuables. State governments affected by the insurgency had also made effort to bring relief to the IDPs by supplying food, mattresses, and other essential items. Both the Federal and State Governments had also made effort to construct make-shift shelters as well as provide medical services at the camps, International agencies like the Red Cross and other private health organizations had made concerted effort to provide medical services to the IDPs. Private individuals, community leaders, traditional rulers and members of the legislative body had also contributed immensely to ameliorating the conditions of the IDPs in the camps. Educational institutions like the American University of Nigeria had been to be IDP camps to deliver supplies and money to the IDPs.

An open interview conducted with the IDPs showed however, that not all items provided for their relief at the camps were provided them by government officials vested with the responsibility to do so. According to the IDPs, in many instances, the items were carted away even before they were distributed to the IDPs. They were however, thankful to private individuals and organizations which often insisted on distributing relief materials they provided themselves. When this was the case, the IDPs said they experienced full satisfaction with the distribution process.

### **Effects of Insecurity on Education**

The effects of insecurity created by activities of the insurgents are numerous. First, in the words of Campbell (2008) and Africa File (2008), where insecurity prevails, education cannot make any meaningful headway. Consequently, hostage taking as in the case of the Chibok school girls, has adverse effect upon the educational development of the girls. More so, invading a school in the process of hostage taking has only made the school environment unsafe for teaching and learning. In the words of Kolo and Eweniyi (2011), a safe environment is one that is danger-free in which fenced walls are put in place, security personnel are employed to check the movement of staff, students and visitors in and out of the school. Unfortunately however, in the last decade, the activities of insurgents have made this noble objective difficult to achieve, as they have invaded schools both in the night and broad daylight, killed staff and students and carried off scores of school children to undisclosed locations.

In the face of insecurity, there will be drop in school enrolment. In the North-East, school enrolment has dropped to 28% (Bwala, 2012). In addition, many children of school age have dropped out of school, and in Damaturu, the Yobe State capital, the dropout rate is increasing by the day due to the activities of insurgents (Abdullahi & Kyari, 2014). Over 882% of school age children have dropped out of school (Bwala, 2012). Today, government is experiencing difficulty in persuading parents to send their wards to school and allow them stay on (Saleh, 2011). Nigerians, and indeed citizens in the North-East now live in constant fear of attacks from suicide bombers and hostage takers (Okorie, 2011; Fasan, 2011).

There are several other effects of insecurity on education. Where there is a general atmosphere of insecurity, schools are likely be closed. There will be a loss in students' memory as well as learning materials. The school calendar will also be distorted and will have to be extended. In some cases, the syllabus will not be covered and in the end, students will not be properly taught as required ((Pali, Jatau & Wadak, 2003). In the words of Umar and Manabete (2015), insecurity has also created psychological trauma in serious students and parents. Parents have had to live with the trauma of losing their children to insurgents in broad daylight, and as Umar and Manabete argued, chances are that some of the abducted Chibok school girls have been killed in suicide bombings, some have been married off to fellow insurgents from neighboring countries and some have been married by the insurgents themselves.

### **Strategies for combating Extremism and terrorism**



There are several strategies that can be adopted to enhance peace and security in Nigeria in general and the North-East in particular. Lamurde (2013) suggested that the National Assembly needs to fast track the review of the Money Laundering (Prohibition) Act and the Anti-terrorism Act as well as the Cyber Security Law. Mustapha and Mohammed (2011) advocated for tolerance and the application of stiff penalties against perpetrators. Equally, the authors held that the political class who spearhead political violence, especially before, during and after elections must be brought to book. The youth who are also used by the political class need to be gainfully engaged in useful ventures. Buttressing these points, Boulding in Alimba (2008) held that to achieve a stable peace system, peace must be cultivated as of habit, and taboos against violence must be seriously imposed. Umar and Manabete ((2015) suggested that peace and diplomatic initiatives need to be employed to forestall any break down of law and order. Government needs to put in place measures to curtail security breaches. Public enlightenment campaigns must be mounted to educate the public on the need for peaceful coexistence. Equally, religious leaders need to preach peace and avoid the use of incisive languages. Elders, community leaders and traditional rulers need to appeal to their subjects to be law abiding. This way, peace and security will prevail in the North-East Geo-political Zone.

### **Vocational Education as Instrument for tackling Terrorism**

Global concerns about youth unemployment and the growing restiveness in many parts of the world have renewed interest in vocational education and training. For areas that are experiencing restiveness and terrorism, vocational education and training has been identified as one of the best ways to combat extremism and terrorism (Jia, & Xinying, 2018). The authors worked extensively on the effect of vocational training in fighting Islamic extremism in Southern region of China with great success. Vocational training is universally aimed at equipping students with practical skills for a specific field (Stanley, 2018). Vocational courses are tailor-made for students to be completely job ready. Vocational education is premised on the fact that it represents the means to prepare the youth to be actively equipped with the means to acquire work experience and find decent jobs to improve their prospects. It comprises education, training and skills development relating to a wide range of occupational fields. Vocational education in addition to providing the youth with practical working skills and make it easier to find jobs, it can also improve their communication skills. Communication skills are valuable tools in today's world of communication, without which many find it difficult to navigate the complex world of technological developments.

There is a growing recognition of vocational training in international agendas such as the UNESCO which identifies vocational training as central to the achievement of the 2030 agenda for sustainable development (UNESCO, 2015). Vocational education and training goes along with the Sustainable Development Goals (SDG) which aims to end poverty in all forms, ensure quality education, and promote life-long learning opportunities for all. SDG further encourage for developing programs that place emphasis on providing people with educational and economic opportunities, and to support young people in gaining access to continued learning and vocational resources. SDG has identified vocational education as the most credible and comprehensive skills system that can be built to support individuals and communities to generate and maintain enhanced livelihood opportunities (McGrath, et.al, 2019)

The non-inclusion of the youth in productive activities appears to be partly if not primarily responsible for the climate of violence and radicalization in the North East. Vocational training could be a good source of integrating young people into economic and social life. In undertaking such skill training policy, a major challenge lies in understanding community needs as basis of the program.

This points to the need to get beyond what is obtainable in other parts of the country to what skills appear to be needed. Here, there are clear potential connections to the community development approach and need analysis to determine critical areas of training needs. It is particularly important to take into consideration the cultural and religious sensitivity of the communities. The training centers must therefore respect the spiritual and cultural needs of trainees. The centers can integrate de-radicalization into the whole process of training through the teaching

of civics, ethics and the rule of law. To remedy lack of occupational skills and employment, vocational skills training programs can provide trainees with important opportunity to improve their employability or even be employers themselves. Based on local demands, the courses could include courses like garment making, livestock breeding, food processing, electrical/ cell phone repairs, auto mechanic and other technical skills.

### Conclusion.

It is the fundamental task of any responsible government to remove the malignant tremor of terrorism that threatens lives and security to safeguard and protect life, health and development, and to ensure they enjoy a peaceful and harmonious social environment. The North East of Nigeria is the key battlefield in the fight against terrorism which has been going on for over a decade. Although several military strategies have been deployed to combat it, the problem still persist. Vocational training can prevent the breeding and spread of religious extremism and terrorism by educating and rehabilitating people influenced by religious extremism. This could be achieved by establishing vocational centers to offer functional education. Furthermore, such a vocational center can help trainees acquire better education and vocational skills, find employment and gain income. The use of vocational training for eliminating terrorism is the basic principle of international efforts in countering extremism and terrorism and must be pursued vigorously by governments at all levels in Nigeria.

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**EFFECTS OF THREE-DIMENSIONAL (3-D) INSTRUCTIONAL MEDIA ON JUNIOR SECONDARY TWO STUDENTS' ACHIEVEMENT IN BASIC SCIENCE AND TECHNOLOGY IN JOS, PLATEAU STATE, NIGERIA.**

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## **Abstract**

This paper investigated the effects of three-dimensional (3-D) instructional media on junior secondary two students' achievement in Basic Science and Technology in Jos North Local Government Area of Plateau State, Nigeria. The study employed the pre-test, post-test quasi experimental control group design. A total of 120 Junior secondary two students in two schools out of a population of 1,653 students in 22 schools, constituted the sample of the study. The sampled schools were randomly assigned to an experimental group and a control group, respectively. Students in the sampled schools were used in their intact class settings, and, as such, did not undergo sampling. A Basic Science and Technology Achievement Test (BSATAT) with a reliability index of 0.78 was used to collect data from students. Two research questions were raised and two hypotheses formulated to guide the study. The experimental group was taught Basic Science and Technology concepts for four weeks using 3-D instructional media while the control group was taught the same concepts for the same length of time using lecture method. Research questions were answered using mean and standard deviation while the hypotheses were tested using Analysis of Covariance (ANCOVA) at 0.05 level of significance. Findings showed that students taught using 3-D instructional media obtained a significantly higher mean achievement score than those taught using lecture method. Gender was found to have no significant influence on students' achievement in Basic Science and Technology. It was concluded that the use of 3-D instructional media was effective in improving students' achievement in Basic science and Technology. It was recommended that teachers should incorporate 3-D instructional media into the teaching and learning of Basic Science and Technology.

**Keywords:** Achievement, Basic Science and Technology, Three-dimensional (3-D) instructional media.

## Introduction

Science education has been recognized the world over, as a pre-requisite for scientific and technological development. It provides opportunities for students to acquire relevant and functional knowledge and skills that are associated with scientific processes needed for advancement in a science and technology-driven world (David, 2018). Science and technology education therefore, is a veritable tool for scientific and technological advancement of any nation. This fact is enshrined in the National Policy on Education of the Federal Republic of Nigeria (FRN, 2013) which states that science and technology education should among other things equip students to live effectively in the modern age of science and technology. The introduction of science into the junior basic level of education is a right step towards nurturing the young intellectuals against the global challenge of science and technology.

Basic Science is the study that relates to basic discovery, inventions in the field of science (Igbokwe, 2015). It was introduced in an attempt to present science as a unified whole and aims at presenting a holistic view of science contents to learners. It is expected that by teaching basic science and technology to students at the basic education level, every Nigerian student would be given the basic knowledge and understanding of what science and technology are about and some of the innovations, global challenges and environmental issues that are taking place around them. This assertion blends with the objectives of science teaching at the upper basic level of education which is to produce individuals who will be able to live effectively in the modern age of science and technology and contribute to the development of the nation (FRN, 2013). This makes basic science and technology an important subject for national development as it serves as a spring board for many careers in science and technology, and has application nearly in every field of life.

In view of the fore-going, the government made some notable investments in basic science and technology education by employing basic science teachers in the various junior secondary schools in the state, investing in the training of basic science and technology teachers in the technical aid programme and the provision of facilities and equipment for the teaching and learning of basic science and technology. The government also made basic science and technology a mandatory subject for all Nigerian students at the basic education level. This was borne out of the emphasis on science and technology education in the National Policy of Education.

However, despite of the significant role science and technology plays in the development of a nation, as well as, the efforts of the government in promoting the teaching of basic science and technology in secondary schools, students' achievement in the subject has been plagued by a number of factors. Several reasons are responsible for the poor achievement of students in basic science and technology as disclosed by concerned researchers (Osuafor, 2016; Ozoji, 2010; Musa, 2017; Umar, Ozoji & Ikpechukwu, 2018).

These reasons cut across ill-equipped laboratories, inadequate teaching and learning facilities, inadequate exposure of students to hands-on activities, inadequate preparation of teachers, and inability to comprehend questions, gender insensitivity, lack of qualified science teachers and poor instructional strategies.

This worrisome state and dwindling achievement in science and technology has thus been a great concern for stakeholders in education (Abakpa, 2011; Joseph & Ikechukwu, 2013; Ozoji, Attah, Lemarck & Olanrewaju, 2020) and also evidenced by the chief examiner's reports of the Basic Education Certificate Examinations (NECO, 2016; & BSEB, 2017). Despite the relevance of Basic Science and Technology as the foundation course for higher education and national development, research reports by Akinmade (2011), Agogo (2012) and Mbanefo (2015) revealed that students still recorded poor achievement in the subject. Consequently, Josiah (2020) concluded that poor results over the years have been attributed to ineffective strategies adopted in the teaching of sciences.

The teaching and learning of science and technology is to be learner-centered, participatory, and activity-oriented. The central goal of Basic Science and Technology is to lay a sound basis for scientific, technological and reflective thinking. In pursuance of this, the National Policy on Education (FRN, 2013) states that government will provide materials and manpower for practical,



explorative and experimental teaching and learning besides ensuring teacher-student ratio of 1: 30. This implies that the students and teachers are to be actively involved in the teaching and learning processes.

However, this is not so as according to Oludipe (2012), basic science and technology teachers use stereotyped and teacher-centered methods instead of innovative and student-centered teaching methods. This has continued to hinder academic achievement among students. The most widely used teacher-centered method of instruction is the conventional lecture method. Lecture is employed so much in teaching probably because it enables the teacher to cover large volumes of content in a single lesson and also teach a large number of students at the same time but it has not always encouraged improved achievement (Oludipe, 2012). This agrees with Omebe and Omiko (2015) whose findings revealed that the lecture method of teaching Basic Science and Technology has been utilized for several years by teachers, yet the results of the students in the Junior Secondary School Certificate Examinations (JSSCE) have not been encouraging.

The study by Kabutu, Oloyede and Bandele (2015) and Samuel (2017) further revealed that poor instructional strategies employed in the teaching of basic science and technology are responsible for the difficulty students find in understanding the concepts of the subject that appear abstract. This state of affairs is against the advocacy of curriculum design in the National Policy of Education that, the teaching of basic science and technology at the junior secondary school should be the guided-discovery approach (FGN, 2013). Basic science and technology is activity-based and should be so taught to the students. Thus, it has become necessary for educational stakeholders to ensure that appropriate teaching methods are used in the classroom.

There is therefore, a need for teachers to employ innovative teaching methods that will help students comprehend the concepts in basic science and technology as the instructional method used might make or mar a child's interest in offering core science and technology subjects at the senior secondary level. Researchers (Ozaji, 2010; Umar, Ozaji & Ikpechukwu, 2018) advocate the integration of innovative teaching methods into the teaching of basic science and technology to improve students' academic achievement in the subject. An example of such innovative teaching method is the use of 3-D instructional media.

Three-dimensional instructional media characteristically have length, width, height, hence they are said to be 3-dimensional. They are basically non projected materials used to make the teaching process easier. Three-dimensional instructional media are different from charts and graphs which are illustration of two- dimensional materials because of the incorporation of a third element. Thus, whereas graphs and charts embrace the width and height of a visualized object, three-dimensional media embrace this third element, a feature that makes the three- dimensional material a replica of the real thing. They include models and mock-ups, realia, specimens, kits and dioramas- which refer to the creation of a scene in an event (Mkpa as cited in Igidi, 2019).

Models are used for demonstrating the three-dimensional representation of real objects. For instance, the model of an eye, or abstract things (model of solar system). They are particularly used as visual support materials in instructions, as objects for study or manipulation in individualized learning and as construction project for individuals, small groups or even the entire class. Mock-ups are generally used in the teaching-learning process, when a teacher finds it difficult to provide first-hand experience to the learners. A mock-up is an operating model, designed to be worked with directly by the learner for specific training or analysis. Mock-ups represent real things, Sometimes, certain elements of a real thing are purposefully eliminated to draw the learners' attention to others. A diorama is a still display system which combines a three-dimensional foreground of pictures, figures, etc. with a two-dimensional painted background, thus creating a highly realistic effect. Dioramas are useful media in the teaching of many subjects. One can use dioramas in subjects like geography, biology, basic science and technology to enhance the achievement outcomes of male and female students.

Gender has continued to be an issue of concern to educators and researchers as it has been identified as one of the factors influencing students' achievement at secondary school level of education in Nigeria (Eze, 2010). Thus, gender differences have always been the case in students'

achievement in basic science and other science-related subjects. With regard to gender gap in science achievement, the finding is inconclusive. While some researchers (Amogne, 2015; Olasehinde & Olatoye, 2014; Peter, 2014 & Oludipe, 2012) have reported no significant differences between male and female students' academic achievement, others found out that there were statistically significant differences between male and female academic achievement in favour of male students (Abdu-Raheem, 2012; Olorukooba, Lawal & Jiya, 2012; Obekpa, 2013; Ezeudu & Obi, 2013; & Okafor, 2016). Yet, other studies showed significant differences in favour of female students in science-related subjects (Nnamani & Oyibe, 2016; Musa, 2017; Okorie & Eze, as cited in Ezechi & Adukwu, 2018). Hence, it has been difficult for existing researchers to reach a consensus on the issue of gender as regards students' interest and achievement in Basic Science and Technology. This makes the issue of gender an important one in science and technology education especially with increasing emphasis on ways of boosting manpower for technological development, as well as, increasing the population of females in science and technology fields.

It was based on this premise that the present study investigated the effects of 3-D instructional media on junior secondary two students' achievement in Basic Science and Technology in Jos North Local Government Area of Plateau State, Nigeria

### **Purpose of the Study**

The purpose of the study was to determine the effect of 3-D instructional media on JS 2 students' achievement in Basic Science and Technology in Jos north, local government area of Plateau State. Specifically, the objectives of the study were to find out the:

- xiv. Mean difference between the post-test mean achievement scores of JS 2 students taught using 3-D instructional media and those taught using the lecture method.
- xv. Mean difference between the mean achievement scores of JS 2 male and female students taught using 3-D instructional media.

### **Research Questions**

The following research questions guided the study:

- 17. What is the mean difference between pre-test and post-test mean achievement scores of JS 2 students taught Basic Science and Technology using 3-D instructional media and those taught using the lecture method?
- 18. What is the mean difference between the post-test mean achievement scores of JS 2 male and female students taught using 3-D instructional media?

### **Hypotheses**

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

- 14. There is no significant difference between the post-test mean achievement scores of JS 2 students taught Basic science and Technology using 3-D instructional media and those taught using the lecture method.
- 15. There is no significant difference between the post-test mean achievement scores of JS 2 male and female students who were taught Basic Science and Technology using 3-D instructional media.

### **Method**

The research design used in the study was the pre-test, post-test quasi-experimental control group research design. The design was considered appropriate for the study because intact classes were used to avoid disruption of normal classes in the schools used. The simple random sampling technique was employed in selecting one out of 22 junior secondary schools that offered Basic Science and Technology in Jos North Local Government Area of Plateau State, Nigeria. Two classes in the selected school were randomly assigned to an experimental group and a control group, respectively. Students in each intact class were 60 in number, thereby, bringing the sample size to 120 from a total population of 1,653 JS 2 students.

A Basic Science and Technology Achievement Test (BSTAT) was used to collect data from students. The BSTAT was composed of two sections, namely, Section A and Section B. Section A sought the demographic information of students while section B consisted of 30 multiple choice test



items on the concepts of simple machines. The BSTAT was content validated by an expert in science education and an expert in measurement and evaluation, both in the Faculty of Education, University of Jos, Nigeria. The reliability index of the instrument was determined as 0.78 using the Cronbach alpha method.

Students in the experimental and control groups were administered a pre-test in BSTAT by the researchers. The experimental group was taught with 3-D instructional media by one of the researchers. The control group was taught by a basic science teacher in the school used for the study employing the lecture method. The teaching exercise lasted for four weeks after which a post-test in BSTAT was administered to both groups. Students scripts were scored over 100 and the scores collated for analysis using SPSS version 25. Research questions were answered using mean and standard deviation while the hypotheses were tested using Analysis of Covariance at 0.05 level of significance.

## Results

### Research Question 1

**Table1: Mean Difference between the post-test mean achievement scores of JS 2 Students taught Basic Science and Technology with Three-Dimensional (3-D) Instructional Media and those taught using the Lecture Method**

Group	N	Mean	SD	Mean difference
Experimental	60	56.93	7.99	9.43
Control	60	47.50	8.43	

Table 1 shows the post-test mean achievement score and standard deviation of JSS 2 students taught using three-dimensional (3-D) instructional media as 56.93 and 7.99, respectively, and those of them taught using the lecture method as 47.50 and 8.43, respectively. The mean difference between the post-test mean achievement scores of the experimental and control groups is 9.43.

### Research Question Two

What is the mean difference between the post-test mean achievement scores of JSS 2 male and female students taught using the 3-D instructional media?

**Table 2: Mean Difference between the Post-test Mean Achievement Scores of JS 2 Male and Female Students' taught Basic Science and Technology with 3-D Instructional Media**

Groups	N	Mean	SD	Mean difference
Male	30	54.91	9.64	0.90
Female	30	53.17	8.12	

Table 2 shows the effect size of using three-dimensional (3-D) instructional media on male and female JS 2 students' achievement in Basic Science. Male Students taught Basic Science with Three-Dimensional (3-D) Instructional Media had a post-test mean achievement score of 54.91 and a standard deviation of 9.64 while female students had a mean achievement score of 53.17 and standard deviation of 8.12. There was a mean difference of 0.90 between male and female students taught Basic Science with Three-Dimensional (3-D) Instructional Media.

### Hypothesis 1

There is no significant difference between the post-test mean achievement scores of JS 2 students taught Basic Science using three-dimensional media and those taught without using the lecture method.

**Table 3: Summary of Analysis of Covariance of Post-Test Basic Science Achievement mean score of JS 2 Students taught sing Three–Dimensional Media and those taught without using Three Instructional Media**

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Squared	Eta
Corrected Model	62.018 <sup>a</sup>	3	20.673	2.363	.079	.097	
Intercept	21227.609	1	21227.609	2426.329	.000	.974	
group	55.495	1	55.495	6.343	.014	.088	
gender	.030	1	.030	.003	.953	.000	
group * gender	12.287	1	12.287	1.404	.240	.021	
Error	577.425	116	8.749				
Total	22499.000	120					
Corrected Total	639.443	119					

a. R Squared = .097 (Adjusted R Squared = .056)

Table 3 shows the summary of the one-way analysis of Covariance (ANCOVA) table on Post-test Basic Science Achievement Test mean score of JSS 2 Students taught Using 3-D media and those taught without using three instructional media. This result indicates that the noted difference between the mean achievement scores of students in experimental and control groups is significant. This is from the fact that  $F(1, 120) = 6.34$ ,  $p = 0.014$ . The p-value 0.014 is less than 0.05 level of significance. Hence, the null hypothesis was rejected showing that there was a significant difference between the mean achievement scores of students taught using 3-D instructional media and those taught using the conventional lecture method.

## Hypothesis 2

There is no significant difference between the post-test mean achievement scores of JSS 2 male and female students taught using 3-D instructional media.

Table 3 shows the summary of the one-way Analysis of Covariance (ANCOVA) table on Post-test Basic Science Achievement Test mean scores of JSS 2 male and female students taught Using 3-D media. This result indicates no significant difference between the mean achievement scores of male and female students in experimental group at 0.05 level of significance. This is from the fact that  $F(1, 60) = 0.003$ ,  $p = 0.95$ . The p-value 0.95 is greater than 0.05 level of significance. The null hypothesis was therefore accepted.

## Discussion

The findings of this study revealed that teaching basic and technology concepts with 3-D instructional media had significant effect on students' achievement in Basic Science and Technology. Students who were exposed to 3-D Instructional media had higher mean scores than their counterparts taught using the conventional method. This improved achievement was likely due to the interactive nature of the 3-D instructional media, the effects of audio and visual aids on the senses which resulted in divergent thinking, critical reflection and meaningful learning of the concept of simple machines.

The findings further revealed that the 3-D instructional media had no significant effect on the achievement of male and female students in Basic Science and Technology Test. This result is in consonance with the findings of Ugwu (as cited in Nwagbo & Okoro, 2013), Godspower and

Ihenko (2017) which showed that gender had no significant influence on achievement of students when exposed to the same instructional approach. On the contrary, the finding of this study disagrees with the finding of Nwagbo and Okoro (2012) which indicated gender as a significant factor on achievement of students exposed to interactive patterns in biology concepts, where the mean scores of boys in three interactive patterns were consistently higher than those of their female counterparts.

## Conclusion

It was concluded that the use of 3-D instructional media was effective in enhancing students' achievement in basic science and technology. The use of 3-D media also promoted gender equality in basic science and technology achievement.

## Recommendations

Based on the findings of the study, it was recommended that :

- xv. Teachers should incorporate the use of 3-D media into basic science and technology classrooms for improved achievement outcomes.
- xvi. Three-D instructional media should be used as a gender-friendly strategy to promote gender equality in Basic Science and Technology classrooms.

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## COMPETENCIES REQUIRED BY TECHNICAL AND VOCATIONAL EDUCATION AND TRAINING TEACHERS FOR ENHANCED INSTRUCTIONAL DELIVERY IN TERTIARY INSTITUTIONS

By

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### Abstract

The study adopted a cross sectional survey design basically to determine the competencies required of technical vocational education and training (TVET) teachers for improving TVET instructional delivery in Nigeria. To achieve this basic objective, a structured questionnaire tagged Competency Questionnaire (CQ) was designed and administered to six curriculum experts and 15 lecturers from four tertiary institutions offering TVET in Nigeria. The entire population was used for the study since its size was manageable. The reliability of the instrument was established as 0.89 using cronbach's alpha coefficient. Findings of the study showed that the respondents all agreed that the questionnaire items were required as the competencies for improving the quality of TVET instructional delivery in Nigeria. The competencies were of three domains, namely, facilitating competency, professional competency and communication competency all with their educational implications for TVET facilitators. The study recommended that TVET instructional delivery should be best performed through facilitating processes of Socratic and social constructivist method of learning where learners actively participate in discovering knowledge and solving problems. TVET instructional delivery should not be strictly through teaching approach as in the case of traditional method where the teacher acts as the knowledge conduit.

**Key words:** Competency, TVET, Facilitator, Instructional Delivery

## INTRODUCTION

Competent teachers are the driving force behind effective teaching and learning of technical and vocational education and training (TVET). To this effect, Komur (2010); and Kleickmann (2012); agreed that competent and knowledgeable teachers are essential to the processes of teaching and learning. Therefore, there is the need to ensure that the skills, knowledge, and attitudes of TVET teachers align with technological changes, current job requirements, equipment, machines, and processes. It is the view of Demorest (2017) that facilitators are best suited for TVET instructional delivery since their roles include gently guiding the participants to new insight. Nungse, Lidima, Iliya and Rish (2018) further stressed that the facilitator of TVET as a guide, indicates that the teacher is to motivate, facilitate, guide, and challenge learners towards achieving the objectives in question, but not to attempt to act as a knowledge conduit.

TVET has one of its cardinal domains as orientation towards the world of work with emphasis on the acquisition of employable skills. According to Ezemma (2017), TVET has major focus on the provision of knowledge, skill development and attitudes that are necessary for entry into an occupation. It also includes those aspects of educational process involving, in addition to general education, the study of relevant technologies, related science and acquisition of practical skills, attitudes, understanding and knowledge relating to occupation in various aspects of economic life (UNESCO, 2005). However, TVET faces a key challenge of poor quality of instructional delivery which Chakraborty (2013) attributes to lack of competence in TVET instructional delivery.

Generally, competency is a combination of attitude, knowledge, and skills (ILO 2010). Competency, according to Volmari, Helakorpi, Frimodt, (2009); is an indicator of an individual's level of capacity, capability, and performance in duties/jobs; competency is necessary for both facilitator and teacher to be more competitive. Teacher's competence level can be increased through training as required in the lifelong training. Core competencies can be developed as a model to benchmark the performance of TVET teachers in an organization.

A TVET teacher is someone who has been trained and is competent in his chosen technical field and in the delivery and evaluation of teaching (Nungse, 2018 and Guthrie, 2010). In this study, the TVET teacher is viewed as a facilitator, professional who has the ability to demonstrate skills and continuously develops and progresses in the career by gaining more knowledge and skills in the field. Review of other previous studies indicated that the TVET teacher must have social competency (Monnier 2015); knowledge and competency in work processes (Boreham 2002); professional and pedagogical competency (Mirzagitova & Akhmetov 2015; teaching, social, management, technological and technical skills (Othman, et al. 2011). These competences are *sine qua non* for the improvement of the quality of TVET instructional delivery to allow for sustainable development to take place.

The study addressed the competencies required by TVET teachers for instructional delivery for sustainable development to include domains such as facilitating, professional, communication and evaluation competencies. Facilitating competence, according to Demorest (2017), are those instructional competencies that a facilitator requires to improve the quality of instructional delivery in the class. For instance, the facilitator should be competent in helping learners to discover knowledge for themselves through Socratic and social constructivist<sup>2</sup> constructivist method. Socratic debate is a form of cooperative argumentative dialogue between individuals, based on asking and answering questions to stimulate critical thinking and to draw out ideas and underlying presuppositions (Becirovic, 2016). Facilitating competence is necessary to sustain the development of the country, as it is synonymous to constructivist approach.

Constructivism emphasizes how individuals actively construct knowledge and understanding. Social constructivist approaches emphasize the social contexts of learning, and that knowledge is mutually built and constructed within an individual's mind (Jonassen., Peck., & Wilson, 1999). By implication, teachers should create learning situations that are close to real-world

circumstances as possible e.g., to learn more about Printed Circuit Board (PCB), have some students take the role of engineers in designing the PCB while others in manufacturing PCB, and vice versa. Similarly, one of the tenets of social constructivism emphasized the need for a teacher of TVET to be a guide metaphor. A guide metaphor indicates that the teacher is to motivate, facilitate, guide, and challenge learners towards achieving the objectives in question. Young and growing learners need to develop such capability to think and bring out the best in them technologically in order to sustain the pace of development. The ability of a facilitator to create a collaborative and practical cooperative interaction between learners to reflect the lesson objectives forms part of the professional competency, and it includes making learners to be active participants and contributors in the learning process.

TVET teachers must be proficient in instruction delivery so as to ensure that sustainable development is achieved in the nation. Professional competency therefore, ensures that TVET teachers master the contents of knowledge and the pedagogy with the latest information required by vocational learners (Grollmann, 2008). Failure to impart this results in graduates who can't perform in the world of work. To convince and impart the knowledge to the learner as well as to give advice, a teacher also requires a communication competence, (Oluwasola, 2014). This ability helps teachers to communicate effectively, not only with learners, but also with the parents of learners, colleague and the industry. However, the most important communication happened in the classrooms by conveying learning contents, controlling the classrooms and consulting the learners (Amiruddin et al., 2015; Diep & Hartmann, 2016). Therefore, the competencies discussed in this work and presented in Fig 1.1 are required by the teacher for improving TVET instructional delivery.

Instructional delivery is an instructor's personal approach to teaching, based on his or her own professional ability to create a unique classroom culture. Final Master (2014) explained instructional delivery to mean the interaction among the student, the teacher, the content, and the knowledge/skills/dispositions students will need for learning and collaborating with others in a diverse society and rapidly changing world. The process of instructional delivery involves applying a repertoire of instructional strategies to communicate and interact with students around academic content and to support student engagement (Council of Chief State School Officers, 2013). The process is imperative for the sustainability of developmental process.

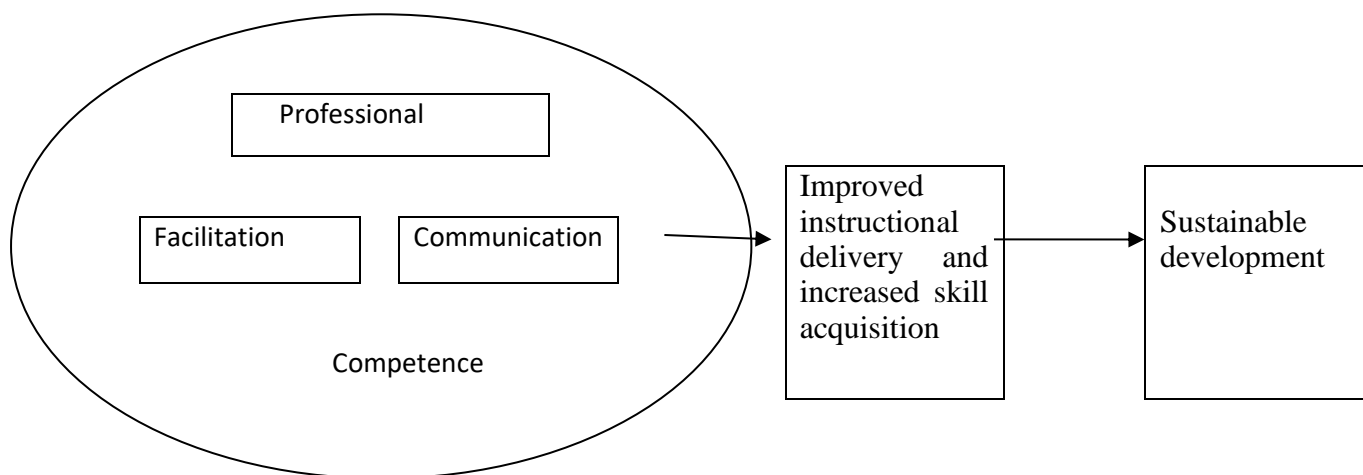


Fig 1.1 CFP Competence schema developed by Nungse (2018)

The competence schema is such that a TVET teacher needs the three domains of competencies for improvement and effective TVET instructional delivery. This will in turn split down to functional TVET skills for the world of work and subsequently the achievement of the sustainable development goal.

## STATEMENT OF THE PROBLEM

A facilitator should be competent in helping learners to practically discover knowledge for themselves through Socratic and social constructivist method. This shows that teachers desire to create learning situations that are close to real-world circumstances as possible. TVET teachers are also expected to master the contents of knowledge with the latest information required by TVET learners. They need to master the knowledge and skills related to the current industrial needs. In addition, TVET teachers need to keep themselves on new and relevant theory and new technologies to be used in the classrooms. Most importantly the understanding of new paradigm shifts from the teacher centred to learner centred approach of learning.

Unfortunately however, TVET instructional delivery is still performed through the old teacher centred approach where the teacher dominates the class. The implementers of TVET curriculum are yet to acquaint themselves with the competencies required for improving TVET instructional delivery. Even if teachers are aware of the significance of adopting Socratic and social constructivist approach to learning, they are yet to create the atmosphere for cooperative argumentative dialogue between learners, based on asking questions to stimulate critical thinking, leading to solutions to problems. Distinguishing between the role of teacher and a facilitator poses a significant problem in this regard. The need arises therefore, to determine the competencies required to optimize the competence of facilitators of TVET towards improving the quality of TVET Instructional delivery in Nigeria. Failure to impart this, results to hatching graduates who can't meet with the current digital TVET skills demanded in the world of work today. Therefore, the fundamental problem of this study can be seen in the following broad question: What are the facilitating, professional and communication competencies required by TVET teachers for improving the quality of TVET instructional delivery?

### Purpose of the study

The general purpose of the study was to determine the competencies required by TVET teachers for improving the quality of TVET instructional delivery in tertiary institutions in Nigeria. Specifically, the study sought to ascertain:

- xvi. the facilitating competency required of TVET facilitator to improve the quality of TVET instructional delivery
- xvii. the professional competency required of TVET facilitator to improve the quality of TVET instructional delivery
- xviii. the communication competency required of TVET facilitator to improve the quality of TVET instructional delivery

### Research questions

- xvii. What is the facilitating competency required of TVET facilitator to improve the quality of TVET instructional delivery?
- xviii. What is the professional competency required of TVET facilitator to improve the quality of TVET instructional delivery?
- xix. What is the communication competency required of TVET facilitator to improve the quality of TVET instructional delivery?

## METHODOLOGY



The study adopted a cross sectional survey design. According to Gall, Gall and Borg (2007), a cross sectional survey design is meant to describe survey that involves a single snapshot of data collection from a sample to represent the population to which the findings of the data analysis can be generalized. The study covered four tertiary institutions, namely, University of Nigeria, Nsukka, Federal College of Education, Pankshin, Plateau State Polytechnic, BarkinLadi and Kaduna Polytechnic. These institutions have established and experienced technical and vocational and technical education teachers numbering who have been teaching of technical and vocational education. The population of the study was 50 respondents, consisting of 12 curriculum experts and 38 lecturers, drawn from the Departments of Industrial Technical Education of the selected institutions. The entire population was used because its size was considered manageable and appropriate for the study. The instrument used for data collection was a 38-items structured questionnaire. The questionnaire was faced validated by three experts, two from the University of Nigeria, Nsukka and one from Kaduna Polytechnic. At the end of the validation, corrections were effected which produced a 27-item questionnaire, with nine items for each of the three competencies. To ascertain the internal consistency of the instrument, six copies were administered to six lecturers in the Departments of Technical Education, Abubakar Tafawa balewa University, Bauchi, using research assistants. Reliability of 0.89 was established using Cronbach's alpha coefficient.

The items on the instrument were rated on a four-point scale as follows : Highly Required (HR), 4 Moderately Required (MR), 3 Slightly Required (SR), 2 Not Required (NR), 1. The data collected from the respondents were analyzed using Statistical Package for Social Sciences (SPSS) version 22. Mean and standard deviation were the analytical tools used to interpret the data. The responses were required or not required based on 2.50 decision rule. Any item with mean value of 2.50 and above was regarded as required. Item with mean value of less than 2.50 was regarded as not required.

The results of the study were presented in tables as follows:

### Research Question 1

What is the facilitating competency required of TVET facilitator to improve the quality of TVET instructional delivery?

The data presented in Table 1 were used to answer research question 1.

**Table 1**

**Mean and Standard Deviation of Respondents on the Facilitating Competency Required of TVET Facilitators to Improve the Quality of TVET Instructional Delivery**

S/N	The required facilitating competence of TVET teacher includes the ability to;	Mean	SD	RMK
1	help the learners to discover knowledge for themselves through the Socratic and social constructivist's approach	2.66	1.07	<b>R</b>
2	make learners active contributors of learning process	2.88	1.01	<b>R</b>
3	provide new ways of acquiring TVET skills	3.33	0.62	<b>R</b>
4	provide new ways of engaging learners	3.33	0.78	<b>R</b>
5	create collaborative and cooperative interaction	3.40	0.69	<b>R</b>
6	guide the learners toward achieving the objectives	3.03	0.89	<b>R</b>
7	prepare learning activities for individual group	3.22	0.93	<b>R</b>
8	make learners thing beyond the book	3.37	0.74	<b>R</b>
9	guide learners towards constructing knowledge	2.66	1.10	<b>R</b>

**N.B, R=required**

Table I shows that all the items have mean values ranging from 2.66-3.40. These values are all above the criterion value of 2.50. This indicates that the responses of the respondents have certified the items to be the facilitating competency areas required of a TVET facilitator for improving TVET instructional delivery.

## Research Question 2

What is the professional competency required of TVET facilitator to improve the quality of TVET instructional delivery?

In Table 2 are presented data used to answer this research question.

**Table 2**

**Mean and Standard Deviation of Respondents on the Professional Competencies Required of TVET Facilitator to Improve the Quality of TVET Instructional Delivery**

S/N	The required professional competency of TVET teacher includes the ability to;	Mean	SD	RMK
1	master subject-specific content	2.74	1.02	<b>R</b>
2	master subject-specific pedagogical content	3.00	1.03	<b>R</b>
3	master subject pedagogies	3.03	0.89	<b>R</b>
4	undergo an on-the-Job training regularly	3.07	0.72	<b>R</b>
5	preparing TVET textbooks	3.00	0.96	<b>R</b>
6	attain a training in the use of various TVET teaching strategies	3.29	1.03	<b>R</b>
7	use the workshop training tools	2.81	0.96	<b>R</b>
8	preparing students for Industrial training programmers	3.00	1.03	<b>R</b>
9	ability to master all the TVET Skill instructional delivery strategies	3.18	0.87	<b>R</b>

**N.B,** R=required

Table 2 shows that all the listed items have their mean values ranging between of 2.74-3.29. The values are above the criterion mean of 2.50. This shows that all the items constitute the professional competency required of a TVET facilitator in successful improvement of TVET instructional delivery.

## Research Question 3

What is the communication competency required of TVET facilitator to improve the quality of TVET instructional delivery?

Research question 3 was answered by using the data presented in Table 3.

**Table 3**

**Mean and Standard Deviation of Respondents on the Communication Competencies Required of TVET Facilitator Improve the Quality of TVET Instructional Programme Delivery**

S/N	The required communication competence of TVET teachers include;	Mean	SD	RMK
1	Attentiveness	3.14	0.86	<b>R</b>
2	Perceptiveness	3.48	0.75	<b>R</b>
3	Responsiveness	3.18	0.83	<b>R</b>
4	Emotional sensitivity	3.07	0.95	<b>R</b>
5	Emotional expressivity	3.03	1.09	<b>R</b>
6	Emotional control	3.37	0.83	<b>R</b>
7	Social expressivity	3.25	0.71	<b>R</b>
8	Social sensitivity	3.14	0.98	<b>R</b>
9	Social control	3.44	0.57	<b>R</b>

**N.B,** R=required

The result of Table 3 depicts that a TVET facilitator requires all the listed items as communication competency areas for successful delivery of TVET instruction since the mean scores which range between 3.07-3.48 have satisfied the criterion value of 2.50.

## MAJOR FINDINGS

Tables 1-3 indicate the competencies required of a TVET facilitator towards improving TVET instructional delivery . Findings of the study show that the facilitating, professional and

communication competencies are highly required for TVET instructional delivery in the selected institutions. In the aspect of facilitating competency, TVET teachers desire to be competent in helping learners to discover knowledge themselves, make learners active contributors of the learning process and provide new ways of acquiring TVET skills, among others. The professional competency would require TVET teachers to be competent in the ability to master subject-specific content, prepare TVET textbooks, and master all the TVET skill instructional delivery strategies, among others. Since the most important communication happens in the classroom by conveying the learning content, the ability of a TVET teacher to be attentive, perceptive, responsive, and emotionally sensitive, among others, are the communication competency areas required of the TVET teachers in tertiary institutions.

## **DISCUSSION OF FINDINGS**

Findings of research question 1 revealed that all the items had mean values ranging from 2.66-3.40. These values were all above the criterion value of 2.50. This indicated that the responses of the respondents certified the items to be the facilitating competency areas required of a TVET facilitator for improving TVET instructional delivery. This result concurs with the findings of Oluwasola, (2014) and Demorest (2017) whose findings also revealed that facilitating competency requires that a TVET teacher should be competent in facilitating, professionalism and communication competence, while helping learners to discover knowledge for themselves through Socratic and Social constructivist approach.

Result of Table 2 found that all the listed items ~~also~~ had their mean values ranging between the of 2.74-3.29. The values were above the criterion mean of 2.50. This showed that all the items that constituted the professional competency are required of a TVET facilitator in the successful improvement of TVET instructional delivery. This finding is affirmed by the work of Grollmann, (2008) which found that professional competency is needed to ensure that TVET teachers master the contents of knowledge and pedagogy with the latest information required.

The result of Table 3 found that a TVET facilitator requires all the listed items for successful delivery of TVET instruction since the mean scores fell within the criterion value of 2.50. Those items were required for improving TVET instructional delivery. This finding gains support with the studies by Amiruddin et al., (2015) and Diep and Hartmann, (2016) which found that the ability helps teachers to communicate effectively, not only with learners, but also with the parents of learners, colleague and the industry. However, the most important communication happened in the classrooms by conveying learning contents, controlling the classrooms and consulting the learners. Consequently, communication is a vital element through which information reaches the learner from the teacher. The TVET teacher therefore, should not hesitate to possess the communication competency essential for TVET instructional delivery.

## **IMPLICATIONS OF THE STUDY**

The facilitator should be competent in helping learners to discover knowledge by themselves through Socratic and social constructivist method (Muhammad, Roziah, Mohd & Muhd, 2017; Demorest, 2017). The ability of a facilitator to create a collaborative and practical cooperative interaction between learners to reflect the lesson objectives forms part of the facilitating competency. It also depicts that the facilitator should make learners to be active participants and contributors in the learning process. Professional competency implies that TVET teachers should master the contents of knowledge with the latest information required by vocational learners. They need to master the knowledge and skills related to the current industrial needs. Failure to impart this results with the graduates who can't perform in the world of work.

Another essential implication of the study is that which is attached to communication competence. This ability implies that teachers would perform effective communication not only with learners, but with parents of learners, colleagues and the industry as well. However, the most important communication happens in the classrooms through ~~of~~ conveying learning contents, controlling the classrooms and consulting the learners. The facilitator therefore, needs to

come to the limelight of the significance of these competencies in order to improve TVET instructional delivery in tertiary institutions in Nigeria.

## CONCLUSION

In this paper, three interrelated domains were discussed through the competency domains. The educational implication of the facilitating domain stressed the need for a facilitator to be competent in helping learners to discover knowledge by themselves through the Socratic and social constructivist approaches. It also depicted that the facilitator should make learners to be active participants and contributors in the learning process. Professional competency implied that TVET teachers should master the contents of knowledge with the latest information required by vocational learners. Communication competency is anchored on the ability of facilitators to perform effective communication not only with learners, but also with parents of learners, colleagues and the industry. Imparting this yields with the graduates who can perform effectively in the world of work. The facilitator therefore, needs to come to the limelight of the significance of these competencies in order to improve TVET instructional delivery in tertiary institutions in Nigeria.

## Recommendations

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

1. TVET Instructional delivery should be best performed through facilitating process of social constructivist approach where learners actively participate in discovering knowledge and solving problems.
2. TVET delivery should not be through teaching approach as in the case of traditional method where the teacher acts as the knowledge conduit
3. A TVET facilitator who is traditionally a teacher should desire to acquire the competencies that would enable them fit into the TVET system for proper instructional delivery towards a sustainable development.

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## **EFFECTS OF COMPUTER ASSISTED INSTRUCTIONS ON SECONDARY SCHOOL STUDENTS' INTEREST IN GEOMETRY IN KEFFI EDUCATION ZONE, NASARAWA STATE, NIGERIA**

By

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### **Abstract**

The study investigated the effects of Computer Assisted Instruction on secondary school Students' Interest in Geometry in Keffi Education Zone, Nasarawa State. Quasi-experimental design of the non-equivalent control group pretest posttest type was used. Two research questions guided the study and two hypotheses were tested at 0.05 level of significance. Simple random sampling technique was used to draw 104 JS II students as Sample of the study. Instruments used for data collection was Geometry Interest Scale (GIS). The instrument was validated by three research experts with logical validity index of 0.73. The reliability of GIS was obtained using Cronbach's coefficient alpha method and the reliability coefficient of 0.69 was obtained. Mean and standard deviation were used to answer the research questions while the hypotheses were tested at 0.05 level of significance using Analysis of Covariance (ANCOVA). The results revealed that Computer Assisted Instruction (CAI) group had a higher interest than the Conventional lecture method (CLM) which means that using the CAI strategy could be more preferred as it can enhance students' interest in geometry. It was also found out that CAI has the same effects on male and female students' interest in geometry. The study has recommended among others that Mathematics teachers should be encouraged to develop and adopt Computer Assisted Instruction in the teaching and learning of other topics in mathematics to improve on students' interest. They should also be sensitized by way of organizing seminars, conferences and workshops on the use of computer assisted instruction for onward application in mathematics classroom instruction. These seminars, conferences and workshops could be organized by associations like Mathematics Association of Nigeria (MAN), Science Teacher Association of Nigeria (STAN) and National Mathematical Centre Kwali-Abuja (NMC).

**Key Words:** Computer Assisted Instruction, Students' Interest, Students' Gender and Geometry.

## Introduction

Mathematics is required in daily lives, regardless of educational background and or social life. Geometry as a basic and important branch of Mathematics is the study of size, shape and position of 2-dimensional shapes and 3-dimensional figures. Good and meaningful lessons in geometry could contribute immensely to helping students develop the skills of critical thinking, problem solving ability, conjecturing, deductive reasoning, logical argument and proof.

As important as Geometry is, students' achievement in this area has not been encouraging. Kurumeh as cited in Musa (2017) observed that generally, students fear and hate Mathematics which results to lack of interest and poor achievement. In addition, geometry is considered as the most difficult aspect of Mathematics (Adolphus, 2011). The annual reports of the Basic Education Certificate Examination BECE (2014-2018) in Nasarawa State, Nigeria shows an unpredictable trend of Student's Achievement in Mathematics at Junior Secondary School level.

The low level of performance is displeasing and worrisome. This could hamper meaningful development in Nigeria and Nasarawa state in particular. The Students' poor achievement in Geometry over the years has been attributed to teacher's use of inappropriate teaching methods amongst other factors which make students passive rather than being active participants with each other doing task (Zakaria, Solfitri, Daud & Abidin, 2012). Researches by Aguele, Omo-Ojugo and Imhanlahimi (2010), Tyoor and Musa (2017) found that activity based teaching methods are more effective in enhancing the teaching and learning of Mathematics than the conventional lecture method.

The introduction of information and communication technology seems to have ushered in a new dimension into the pattern of teaching and learning of subjects in schools. (Ojiaku, 2012). This development explains the need for the use of computer as part of the instructional material for curriculum development. Computer assisted instruction is the use of computer to provide instruction. Computer Assisted Instruction (CAI) is an interactive strategy whereby a computer is used to present instructions to the students and also to monitor the learning that takes place in them. CAI uses a combination of texts, graphics, audio and video in the learning process (Gimba, Hassan, Abdularaham and Bashir, 2015). CAI is used in conjunction with the teacher. The teacher prepares a lesson according to some pedagogical specifications and saves it in Compact Disc Read Only Memory (CD-ROM). CAI is of six different types; they are: Tutorials, Drill and practice, simulation, Games, Problem solving and Discovery (Usman, K.O. & Ezech, S.I. 2010).

Lack of interest and poor achievement of secondary school students in Mathematics was as a result of inappropriate teaching strategies used by the teachers (Zakaria, Solfitri, Daud & Abidin, 2012). Therefore, there is need to plan strategies that will improve students interest and understanding of Mathematics concepts especially at the lower level. In spite of the application of other teaching strategies, secondary school students' interest and achievement in Mathematics remain relatively low (WAEC Chief Examiners' Reports, 2013, 2014, 2015, 2016 and 2017). Hence, there is need to see whether CAI strategy will improve students' interest in Geometry.

Interest is a psychological disposition that could be a factor in determining achievement of students in Mathematics. Generally, interest is quite powerful and influential in guiding over behaviour and in making choices. This influence is always evident in students' desire to re-engage in content over time to seek answers to questions, and to acquire more knowledge.

Musa (2017) opined that the degree and direction of attitudes towards Mathematics are largely determined by the kind of interest developed by students for Mathematics. Obodo (2005) and Okeke (2009) viewed that student poor interest is one of the stumbling blocks in learning Mathematics. They attributed poor achievement of students in Mathematics to factors such as lack of learners' interest. When students participate in activities related to their life experiences, it facilitates transfer of learning, it serves as a motivational factor which arouses their interest and makes learning more

meaningful. Practical experiences, activities, concretization and use of objects familiar to teachers and students arouse students' interest and foster effective teaching and learning of Mathematics (Musa, 2017).

Gender is considered as a state of being male or female. Arigbabu and Miji (2008) stated that gender generalization is manifested in the type of vocations and professions in which men and women are involved in. Fields such as medicine, engineering and architecture are traditionally regarded as male's fields, while fields such as nursing, catering, typing and Arts are regarded as female areas.

Researchers have not come to a consensus over the influence of gender on students' interest towards Mathematics. While some researchers found out that a significant difference exists in the interest of male and female students towards Mathematics others found out that there is no significant difference in the interest of male and female students towards mathematics. Gender has been one of the major factors perceived to be influencing achievements of students in Mathematics; therefore, the reason why males are pursuing Mathematics related disciplines and professions than females. In view of the conflicting findings on the influence of gender and interest on achievement of students in Mathematics, it has become imperative for this study to investigate the effects of CAI on secondary school students' interest in Geometry in Nasarawa State, Nigeria.

### **Statement of the Problem**

The consistent underachievement in teaching and learning of Mathematics has been attributed to ineffective instructional strategies adopted by mathematics teachers. Other factors include: non-availability of instructional materials, gender differences, poor reasoning skill, inadequate time, and inadequate school curriculum. All these are believed to have a negative effect on the learning of geometry which result in rote learning with the indication that such instructional strategies have not adequately enhanced and improved students' Interest, achievement and retention in mathematics.

Studies have revealed that difficulty in teaching and learning of Mathematics especially geometry have resulted in mass failure in examinations (NMC, 2009). Research findings have confirmed that geometry is one of the topics among the abstract and complex aspects of Mathematics which students find difficult to learn (Adolphus, 2011).

In view of the above, there is need to identify the appropriate teaching and learning methods that may improve students' interest in Geometry. Therefore, the thrust of this study is: will the utilization of Computer Assisted Instruction in the teaching of Geometry brings about improve interest among Junior Secondary School students in Nasarawa State?

### **Objectives of the Study**

The specific objectives of the study were to:

- xii. determine the interest ratings of junior secondary two (JS II) students in geometry before and after exposure to Computer Assisted Instruction (CAI) and Conventional Lecture method (CLM).
- xiii. find out the interest ratings of junior secondary two (JS II) male and female students in geometry before and after exposure to Computer Assisted Instruction (CAI)
- xiv. to ascertain whether a significant difference exist between the interest ratings of junior secondary two (JS II) exposed to CAI and Conventional lecture method (CLM)
- xv. determine whether a significant difference exist between the interest ratings of junior secondary two (JS II) male and female students in geometry exposed to CAI

### **Research Questions**

The following research questions have been designed to guide the study:

1. What are the mean interest ratings of JS II students taught geometry before and after exposure to Computer assisted instructions (CAI) and Conventional lecture method?
2. What are the mean interest ratings of JS II male and female students taught geometry using CAI?



### Statement of the Hypotheses

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

- 1 There is no significant difference in the interest ratings of JS II students' taught geometry using Computer assisted instructions (CAI) and those taught using Conventional lecture method (CLM).
- 2 There is no significant difference in the interest ratings of JS II male and female students taught geometry using CAI

### Methodology

The research design adopted for this study was quasi-experimental of the non-equivalent Control group pretest post-test type. The sample for the study was made up of 104 Junior Secondary II (JS II) students in Nasarawa State public secondary schools. The sample was made up of 55 males and 49 females. Purposive sampling technique was used in selecting two co-education schools to make up the sample for the study. The reason for the choice of purposive sampling technique was to enable the researcher select schools with well equipped computer laboratories, experienced computer literate Mathematics teachers with at least five years teaching experience. One intact class from the two sample schools was assigned to the experimental group and the other intact class to a control group using Simple random sampling technique.

The instruments used for data collection was Geometry Interest Scale (GIS). The Geometry Interest Scale (GIS) was adapted by the researchers from Snow's (2011) interest rating scale which had Hidi and Renninger's (2006) four-phase model as the theoretical foundation. The instrument was modified to suit the present study and to reflect students' interest in geometry. In adapting the GIS, the researcher modified the inventory based on the four point scale of Strongly Agree (SA), Agree (A), Disagree (D), and Strongly Disagree (SD). Also some statements were modified based on Geometry rather than general mathematics used by Snow. The researchers believed that this method made the inventory clearer to the students and to ensure its cultural fairness. The responses were scored as follows: SA=4, A=3, D=2, SD=1 for each item.

The GIS scale has a total number of 20 items that were used to test for a change in interest after teaching geometry using CAI and CLM. The GIS was administered to both the experimental and control groups to determine whether students had increased or decreased interest towards geometry. The GIS was validated by the three experts with the logical validity index of 0.73. Cronbach's coefficient alpha was used to determine the reliability coefficient of the GIS and its coefficient was measured as 0.69. The reason for the use of this method was because the items had several possible answers each of which was given different weight. Descriptive statistics (mean scores and standard deviation) was used to answer all the research questions and Analysis of covariance (ANCOVA) was used to test the two hypotheses at 0.05 level of significance.

## RESULTS

### Research Question one

What are the mean interest ratings of JS II students taught geometry before and after exposure to Computer assisted instructions (CAI) and Conventional lecture method (CLM)?

Data in respect of analysis are presented in Tables 1.

**Table 1: Means and standard deviations of interest ratings in GIS of students taught Geometry using Computer Assisted Instruction Strategy and those taught using conventional methods**

	Pre- interest	Post- interest
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Group	N	Mean	SD	Mean	SD
CAI	54	48.15	14.19	60.39	17.29
CLM	50	46.18	15.53	52.72	16.91

Table 1 shows mean interest ratings of students exposed to Computer assisted instructions (CAI) strategy and Conventional lecture method (CLM). Students exposed to Geometry using CAI had higher interest rating of 60.39 and those exposed to CLM had lower interest rating of 52.72. The Standard deviation scores for the pre-interest and post -interest were not at much variance.

### Research Question two

What are the mean interest ratings of JS II male and female students taught geometry using CAI?

**Table 2: Means and standard deviations of interest ratings in GIS of male and female students taught Geometry using Computer Assisted Instruction**

Group	Gender	N	Pre-test		Post-test	
			Mean	SD	Mean	SD
Computer Assisted	Male	28	50.29	15.87	60.57	19.26
	Female	26	47.92	12.31	59.81	14.75

Table 2 shows mean interest ratings of male and female students exposed to CAI. The male students had the higher mean interest rating of 60.57 after exposure to CAI. The Standard deviation scores for the pretest and posttest based on gender were not at much variance.

### Hypothesis One

There is no significant difference in the interest ratings of JS II students' taught geometry using Computer assisted instructions (CAI) and those taught using Conventional lecture method (CLM).

The result obtained is as presented in table 3

**Table 3: Results of Analysis of Covariance on Students' Interest ratings in GIS**

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	40720.449 <sup>a</sup>	3	13573.483	312.511	.000
Intercept	744.835	1	744.835	17.149	.000
PreInterest	39032.312	1	39032.312	898.665	.000
Method	811.491	2	405.746	9.342	.000
Error	6167.578	142	43.434		
Total	527418.000	146			
Corrected Total	46888.027	145			

Table 3 reveals a significant difference in the interest ratings of students exposed to Computer Assisted Instructions Strategy and Conventional Method. F = ratio of 9.342 was obtained with associated exact probability value of 0.000. Since the associated probability (0.000) is less than 0.05 set as level of significance, the null hypothesis was rejected. The result implies that the Computer Assisted Instructions and conventional method produced a significant effect on the post-test interest scores of students when covariate effect (pretest) was controlled. Hence, there was a significant difference among the two groups of Computer Assisted Instructions Strategy and Conventional Method in favour of Computer Assisted Instructions.

### Hypothesis two

There is no significant difference in the interest ratings of JS II male and female students taught geometry using CAI

The test for this hypothesis provided the data on Table 4.

**Table 4: Results of Analysis of Covariance on Students' interest ratings in GIS Based on Gender and Computer Assisted Instructions.**

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	12219.578 <sup>a</sup>	2	6109.789	95.783	.000
Intercept	227.254	1	227.254	3.563	.065
PreInterest	12211.714	1	12211.714	191.443	.000
GCAI	42.055	1	42.055	.659	.421
Error	3253.182	51	63.788		
Total	211195.000	54			
Corrected Total	15472.759	53			

Table 4 shows an F=ratio 0.659 with associated exact probability value of 0.421 which is greater than the bench mark probability value of 0.05. This indicates that there is no significant difference in the mean ratings of male and female students exposed to Computer Assisted Instructions Strategy. Tables 4 revealed that there is no significant difference between the mean interest ratings of male and female students exposed to CAI. Since a significant difference has not been observed, the null hypothesis was not rejected. This implies that gender did not produce a significant effect on the post-interest ratings of students. This shows that the male and female factors have no effect on the interest ratings of the students.

### Discussion of Findings

The results of hypothesis one reveals significant difference between the interest ratings of students in Computer Assisted Instruction Strategy and Conventional Method in favour of Computer Assisted Instruction. The mean interest ratings of student taught using Computer Assisted Instruction is higher than that of their counterparts who have been exposed to Conventional method. Computer Assisted Instruction has been found to be facilitating in enhancing students interest in geometry. This might be due to the fact that Computer Assisted Instruction seems to have students' activities and step by step assessment which help the students to master geometric concepts without much difficulty. It also helps students remember more conceptual ideas and is able to relate the test to prior knowledge. This was consistent with the findings of Usman, K.O. & Ezech, S.I. (2010, Gimba, R. E. (2014), Maigana, B. M. (2016), Agu, P. A. and Esson, I. K. (2017), Musa, D. C. (2017).

The results of hypothesis two has shown no significant difference between the interest ratings of male and female students who were exposed to Computer Assisted Instruction. This finding is in agreement with the findings of Gimba, R. E. (2014), Maigana, B. M. (2016), Musa, D. C. (2017) opined that gender has no significant difference in the students' interest in mathematics.

### Conclusion

The findings of this study have shown that Computer Assisted Instruction is more effective than Conventional lecture method. These results imply that the learning approaches employed by Mathematics teachers in teaching might have been partly responsible for the persistent lack of interest and under-achievement of students in geometry since they were using the conventional methods most of the times. The implications of this study hinges on the development of more virile learning approaches for teaching geometry.

### Recommendations

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

1Mathematics teachers should be encouraged to develop and adopt Computer Assisted Instruction and Problem Solving Strategy in teaching and learning of mathematics to improve on students' interest, achievement and retention.

2Mathematics teachers in secondary schools should be sensitized by way of organizing seminar, conferences and workshops on the use of computer assisted instruction for onward application in mathematics classroom instruction. These seminars, conferences and workshops could be organized by associations like Mathematics Association of Nigeria (MAN), Science Teacher Association of Nigeria (STAN) and National Mathematical Centre Kwali-Abuja (NMC).

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## **THE IMPACT OF DIFFERENTIATION METHOD ON STUDENT'S PERFORMANCE IN FINDING THE CENTRE AND RADIUS OF A CIRCLE AMONG STUDENT OF KADUNA POLYTECHNIC KADUNA**

By

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### **Abstract**

The purpose of the study was to compare student performance in finding the center and radius of a circle taught using the differentiation method and those taught using the completing the square methods . A randomly selected sample of 100 students out of 320 from the college of engineering, Kaduna polytechnic made up the response for the study. The study was quasi-experimental in approach. The research instrument used for the data collection consisted of equation of circle achievement test (ECAT). This was developed by the researcher and validated by mathematics educators, science educators and mathematicians. (ECAT) has a reliability coefficient of 0.81. The respondents were shared in to two groups, one experimental and other control group. A pre-test was administered to the subject to find out their equivalent ability. The respondent in the experiment group were exposed to treatment (differentiation method) and the respondent for control group were taught using the completing square method for a period of three weeks in each case and were post-tested. One null hypothesis was formulated and tested using descriptive statistics analysis using t-test at  $P < 0.05$  level of significance. The study found that significant difference existed in the performance of student taught finding the centre radius of a circle using the differentiation method compare to those taught using the completing the square method. It was recommended that differentiation method strategy should be encouraged in finding the centre and radius of equation of a circle in tertiary institution.

**Key Words:** Differentiation method, performance, circle, radius and center.

### **Introduction**

According to Adewale (1992) the success or failure of the student in examination is a clear manifestation of the student academic activities during the course.

According to Nicol (1997), “a teacher can only be seen to be effective when the students can learn with greater ease and perform well with his help than without his help”

Mathematics as a communication of systems of concepts of shape, size, quantity and order also helps students to describe diverse phenomena both in physical and economic situations. It is man’s valiant effort to deal mentally with his environment and a vital subject among the school curriculum (Ojerinde 1999).

Students’ performance in mathematics examination in both internal and external year in year out has not been encouraging (Ale, 2005).

Mathematics is a powerful social entity that plays a key role in sharpening how individual deals with the various spheres of private social and civil life (Kajuru and Popoola 2010).

This view is shared by Kajuru and Popoola 2010), who pointed out that student’s performance has fallen below expectation in recent years despite the relative importance of the subject. Nwabugwu (2012) reported that the federal government describe the performance of students in Nigeria as unacceptable and warns that the trend must be checked if the country has to move forward.

Consider the general equation of a circle:  $x^2 + y^2 + 2gx + 2fy + c = 0$

Differentiating implicitly w.r.t.  $x$  gives

$$2x + 2y \frac{dy}{dx} + 2g + 2f \frac{dy}{dx} = 0 \Rightarrow (2y + 2f) \frac{dy}{dx} = -(2x + 2g)$$

$$\therefore \frac{dy}{dx} = \frac{-(2x + 2g)}{2y + 2f} = \frac{-(x + g)}{y + f}$$

$$\text{At stationary points, } \frac{dy}{dx} = 0 \Rightarrow \frac{-(x+g)}{y+f} = 0 \Rightarrow -(x + g) = 0 \therefore x = -g$$

So also, differentiating implicitly w.r.t.  $y$  gives

$$\frac{dx}{dy} = \frac{-(2y + 2f)}{2x + 2g} = \frac{-(y + f)}{x + g} = 0 \Rightarrow -(y + f) = 0 \therefore y = -f$$

Therefore the centre of the circle is  $(x, y) = (-g, -f)$  and the radius given by

$$r = \sqrt{g^2 + f^2 - c}$$

To illustrate this approach we consider this equation as an example;

$$x^2 + y^2 + 4x - 10y - 12 = 0.$$

Differentiating implicitly w.r.t.  $x$  gives

$$2x + 2y \frac{dy}{dx} + 4 - 10 \frac{dy}{dx} = 0 \Rightarrow (2y - 10) \frac{dy}{dx} = -(2x + 4)$$

$$\therefore \frac{dy}{dx} = \frac{-(2x + 4)}{2y - 10} = \frac{-(x + 2)}{y - 5}$$

$$\text{At stationary points, } \frac{dy}{dx} = 0 \Rightarrow \frac{-(x+2)}{y-5} = 0 \Rightarrow -(x + 2) = 0 \therefore x = -2$$

So also, differentiating implicitly w.r.t.  $y$  gives

$$\frac{dx}{dy} = \frac{-(2y - 10)}{2x + 4} = \frac{-(y - 5)}{x + 2} = 0 \Rightarrow -(y - 5) = 0 \therefore y = 5$$

Therefore the centre of the circle is  $(x, y) = (-2, 5)$  and the radius is

$$r = \sqrt{-2^2 + 5^2 + 12} = \sqrt{4 + 25 + 12} = \sqrt{41}$$

### Statement of the Problem

Performance in mathematics has been poor at all levels of education. This problem has been consistent all over the years as was reported by Ajagun (2000) and has evoked much research efforts to redress the situation. The inappropriate teaching methods were view to be one of the major causes of poor performance in test and examination. The persistent/consistent difficulty exhibited by students in finding the centre and radius of the equation of a circle propelled the researchers to use the differential approach to find the centre and radius of the equation of a circle. This is possible because the equation of the circle is differentiated implicitly. Moreover, for decades the traditional methods (completing the square) have continued to prove difficult to most students. The researchers therefore provide an alternative method.

### Objective of the Study

The main objective of this study is to find out the effect of using the differential approach in finding the centre and radius of the equation of a circle on the performance of student of college of engineering Kaduna polytechnic.

The specific objectives were to.

- xvi. Investigate if there is any significant difference between students' performance in finding the centre and radius of the equation of a circle using the traditional methods(completing the square) and those taught using the differential approach .

### Research Questions

The study will examine the following questions:

16. Is there any significant difference between students' performance in finding the centre and radius of the equation of a circle taught using the traditional method (completing the square) and those taught using the differential approach?

### Null hypothesis

On the basis of the research questions the following null hypothesis were formulated and tested at 0.05level of significance.

$H_{oi}$ : there is no significant difference in the performance of students taught in finding the centre and radius of the equation of a circle using the traditional method(completing the square) and those taught using the differential approach.

### Methodology

The study was quasi-experimental in approach. One group was used as the experimental group while the other group was used as a control group. A pre-test and post-test design was administered. The experimental group were exposed to the integral approach while the control group used the traditional method (expansion).

### Research Design

EG  $\rightarrow$  O<sub>1</sub> $\rightarrow$  X<sub>1</sub> $\rightarrow$  O<sub>2</sub>

CG  $\rightarrow$  O<sub>1</sub> $\rightarrow$  X<sub>0</sub> – O<sub>2</sub>

EG  $\rightarrow$  Experimental Group

CG  $\rightarrow$  Control Group

O<sub>1</sub> – Pre-test

O<sub>2</sub> – Post-test

## Population of the Study

The population of the study is 240 students of the College of Engineering Kaduna polytechnic. The breakdown of the population shows 140 males and 100 females. The breakdown is illustrated in the table below.

### Population of the study

	Male Students	Female Student	T o t a l
1	2 0 1	0 0 3	2 0 0

Source:KPTMathematics Department(2018)

## Sample and Sampling Techniques

In this study, random sampling technique was used to select sample (ballot). The sample consist of 100 students drawn from an estimated population of 240, comprising of 56 males and 44 females. This is in line with central limit theorem, which suggested that 30 should be the minimum number of sample for an experimental research (Dantani 2006), the sample is represented in the table below.

**Table2: sample of the study**

	Male Students	Female Student	T o t a l
1	5 6	4 4	4 1 0

Source: KPT Mathematics Department (2018)

## Instrumentation

The data collecting instrument used was equation of a circle mathematics achievement test (ECMAT). This comprises of 5 essay questions covering different kinds of equations of a circle, and was developed by the researchers. This was validated by panel of judges comprising of mathematics educators and mathematician. These experts were PhD holders and were chosen base on their experiences. Corrections and observations of these experts were effected by the researchers. The (ECMAT) was pilot tested and the result from the pilot study was calculated, and the reliability coefficient (r) of the test using Kuder- Richardson estimate (K-R21) was used in the study. The reliability coefficient was found to be +0.81.

## Procedure for Data Collection

The control group is made up of the traditional method (completing the square),while experimental group is made up of the differential approach. The (ECMAT) is administered for two weeks and there after a test was conducted by the researcher.

The test format is as given below:

Find the centre and radius of the following equations of circles:

- xx.  $x^2 + y^2 + 4x - 10y - 12 = 0$
- xxi.  $x^2 + y^2 + 4x - 6y + 10 = 0$
- xxii.  $x^2 + y^2 - 2x - 4y + 4 = 0$
- xxiii.  $x^2 + y^2 + 10x - 4y - 3 = 0$



xxiv.  $x^2 + y^2 - 2x - 6y + 5 = 0$

### Data Analysis Procedure

The descriptive statistics of mean, standard deviation and standard error of mean were used for the experimental and control groups, male and female respondents.

### Analysis, Result and Discussion

Is there any significant difference between the performance of students taught in finding the centre and radius of the equation of a circle using the differential approach and those taught using the traditional method (completing the square)? The mean, standard deviation, standard error of mean of both experimental and control groups were computed and compared.

**Table 3: Summary of Descriptive Statistic of Experimental and Control Group**

	N	Mean	Std. Deviation	Std. Error
Experimental	50	43.7	24.1	0.53
Control	50	25.7	5.9	0.12

In table 3 above, the mean post test scores of the students who learnt how to find the centre and radius of the equation of a circle with different methods were shown. The experimental group had the highest post mean scores of 43.7 and the control group had the

Mean of 25.7. Thus, there is a difference in the mean score of the two groups. To find out whether there is a significant difference among the two groups, t-test analysis was carried out.

### Null Hypothesis 1.

$H_{01}$  There is no significant difference in the performance mean scores of the student taught in finding the centre and radius of the equation of a circle using the differential method and those taught using the traditional method (completing the square). To test this hypothesis the post-test scores of the subjects in the experimental and control groups were compared using t-test static.

**Table 4: t-test Analysis Comparison of the Mean Scores of the Post-test for Experimental and Control Group.**

Method	N	Mean	Std. Deviation	Std. Error	t-value	df	Significance (2-tailed)	Decision
Differentiation Method	50	43.7	24.1	0.53	38.960	98	.000	Rejected $H_{01}$
Formula Method	50	25.7	5.9	0.12				

T-statistics with p-value of 0.01 which is less than 0.05 shows a significant difference between the two groups. Therefore, the null hypothesis is rejected. This means that there was a significant difference between the performance of the experimental and the control groups. The result has shown that the integral approach is more effective in improving students' performance.

### CONCLUSION

The study has shown that the differential method of finding the centre and radius of the equation of a circle is effective in the teaching and learning of equations of circle. It also provides an alternative to the existing method. The outcome of this research also revealed that affected by use of the differential method. The data collected for this research confirms that students' academic achievements is partly due to the method of teaching use by the teachers. Teachers will need to explore and diversify their teaching method in both secondary and tertiary institution in order to curb the problem of poor performance in the learning of mathematics.

### Recommendation

Based on the findings, the following recommendations were made:

- xix. The differential method of in finding the centre and radius of the equation of a circle should be encouraged in our senior secondary schools and tertiary institution such as colleges of basic studies, colleges of education, polytechnics, universities etc.
- xx. Seminars/workshops should be organized to sensitized teachers on the usage of differential method of finding the centre and radius of the equation of a circle through the National Teachers institute (NTI) and National Educational Resource Centre (NERC).

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