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SCIENCE AND TECHNOLOGY FOR AFRICAN DEVELOPMENT

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Science and Technology are Critical to Africa's Economic Development

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There are 1.3 billion people living in the African region, which makes up 20% of the surface of the planet. By 2050, that number will likely increase to 2.53 billion. It boasts 30 percent of the world's mineral reserves, vast tracts of forested land, and 60 percent of the world's arable land. Nevertheless, despite its wealth, China contributes only 3% of the world's GDP, less than 3% of global commerce (mostly in basic goods and raw materials), and 25% of the world's disease burden. When it comes to research and innovation, Africa ranks last, accounting for only 2% of global research output, 1.3% of research spending, and 0.1% of all patents.

Africa's economic transformation has been hampered by a dearth of investment in Science and Technology, both structurally (the transfer of labor and resources from low- to high-productivity sectors) and sectorally (the growth of productivity within sectors). Wide-ranging effects of this lack of funding include the continent's continuous reliance on the colonial development model of resource extraction, which is both unsustainable and largely to blame for its crippling poverty and aid dependence because it lacks the economic and scientific infrastructure required for innovation. Economic dispersion has made these problems worse by preventing long-term investments and patient capital that would promote innovation and accelerate technology transfer in the context of globalization.

In several ways, Science and Technology have significantly aided the development of most countries and communities. A few of the sectors affected by Science and Technology development include infrastructure, energy, industry, health, education, communication, finance, entertainment, transportation, agriculture, and environmental protection.

1. **Information Technology (IT):** As the world has moved from an analog to a digital system, any information can now be digitally converted and rapidly shared throughout society. Information technology has led to the development of brand-new forms of communication, including the Internet and cell phones, and the addition of satellite transmission to already-existing ones. The range of human activities and interactions has increased because of improvements in mobility and telecommunications technology, including the telephone and radio. Machines now come in a wider range thanks to computerized programming, which enables them to carry out a variety of tasks with greater effectiveness and speed.

2. **Health:** Another field where paradigms are changing is the medical or health industry. The discovery of novel disease-causing agents like viruses and prions that are accountable for disorders with unknown origins has been made possible by the evolution of biological processes from a structural to a molecular basis. The mechanisms of action for most diseases have been discovered, and novel high-throughput diagnostic techniques with high sensitivity and specificity have been developed for a wide range of illnesses and diseases, enabling effective treatment. The development of the pharmaceutical business and the identification of new drug targets are other effects of novel technologies.

3. **The discovery of new energy sources**: The myth of diminishing crude oil ores has almost completely been dispelled by the discovery of new energy sources, especially renewable ones. Energy can be stored using the sun, breeze, water, organic materials found in plants, and other renewable natural resources. Thermal energy and nuclear energy from nuclear power plants are two additional emerging energy sources that could meet the demands of a growing populace.

4. **Infrastructural** development: There has been a major acceleration in infrastructure development worldwide. Because of interconnected transit infrastructure, including highways, trains, and GPS technology, traffic congestion has decreased. Cities with cutting-edge architecture are thoughtfully planned to prevent overcrowding and make them available to all.

Science and Technology have significantly contributed to the attainment of national development objectives and rewriting Africa's economic growth narrative in all sectors. The Book "Science and Technology for African Development" seeks to examine the contributions of science and technology in developing the economies of African States.

The Digitalization of Science, Technology and Innovation: Key Developments and Policies

OECD iLibrary
Washington DC, United State

This report examines digitalisation's effects on science, technology and innovation and the associated consequences for policy. Digitalisation today is the most significant vector of innovation in firms, science and governments. If properly harnessed, digital technologies could advance science, raise living standards, help protect the natural environment and improve policymaking itself.

Digitalisation and Science
Digitalisation is bringing change to all parts of science, from agenda setting, to experimentation, knowledge sharing and public engagement. To achieve the promise of open science research budgets need to account for the increasing costs of managing data. Greater policy coherence and trust between research data communities are needed to increase sharing of public research data across borders. Co-operation is required to build and provide access to cyber-infrastructure internationally. And open access (OA) publication requires incentives for OA that match mandates coming from research funders.

Governments should also support platform technologies for science, such as distributed research and development networks, and storage for digital/genetic data. Room exists to better exploit advanced digital technologies in science. Artificial intelligence (AI) can increase productivity in science, at a time when research productivity may be falling. But policies are needed on high-performance computing, skills, and access to data (such as standardisation for machine readability of scientific datasets). AI in science also raises novel policy issues: for instance, will intellectual property systems need adjustment as invention by machines expands?

Realising the Untapped Potential of Digital Technology in Policy
Digital technology could support policymaking for science and innovation in novel ways. Few governments have experimented with the opportunities available. Examples include: Self-organised funding allocation; using collective intelligence

through digitally enabled prediction markets and machine-crowd combinations; developing blockchain applications in science; and, using social media to help spread innovation.

Digitalisation and Innovation in Firms
As businesses innovate with data, new policy issues are likely to arise. For instance, restricting cross-border data flows can raise firms' costs of doing business, especially for small and medium-sized enterprises (SMEs). Decisions may soon be required on as yet unanswered policy questions: for example, should data transmitted in value chains be protected from sale to third parties?

AI is finding applications in most industrial activities. But firms with large volumes of data may not have the in-house skills to analyse it fully. Governments can work with stakeholders to develop voluntary model agreements and programmes for trusted data sharing. For more general AI applications, governments can also promote open data initiatives and data trusts and ensure that public data exist in machine-readable formats.

Effective sectoral support is also needed, for instance through roadmaps or sectoral plans, prepared with industry and social partners. Policy should also facilitate collaboration for innovation, for instance, by digitally enabled crowdsourcing and open challenges.

Even in the most advanced economies, the diffusion of advanced digital technologies needs to accelerate. Institutions for technology diffusion such as applied technology centres can be effective, and should be empowered to take longer-term perspectives, rather than prioritising short-term revenue generation. To help diffuse digital technology to SMEs governments can: systematise key information for SMEs; develop information on the expected return on investments in new technologies, and on complementary process changes; provide signposts to reliable sources of SME-specific expertise, along with facilities where SMEs can test varieties and novel combinations of equipment.

Developing Digital Skills
Occupational titles like "industrial data scientist" and "bioinformatics scientist" are recent and reflect a pace of technological change that is contributing to shortages of digital skills. Entirely new fields of tuition are needed, such as dedicated programmes for the autonomous vehicle industry. Existing curricula may also need to change. Too few students learn the fundamental role of logic in AI. Many schools barely teach data analysis, and more multidisciplinary education is needed.

Measures are required to address the fact that in many countries, in some subjects, such as AI, male students far outnumber female students. Digital technologies such as virtual reality could also facilitate skills development, as is happening in industry.

Committing to Public Sector Research

Publicly financed basic research has often been critical to advances in digital technology. A recent levelling off – and in certain cases decline – in government support for research in some major economies is a concern. The complexity of some emerging digitally based technologies exceeds the research capacities of even the largest individual firms. This necessitates a spectrum of public-private research partnerships. Interdisciplinary research is also essential. Policies on hiring, promotion and tenure, and funding systems that privilege traditional disciplines, may impede interdisciplinary research. Scientists working at the interface between disciplines need to know that opportunities for tenure are not jeopardised by doing so.

Building Expertise in Government

Without governments fully understanding technologies and sectors, opportunities to benefit from digital technologies might be lost. Calls to regulate AI highlight the need for expertise in government, such that any regulation of this fast-evolving technology does better than harm. Technical expertise in government will also help to avoid unrealistic expectations about new technologies. As a wide array of critical systems become more complex, mediated and interlinked by code, governments also need improved understanding of complex systems. And as innovation agendas quickly evolve, governments also need to be flexible and alert to change. They must likewise ensure the availability of key infrastructures. For instance, broadband networks – especially fibre-optic connectivity – are essential to Industry 4.0. To use digital science and innovation policy (DSIP) systems to help formulate and deliver science and innovation policy, governments must: ensure the interoperability of the data sets involved; prevent misuses of DSIP systems in research assessments; and, manage the roles of non-government actors, particularly the private sector, in DSIP systems.

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Information Technology and Manufacturing:
A Preliminary Report on Research Needs

National Academies of Sciences
Washington D.C., United States

International economic competition has grown enormously in the last decade, and several U.S. industries are no longer the world leaders they once were. To regain or maintain vitality, U.S. manufacturers are increasingly using information technology — computers, communications, and complex systems that combine the two. Both the technology and the understanding of how best to use it have been advancing, changing the way that customers think and businesses operate. As a result, from conceptualization of a product through research, development, source selection, distribution, and marketing, manufacturing is becoming a set of information-gathering, analysis, decision-making, dissemination, and archiving activities, an outgrowth of which is the conversion of raw materials to finished products.

Information technology is making possible substantial changes in the organization and effectiveness of manufacturing activities. Equipment and stations within factories, entire manufacturing enterprises, and webs of suppliers, partners, and customers located throughout the world can be more effectively connected and integrated through the use of information technology. Information technology provides the tools to achieve goals that are widely regarded as critical to the future of manufacturing: rapid shifts in production from one product to another; faster implementation of new concepts in products and faster delivery of products to customers; more intimate interactions with customers, who more directly and completely specify what they need; fuller utilization of capital; and streamlining of operations to focus on what is essential to a business and to eliminate unnecessary activities. As this list suggests, technology is a critical enabler, but its development and implementation will be shaped by organizational, managerial, and human resources concerns. Because of these concerns, manufacturers have had difficulty getting the most out of the technology that exists today. Sensitivity to these concerns is essential to the successful development and implementation of the technologies associated with visions of manufacturing for the 21st century.

This preliminary report outlines needs for information technology research directly related to manufacturing, information technology research supportive of manufacturing, and action in areas that can be leveraged to enhance or complement the development of information technology for manufacturing (e.g., academic-industrial relations, education and training, and such social constraints as resistance to change). It does not address advances in physical processes except as they relate to computer-based controls, interfaces, and other aspects of their incorporation into manufacturing information systems, although the designers of such processes as well as research funding agencies need to keep at the forefront of their agendas the smooth integration of such processes with contemporary information systems. Federal attention to information technology research that can benefit manufacturers is especially timely, because slimmer profit margins are reducing corporate research and development budgets and the climate has become more favorable for corporations to assimilate useful new technology.

Three themes are evident in the technical recommendations developed by the committee: the advancement of knowledge required to achieve (1) better modeling and prototyping of products, processes, and factories; (2) better real-time control of processes and factories; and (3) better integration of enterprises (internally and with external suppliers or customers). Among the technical needs identified by the committee are the following:

Research is needed to develop methods to enable the realization of a "virtual factory" (i.e., a model that simulates factory operations). This area of inquiry includes extension of existing work on networking and infrastructure research, as well as development of the modeling and simulation capabilities needed for designing the virtual factory before it is built and as a basis for operating it after it is built.

Research is needed in manufacturing process representations in the broadest sense. Such research would support both manufacturing process modeling and the design of the products to be manufactured. The descriptions and models of manufacturing processes in their wide variety will be used to design and operate factories, as well as to experiment with and evaluate control and organizational changes before actual systems are installed. Process representations will also be used to enhance product design, so that by simulation and emulation the best process can be matched to the product design (and vice versa) for maximum economic advantage (or to satisfy whatever criteria such as quality or time to delivery are important for the particular case). This use of simulation and emulation is often termed "design for manufacturability," but the concept transcends that limiting title to encompass design for assembly, design for rapid testing and diagnosis, design for fast maintenance and

repair, and design for modeling more efficient factory processes and operations.

Research is needed in representation theory and methods for describing product components so that their descriptions can be manipulated in computer-aided design programs, analyzed, understood, and stored and retrieved at will. These descriptions must be robust, so that fast, efficient, easy-to-use methods of searching databases for these data can be developed. Better databases themselves are needed to store not only basic data but also, as a means of enhancing creativity, visual simulations and video clips of the parts and components in use in prior designs. Although better representations are needed in all fields, a particular need is evident in the representation of mechanical components and assemblies. Electronic design has, through considerable investment in the last 20 years, reached a pinnacle of capability: progress and investment have lagged in the mechanical domain. Increasingly, the hard issues, even in electronic systems, are mechanical in nature (e.g., packaging, assembly, thermal balance), requiring that progress be made in these areas.

Research is needed to increase understanding of the process of design itself and to enable the creation of better tools for the design of better products investment that will harness the broad spectrum of capability across the country. Domains worthy of special note are those of a cross-disciplinary nature: electrical and mechanical, electronic, and software, and all three combined.

Research is needed in modeling frameworks to link the wide variety of models representing segments of manufacturing activity. A wide range of models is needed to simulate realistically the complexity of even a modest factory. Work is needed not only on general modeling but also on fast methods of tailoring a specific model to the local conditions.

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Chapter 1

Technology and its Negative Impact on the Environment: From Ayi Kwei Armah to Today's Industry

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Abstract

This paper takes a critical look at the protection of the environment and the specific manner in which that activity is carried out by Ayi Kwei Armah and the research extends to the negative impact of industry and some of its products, on the environment. The paper delves into the "cri de coeur" that Armah expresses in The Healers, regarding the destruction of the environment and it also analyzes the difficulties that society faces when it comes to handling the disposal of many of the industrial products. Many people are privy to the fact that several of the products that find their way on refuse dumps and other places are not biodegradable; yet, tons and tons of such materials keep being thrown into our environment or neighborhood, and that tragedy is more pronounced in less developed continents like Africa. The largest part of the population has a vague idea on the danger that paint with led represents for human beings, especially children, and many other hazards that technology throws into our daily life. A case that has been documented is that of the American Natasha Franck, a CEO who, after learning that the fashion industry that uses textile, fibers, products for color is one of the biggest polluters after the oil industry decided to do something about that flail. The paper will therefore explore the recent and novel ways that are being adopted to nullify the pollution of the environment, especially the type of pollution caused by sources that the overage citizen is not aware of. The paper will start with Armah's view on the decimation of the environment in the novel under study and will then explore how the fashion industry and the telecommunication companies and their assets are a real threat to human existence. The theoretical framework of the study is Ecocriticism.

Keywords: *Environment, Modernization pollution, Technology, Textile.*

Introduction

Environmental pollution is one of the challenges that faces our world today. Many attempts made by stake holders seem unproductive, due to factors like modernization made possible by advancement in technology in the telecommunication industry and the fashion industry. Ayi Kwei Armah, one of Africa's prolific writers whose works convey great messages has shared his views on the corruption of the environment today through his books, especially *The Healers*. He is a Ghanaian and was born on 28th October, 1939. He is best known for works like *The Beautyful Ones Are Not Yet Born, Two Thousand Seasons* and *The Healers*. In most of his works he deals with issues regarding corruption among African Leaders, disillusionment and the filth caused to the environment by the activities of greedy individuals. At the beginning of The *Beautyful Ones Are Not Yet Born* for instance, we see a man, serving as the main protagonist in the story, cleaning his spittle by moving his trunk sideways a few times. This paints a mental picture of filth in the society.

Moreover, in *The Healers* as well we see the resultant effect of the bribe taken by the Asante Royal family to sabotage Asante Nkwanta's army. Basically, Armah's novels probe into the nature and causes of and possible way out to, the unending predicaments that confronts African societies in particular and the world at large. *The Healers* is going to be the focal point for discussion because it is the primary text for this write-up. And the area of interest is on how Ayi Kwei Armah presents the environment as well as man's relationship with the environment in the book. *The Healers* is considered because, it brings out the understanding that the presence of a foreigner or foreign objects in a particular place has the capacity of "robbing" the internal peace and stability of that place. Specifically, it can be said in *The Healers* that, before the arrival of Westerners in Africa or Ghana, there was internal peace and stability among the people, and harmony between the people and their environment. But after the arrival of the Westerners, everything began to take a different turn.

At the early chapters of the novel we see how green the environment was and how happy the people of Esuano used to be, as they lived in unity within themselves and the environment as well.

> Here the people of Esuano came at the end of every chosen year for
> the rituals of remembrance…A few remembered the old ceremonies
> as ritual in which all the people of Esuano had done things together
> (p.10 & p.13).

We further see Ayi Kwei Armah giving a vivid description of how beautiful even rivers used to be during those times.

> In all truth the bottom was beautiful. Large pebbles, rounded by
> water and sand and time, lay quiet on the floor, on sand so fine it was

almost silt, except that it had such a pleasant firmness underfoot. There were yellow pebbles black ones, white, purple, reddish, brown pebbles and pebbles streaked and whored with many converging colors all at once (p.31-32).

But towards the end of the novel, it can be seen that Western intrusion had an extremely bad impact on the environment. Apart from the fact that the internal stability that existed among the people was destructed, the environment was really massacred. The fauna and flora take a heavy toll. Many trees were cut down and the habitats of very important animals were lost.

Swamp of the Dead' (p.268) and another place where 'All along the road there was the stench of unburied corpses.' (p.338).

'The forest was cut down beside the road where only small villages had been, new towns sprang up…Bamboo stakes were cut and split… a huge space was cleared and beaten flat (p.311)'

'A royal eunuch had seen a porcupine, the Asante beast himself, slowly crossing the open space before the principal mausoleum. Scarcely had the porcupine reached the center of the open space when the beast that had put him to flight appeared crawling behind him-a great huge silver pythons…he swallowed him whole… (p. 280).

As aforementioned, these elements (the ceremonies, the serenity, the unity etc.) that contributed to the flourishing of the people of Esuano were all corrupted by foreigners and foreign objects. The same phenomenon continues, but interestingly in a different form. It is interesting to see how the destruction, pollution and corruption in the Armah's books are manifested differently in this postmodern society, still by human agents.

The next section of the paper focuses on the tragedy which is represented by the destruction of the environment in the hands of human beings. The domination or intrusion that Armah addresses is replaced by the intrusion of industrialists and multinationals in Africa. The Western intrusion factor still persists but presently in a different form. This time not as Westerners or any foreigners invading the land, but man's actions and activities, invading and polluting the environment. The paper stresses that strong analogy: the intrusion of foreigners causes physical and moral damage to the structures of society and also to the environment; the intrusion or presence or arrival of foreign physical materials provokes equally tremendous changes in the environment, a real calamity that decimates the environment and endangers human life, as the following part shows. It also takes a critical look at better ways of eradicating these predicaments by paying and pointing out special attention to the causes of this flail, and identifies the relevant new causes of the threat to the

environment and human existence: the fashion industry and the telecommunication companies and their assets.

Theoretical Framework
This paper is based on the theory of Ecocriticism which itself is defined in simple terms as how the environment is reflected in literary texts. It is a broad scope of interdisciplinary scholarship which marries knowledge from the Sciences with that of the Arts and Humanities.

The term Ecocriticism was coined in 1978 by William Rueckert in his work titled *"Literature and Ecology: An Experiment in Ecocriticism"*. Reddy (2015), in his work *The Ecocriticism: A New Perspective of Literary Study*, indicates that "in America, nature writing was first seen in the works of William Bertram's *Travel through the Carolinas, Georgia and Florida* (1791) and Walden (1854). Ecocriticism as a movement owes much to Rachel Carson's 1962 environmental exposé in her book titled 'Silent Spring'. Despite efforts made by individuals to represent the environment in literary texts, Ecocriticism was not recognized in publications until in the 1990's which is believed to be when scholars began publishing on it.

In William Howarth's *Some Principles of Ecocriticism*, it is stated that Ecocriticism has Greek bearing; *Eco* and *Critic*, derived from two Greek words, *Oikos* and *Kritis* which means house-judge, more like a person who takes a critical view on culture and the non-human nature of his surroundings; and judges the impact the former has on the latter. So, the *Oikos* according to him is nature and the *Kritis* is the one who celebrates the environment and speaks against the spoilers and the misdeeds done against the environment.

Also, according to Cheryll Glotfelty, the use of 'eco-' over 'enviro-' as in Ecocriticism gives the theory its significance; in the sense that, environment is more anthropocentric with other things in its surroundings that are not connected to it, but *eco* as in Ecocriticism is a stronger term. Ecocriticism as a theory has several other names used in referring to it. Dr. Vathana Fenn's paper on *Roots of Ecocriticism: An exploration of the History of Ecocriticism, A Literary Theory of the Post-modern World*, gives us few of these names as: Green cultural studies, ecopoetics, and environmental literary criticism. In that particular work, she asserts that Ecocriticism deals with harmony of humanity and the environment, as well as destruction caused to it by the changes which take place in the modern world. Cheryll Glotfelty defines Ecocriticism as a theory that negotiates between the human and non-human environment. According to Cheryll, 'It studies the relationship between literature and the physical environment. Just as feminist criticism examines language and literature from a gender-conscious perspective, and Marxist criticism brings an awareness of modes of

production and economic class to its reading of texts, Ecocriticism takes an earth-centered approach to literary studies. Despite the broad scope of inquiry and disparate levels of sophistication, all ecological criticisms share the fundamental premise that human culture is connected to the physical world, affecting it and affected by it, placing value on the interconnectedness of all things' (Glotfelty, 1994). That apart, Thomas K. Dean also defines Ecocriticism as the 'study of culture and cultural products (art, works, writings, scientific theories, etc.) that is in some way connected with the human relationship to the natural world. Ecocriticism is also a response to needs, problems or crises…' As indicated by the Norwegian philosopher, Arne Naess, human beings and human consciousness are thought to be grounded in intimate interdependence with the environment.

Reddy (2015), in his work *The Ecocriticism: A New Perspective of Literary Study*, explains that 'the theory of Ecocriticism is broad and can be applied to all sorts of nature writings in all ages. It is not a method of analysis or interpretation but a redefined area of research and rediscovery' (p. 39). Heise (2016), observes that Ecocriticism has carved a certain identity for itself that some critics prefer to call [it] environmental criticism. Transcending its origin, Ecocriticism has been developed to respond to present day crises and issues that carry environmental identity. And this breaks the theory into waves. The first-wave Ecocriticism began as nation focused before it actually spread to other areas of the world as a response of global environmental challenges the rest of the world faced. The second-wave Ecocriticism cuts across cultures and nations thus referred to as, trans- cultural or transnational. The second-wave Ecocriticism according to (Buell, Heise and Thornber, 2011) reject laying emphasis on cultural distinction but rather, shows greater interest in issues pertaining to metropolis and industrialization. Due to global environmental challenges, Ecocriticism had to quit being nation focused in order to respond to such issues as biodiversity loss, climatic changes among other environmental issues. That is why Buell et al stated that 'A different strategy for opening up the local to global was to re-conceptualize place as a node in global network by highlighting that there is no such thing as a local environmental problem'.

Ecocriticism has broadened its scope to the point that we can now speak of India, China, Japan, Asia among other areas of the world as having a form of nature-related studies that deal with their environmental issues. That being said, it will not be out of the place to have an African Ecocriticism. And this presents us with the clearest platform to advance our discussion using the theory of Ecocriticism as bedrock.

Unity and Inspiration as Armah's Tools for Environmental Protection
How Ayi Kwei Armah carries out environmental protection or conservation is one of a kind. While many people of different nations strive to use tangible and physical

methods in environmental protection, he would rather use seemingly insignificant methods, which are exposed *The Healers* as inspiration and unity. From Ayi Kwei Armah's perspective, the decadence seen in our environment today stems from the mental corruption of man and the loss of the bond of unity within our communities. In *the Healers*, Ayi Kwei Armah demonstrates that unity in a community is equivalent to a balance in the ecosphere that is, the global sum of all ecosystems. He also resorts to inspiration rather than manipulation as a measure of healing. The health of the environment depends on a strong ecosystem devoid of any interruptions. Despite these measures suggested by Armah, the environment still suffers violation, a form of intense and destructive corruption as a result of modernization made possible by technology. Most of the environmental problems today are caused by modernization and technology. It is interesting to point out that coincidentally, a close scrutiny of technology's effect on the environment shows that it displays or contains some of the notions that Armah identifies or handles in treatment of the destruction of the environment in his writings.

Technology can be defined as the modification and usage of knowledge of science to make tools, machines, techniques, crafts, systems and methods of organization; in order to solve a problem, improve a pre-existing solution to a problem, achieve a goal, handle an applied input/output relation or perform a specific function (Kwazo et al, 2014). Technology is regarded as the primary pillar of Fast Fashion as well as telecommunication. Technology is partly to be blamed for environmental and ethical fallouts of Fast Fashion consumption, there is now biotechnological interference with the environment, release of life-threatening textile manufacturing byproducts and waste clouding the ecology (Scaturro, 2008). That notwithstanding, from Ayi Kwei Armah's perspective, these issues facing the environment today are as a result of division and not technology as some may see it. Ayi Kwei Armah sees division as, when no one individual cares about the consequences his/her actions will have on the other. Therefore, greed and the selfish interest of certain developed nations can be equated to the division Armah castigates in *The Healers*. While division and lack of unity in the community is a threat to the environment in Armah's work, lack of respect and consideration for nature in developing nations bring about tragedy.

In *The Healers*, we are presented with a very serene environment during the times when The 'Ebibirman' was together. Water bodies were clean and crystal clear before division set in as seen in the following lines;

> In all truth the bottom was beautiful. Large pebbles, rounded by water and sand and time, lay quiet on the floor, on sand so fine it was almost silt, except that it had such a pleasant firmness underfoot. There were yellow pebbles black ones, white, purple, reddish, brown pebbles and pebbles streaked and whored with many converging

> colors all at once…Anan had his eyes closed. He looked asleep. The thought that he could be relaxed in such a strange environment, under water, made Densu feel inexpressibly close to him…(p.31-32)

Ayi Kwei Armah further describes the extent of filth and deterioration of the environment after the people were divided. In the novel, attitude instead of technology is responsible for waste in the environment.

> The truth was plain: among the wandering people some had chosen homes deeper in the heart of the land, and settled in the forests there. This was division. Some had pushed their way eastward till they came to great, fertile river and settled along its banks. This was division. Some after coming south had gone westward; there they had seen deep mysterious forest places answering their pinned need for withdrawal, and they had settled there. This was division. Some had moved south and south, till the sea told them they could move no farther, and they had settled there along the shore lands. This too was division. (pp.11-12)

From his writings, it is seen that if people have right attitudes towards their surroundings, there would not be a record of all the calamities facing the current generation. Therefore, in an effort to resolve these calamities, Ayi Kwei Armah resorts to Healing of the environment through unity and inspiration by Healers. Let us now ponder over some of the activities that are the results of postmodernism and affect the environment.

The Modern/Postmodern Forms of Issues Raised by Armah in His Writing
   A. Fast Fashion

The Fashion Industry has caused great harm to the environment as it shifted from sustainable Fashion to Fast Fashion (Chandra, 2017). Fast Fashion is borne out of many factors including the desire of the youth to look trendy and unique. Unlike past years where the fashion industry was more sustainable, today, fast fashion has taken over the pre-existing sustainability. One of the reasons is what has already been mentioned. Another reason can be attributed to the fact that, fashion runways and fashion shows which is the biggest inspiration for the fashion industry, were hitherto primarily restricted to designers, buyers and other fashion managers (Najmul et al, 2015). But these fashion shows became a public phenomenon from 1999 onwards, where photographs of the recent fashion shows could be seen in magazines and on the internet culminatingto demystification of the fashion process, hence, getting more people to be fashion driven (Sydney, 2008) cited in (Najmul et al, 2015).

Fast fashion is a term which describes the short period it takes for clothes to be

manufactured. 'It is a contemporary trend in global retailing that refers to the concept of shortening lead time (production, distribution, etc.) and offering new and low-cost products to the market as soon as possible' (Laura, 2016). Looking at the fashion industry today, clothes are produced as fast as within the space of two to five weeks and are cheaper than they used to be, making it possible for consumers to have more with little amount of money. What this means is that the level of disposability goes higher, increase in the emission of carbon dioxide into the atmosphere, pollution of water and aquatic life and many other dangers posed to the environment. (Zeynep, 2017). According to Prof. Dr. Viginija Daukantiené, 'fast fashion clothes are manufactured using synthetic fibres, which raise the problem of the use of oil to create polymers, e.g. acrylic, polymide and polyesters.' This spells a big problem for countries or places where there are no recycling centres for clothing and textiles because, finished products of such raw materials are of high complexity and very difficult if not impossible, to recycle. It becomes a nightmare for a country like Ghana that is already battling with so many issues of environmental pollution, from colonial era to date. One of the concerns of this paper is to point out the environmental implications of the fast-growing rate of the fashion industry and possible ways of dealing with them.

Negative Environmental Implications of Fast Fashion
Fast fashion has put money in the pockets and purses of many at the expense of the environment. The following highlights a number of environmental implications of Fast fashion.

I.   Increased Carbon Footprint
As cited in a 2018 article by Sana Akhtar, Bakhtawar Khalid, Mavara Mussawar, Sajid Rashid Ahmad, Shamaila Inayat and Sidra Asghar on *Tracking the Carbon Emissions from Polyester Fiber Processing Industrial Unit,* Carbon footprint refers to "the total set of greenhouse gas emissions caused directly or indirectly by an individual, organisation, event or product" (EAUC 2007). The use of Polyester in the fashion industry has gained foothold since Wallace Carothers (1896-1937) invention of Nylon. This is a plastic that can be modeled into fibres for making fabrics. Nylon is not a single substance actually, but a name given to a large family of polymides. At the discovery of the versatility of Carothers's invention of Nylon to be processed into synthetic fibres, a company like Daiichi Orimono, a Japanese company established in 1948, has built on its quality to make it look like natural fibres or cotton. This has caused most expensive fashion brands like Gucci, Louis Vuitton and Moncler to patronise synthetic fibres. By virtue of the high use of synthetic fibres like polyester, there is an increase in the carbon dioxide emission level in the environment. The carbon dioxide emission level of Polyester is up to three times more than fibres such as cotton. According to Prof. Dr. Virginija Daukantiené (2015), today, hardly will there be garments in stores that are made of

clothing material consisting of one fibre type. Fast Fashion clothes manufactured with synthetic fibres like polyester creates problem of carbon dioxide concentration in the atmosphere; because they are non-biodegradable.

ii.   Water Consumption and Water Pollution

Production of clothes not only increases carbon foot print because of oils used in creating polyester, it also puts a lot of pressure of water and water bodies at large. An example of water pollution mentioned by Armah is seen in the following lines:

> …At the words 'Accept, accept,' strong men cast him forcibly down and a sword slashed his throat. His blood poured out to redden the river… (p. 187)

It is recorded that it takes about 7,000 litres of water to produce a pair of jeans and 2,700 litres of water to make a single shirt. And it takes a lot of chemicals for these clothes to be produced, some of which are carcinogenic to both human and animal health.

Azo dyes for instance, one of the chemicals used in colouring clothes can be harmful if not used in moderation. Moreover, such pollution does not just end after clothes are stocked in stores. It still continues when the buyer washes it every time; the water used as well as the chemicals in the clothes are reintroduced into the environment. At the discovery of the poisonous content of Azo dyes, several countries have adopted environmental policies to restrict its use in clothing production. A typical example of such legislations is the Consumer Protection Act elaborated by the German government in 1994, prohibiting the use of Azo dyes, on the grounds that some Azo dyes are allergenic. In addition, water pollution is a key issue for clothing and textile sector. Recently, there has been an increase in the levels of surface water pollution. A typical pollution site is the Rana Plaza in Bangladesh, where clothing and textile companies occupying the building source from nearby water bodies. Recent analysis revealed that Bangladesh will have a water supply deficit during the dry season of up to 26% by 2030.

iii.   Waste/Landfill

The difficulty in ascertaining the content of a particular clothing material makes it difficult for recycling and managing the waste produced afterwards. As indicated by Daukantiené (2015), the increasing use of waterproof polymeric coatings, zippers, trimmings, buttons, etc. made from plastics, bones or metals make the finished product of high complexity and very difficult if not impossible, to recycle. And when unused clothes are disposed of anyhow, without proper recycling, it increases landfills and put lives (humans, animals and trees) at risk.

A similar instance occurs in *The Healers* where dead bodies are left unburied, and made

Densu to retch.

> Swamp of the Dead' (p.268) and another place where 'All along the
> road there was the stench of unburied corpses. (p.338).

This indicates the negative health implications that societies which have not mastered the art of proper waste disposal are likely to face. And from the statement made by Natasha Franck, co-founder of Fashion Technology, it is clear that, 'in fashion 90% of the 150 billion articles of clothing made every year, end up in landfills'. That alone is a great threat to environmental sanity. According to her, it becomes more difficult to deal with the trash or even to recycle since there is no transparency regarding the total content of the clothing material. "Lack of transparency is one of the biggest barriers to fashion industry. We can't recycle if we don't know what's in it," Natasha indicates.

From oil spillage in water bodies, dumping refuse in water ways, to indiscriminate felling of trees as seen the following lines:

> The forest was cut down beside the road where only small villages
> had been, new towns sprang up…Bamboo stakes were cut and
> split… a huge space was cleared and beaten flat. (p.311)

Coupled with illegal mining activities to date, I believe beyond doubt that the environment is sick and needs to be taken to Intensive Care Unit. Else the fear of the worst, highlighted by Ayi Kwei Armah in his works lies in wait at our doorsteps. The whispers of the doom trumpet are already being heard.

B. Telecommunication Industry and Assets

Having mentioned the fashion industry, another environmental polluter identified is the telecommunication industry and its assets. From Alexander Bell (1847-1922), inventor of the first practical telephone to today's social media platforms (WhatsApp, Facebook, Instagram, Snap Chat, WeChat, Twitter etc.), there is evidence of increased use of these telecommunication assets. These technologies, borne out of modernization which gained momentum during the days of industrial revolution have altogether made life simple and easier. But while celebrating the goodness of these telecommunication platforms and assets, it is expedient to reason out their impacts on the environment. Questions like: Are these inventions ecofriendly? To what extent have these assets contributed to environmental health? Will the world we see today be the same or better in about five decades to come, having to co-habit with these telecommunication assets, etc. need to be asked; and if the answer to any of these questions is positive, then we can purge ourselves of any unnecessary fear. If not, then this is a call on all and sundry to awake from sleep.

Cell phones and masts have been identified as great threats to the environment as well

as human health due to the following reasons:

i. **High Carbon Dioxide Emission**

Just as the fashion industry, the telecommunication industry produces a lot of carbon dioxide into the environment. Carbon dioxide is denser than normal air. The more it is released the hotter atmospheric air becomes. As atmospheric temperature increases, there is the risk of drastic climatic changes. Also, when carbon dioxide mixes with water, it produces carbonic acid. That is, if carbon dioxide meets with the seas, rivers, and other water bodies, there is the risk of water pollution. Meaning aquatic life will be lost because they will not be able to withstand the toxicity of the water. The United Nations Environment Programme estimates that the manufacture of a mobile phone produces about 60kg of carbon dioxide and that using a phone for a year emits up to122kg of carbon dioxide.

According to Baumann, (2011) -cited in Painting, (2011) - series of experiments where carbon dioxide was bubbled into seawater containing the newly-fertilized eggs of the inland silverside; and Larvae were exposed to levels of acidification representative of modern-day (390-400ppm) right up to projected late 21st century (900-1100ppm) atmospheric CO2 levels, it was revealed after a week that, the higher the atmospheric carbon dioxide, the deadlier it is for aquatic life.

ii. **Toxicity**

Catalina Logan's work on *Effects of Cell Phones as an Environmental Hazard* indicates that, World watch Institute claim that users discard cell phones after an average of 18months in the United States of America. From this rapid turnover it means there is danger of toxic leaching into the environment as cell phones pile up without proper recycling and reusing processes. The Natural Resources Defense Council affirm that lead, mercury and cadmium found in mobile phones can release dangerous toxins into the air and water G.P. Thomas 2012, also indicates that mobile phones that are simply thrown into landfills are hazardous to the environment because they contain chemicals which can leach into the ground water systems and affect local ecosystems and potentially drinking water.

iii. **Biological Effects**

Moreover, despite the many inconsistent reports from WHO stating that there is no one to one relation between masts radiation and wireless networks, and biological effects, people have reported to have experienced headaches, dizziness, tingling sensation in the skin of the head and many other symptoms after using a mobile phone. A friend, told me that he experiences severe headache anytime he speaks on the phone for long. He later discovered it was as a result of radiation from the phone when he started using anti-radiation for his phone. According to a portion of EMF

Scientific Appeal, highlighted on Environmental Health Trust Webpage in 2018,'cumulative daily radiation exposure is associated with serious health effects including; cancer risk, cellular stress, increase in harmful free radicals, genetic damages, structural and functional changes of the reproductive system, learning and memory deficits, neural disorders and negative impacts on general well-being'. Also, Anthony B. Miller, Lloyd Morgan, Iris Udasin and Devra Lee Davis's review paper on *Cancer epidemiology update, following the 2011 IARC evaluation of radio frequency electromagnetic fields*, concludes that 'the current specific evidence supports the conclusion that mobile phone and wireless radiofrequency radiation (RFR)is cancer causing'. 'Dr Vini Khurana Australian neurosurgeon of Indian origin says, Cell phones are today, what tobacco and asbestos companies were 40 years ago. Cell phones cause more cancer than smoking & asbestos' (Nath, 2018).

iv. **Biodiversity Loss**

In addition, the mounting of telecommunication masts poses great threat to the ecology. Before mounting these masts, a land space is cleared to make room for the mast to be built. By so doing, the habitats of some animals are lost. Also, when the land is cleared it is exposed to erosion and loss of important soil nutrients that work together for an effective ecosystem.

Ways to Remedy the Environment of Pollution Caused by the Telecommunication and Fashion Industries

Research has proved that one of the best ways of dealing with environmental pollution is recycling. In an era where some nations of the African continent experience high levels of pollution, it has become necessary to think of recycling as a tool in ensuring environmental health sustenance. I believe it would not be out of place to even look at waste as the new resource. If we see it from that perspective it would not be like a situation where we would only want to do away with waste, but we may want to do something with it, just as South-Africa, India, China, Sweden and other nations of the world have done. Such great steps taken have helped to ease the pressure on natural resource extraction. Recycling saves energy, reduces raw material extraction and combats climate change (Friends of the earth, 2008). Electronic waste may contain materials such as ferrous metals and aluminum, copper and other different plastic materials (Tanskanen, 2012). Mobile phones for instance, contain a number of precious metals as well as harmful materials which can leach into the soil and cause a lot of harm, some are even carcinogenic (Yu et al,2010, cited in Tojo and Manomaivibol, 2011). In the light of this, to deal with e-waste produced by telecommunication industry and its assets, it would be best to recycle. That apart, the high levels of pollution caused by these industries have necessitated the fact that fashion designers must have a rethink of their actions. Some fashion brands have started advocating for sustainable fashion, where the industry will not produce

homogenous goods for its passive customers in large quantities as fast fashion does, but according to customer's need, using eco-friendly materials and production processes (April, 2012). This will help create a longer life span for clothes and reduce the rate of disposability.

As far as Fast Fashion is concerned, recycling, one notable way of dealing with environmental pollution, does not promise a lasting solution to the problems of Fast Fashion. Recycling unused clothes would still mean that mass production of clothes would remain unchanged, which does not foster fashion sustainability. In a bid to save the environment, the best method to adopt is to reduce the mass production of clothes and produce to meet consumer needs. Moreover, to reduce carbon emission into the atmosphere, people should endeavor to find other uses for their old clothes. They can redesign clothes to fit other uses. Clothes should reach landfills only when they have exhausted other waste management methods; reducing, reusing, recycling and recovering. Another way is to ensure proper remuneration of workers in the fashion industry. If there are practical policies and bye-laws that ensure the welfare of workers in the fashion industry, managers and CEO's will be forced to think carefully about the market value of their products. In the sense that, the higher the production cost, the higher the market value and as the prices of clothes increase, customers will limit the number of clothes they buy, in order not to spend a fortune on fashion. This will help reduce disposability rate. Moreover, if 66% of consumers are willing to pay more for environmentally and socially friendly products and services, per the Nielsen Global Survey of Corporate Social Responsibility and Sustainability in 2015, then it means the environment can be saved from 34% of trash.

Conclusion and Recommendations
This paper attempted to demonstrate how environment-conscious the writings of Ayi Kwei Armah are, especially the *Healers*. One other key point that the paper tried to make is to reveal the timeless nature of Armah's writing, in the sense that the corruption in the Ghanaian society which is metaphorically and skillfully captured in *The Beautyful Ones Are Not Yet Born* and the social and ecological changes that are the aftermath of the arrival of the invaders and colonizers in *The Healers* are replicated in another form, by today's industry; and its effect on the environment and human life. In Armah's work, the arrival of Westerners and others disrupt the harmonious functioning of society. In a striking manner, contemporary clothing, telephonic and many other industrial activities clearly show that arrival of multinationals in developing nations and the distant activities of such companies come with the insertion of materials and other items or substances which disrupt the normal functioning of society; because, they threaten human life in an open manner. What has been initiated in the works of Ayi Kwei Armah keeps gaining a wider dimension; the Ghanaian author therefore wrote with a profound and explicit prophetic touch.

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Chapter 2

Effects of Field Trip Method in Teaching Environmental Hazards in Basic Science and Technology and Student's Academic Achievement in JSS in Yala L.G.A.

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Abstract

The study investigated the effects of field trip method of teaching environmental hazards on the achievement and retention of Basic Science and Technology Students. It also considered gender and the cognitive ability levels of students as moderators. To achieve the objectives of the study, four research questions and four hypotheses were formulated to guide the study. Relevant learning theories such as theories of constructivism and cognitive development were reviewed. Major concepts in this study like field trip, environmental hazards, basic science and Technology were also reviewed. Available and accessible empirical studies related to the present study were also reviewed and discussed in details. The design of the study was quasi-experimental research with non-randomized pre-test, post-test control group design. The population of the study consisted of all Junior Secondary School Two (JSS2) students in the 21 co-educational public secondary schools in Yala Local government Area of Cross River State. The population size was 3,546 and the sample size was 100 drawn from two intact classes. A researcher-made instrument tagged: Basic Science and Technology Achievement Test (BSTAT) on environmental hazards components was used for data collection. The BSTAT was subjected to test-retest reliability method and it gives r=0.78. The data obtained were analyzed using descriptive statistics and Analysis of Covariance (ANCOVA). The results are as follows: The field trip method used had significant effects on students' academic achievement and retention in concept of environmental hazards. There was a significant effects of field trip on students' cognitive ability level of high, average and low. The field trip method helped teachers to bridge the initial cognitive gaps between high, average and low-level students. It was recommended that teachers of Basic Science and Technology should use field trip method to teach environmental hazards component of the subject

curriculum as this will to science and technology development in Nigeria and Africa in general.

Keywords: Science, Technology, Field trip, Achievement, Retention, Basic science.

Introduction

Science encompasses the systematic study of the structure and behavior of the physical and natural world through observation and experimentation. Technology is the application of scientific knowledge for practical purposes (Oxfordreference.com). Scientific knowledge allows us to make new observations about the world, build more Scientific and technical knowledge, and build new technologies. Science and technology make us think differently, feel differently, and even dream differently. It is therefore clear that Science and technology feed each other as everything we see around us is the gift of science and technology. The knowledge of science teaches us to express our civic aspirations by connecting with others and contributing to the world around us. The world today cannot do without science and technology as their role is indispensable. While philosophical thoughts pertaining to science dates back at least to the time of Aristotle, general philosophy of science emerged as a distinct discipline only in the 20th century in the wake of the logical positivist movement aimed at formulating the criteria for ensuring all meaningful philosophical statements as well as objectively assessing them. This is what made Karl Popper and Charles Sanders Peirce to move from positivism to establishing a modern set of standards for scientific methodology. It is also imperative to note that the structure of scientific revolutions was formative challenging the view of scientific progress as the steady cumulative acquisition of knowledge based on a fixed method of systematic experimentation rather than arguing that any progress is relative to set of questions, concepts and practices that define a scientific discipline in a particular historical period (en.m.wikipedia.com).

The Basic Science and Technology Curriculum has environmental hazards as one of its themes titled "you and environment". An Environment naturally comprises of water, air, land and atmosphere. Environmental hazards refer to a term used for any situation or state of events which poses a threat to the surrounding environment and which adversely affect plants and animals. The contents of environmental hazards in Basic Science and Technology in Junior Secondary Schools include: flooding, deforestation, soil erosion, bush burning, pollution, desertification and ozone layer depletion. Research has indicated that the academic achievement of students in Basic Science and Technology across Yala Local government of Cross River State is on the average (Cross River State Ministry of Education (CRSME), 2015). This is traceable to

poor instructional methods employed by teachers despite the efforts of government to provide the needed teaching facilities and motivation of science teachers in the state, to make lessons student-centered and practical based. It further posits that students are not achieving up to expectation in Basic Science and Technology in external examinations as a result of poor teaching, which in turn results in lack of understanding of concepts among students (CRSME, 2015).

One of the methods often adopted for teaching the topic by teachers of basic science and technology is expository method. It is a method of teaching in the confines of the classroom using still pictures. Research has shown that students' retention in an expository-based science classroom could be weak. According to Aina and Keith (2015), an average student only retains what is learnt and forgets after a short while if he was not taken out to make observations for himself. Miles (2015) stressed that in expository method, teachers tell the students what to do instead of facilitating them to discover for themselves. This has contributed to poor achievement and retention in Basic Science and Technology as it does not arouse interest for the subject. It also creates difficulty for students understanding of concepts at the senior secondary level as a result of inadequate background at the JSS. In another investigation of student in Basic science and Technology, Ekon *et al*. (2014) stated that students are not achieving up to expectation in Basic Science and Technology because of the use of inappropriate teaching method. Ezeano (2012) had reported that the poor achievement of students in Basic Science and Technology in external examination is caused by inappropriate teaching method. Furthermore, Oni (2014) stated that, students' poor achievement at the secondary school sciences (Biology, Chemistry and Physics) is as a result of improper grooming for SSS Science at the upper basic level of education. Ekong (2019) noted that most teachers tend to prefer the expository method of teaching because it is time saving, inexpensive and a lot of materials can be covered within a short period of time. The disadvantage of this method according to the scholars is that it leads to rote memorization and regurgitation of facts without much understanding of the concepts involved. The expository method uses mainly still pictures.

Still pictures are photographic representations of people, places and things. The still pictures commonly used in instruction are photographs, illustrations from textbooks, periodicals, catalogs and study prints. The category of still pictures encompasses a great variety of non-projected visual materials such as flat pictures, charts, drawings, maps, sketches and graphs. Still pictures could show realities in the classroom. Still pictures can also be used to clarify ideas, correct wrong impressions, provoke discussions and raise questions. In preparing to use pictures in the teaching learning processes, the teacher should pay attention to several considerations, such as clarity, interesting and big enough to show details. Still pictures have advantages such as: translating abstract ideas into a more realistic format. They allow instruction to move

from the level of verbal symbols to more concrete level. They are readily available in books (textbooks), magazines, newspapers, catalogs and calendars. Moreso, still pictures are easy to use since they do not require any equipment. Unfortunately, still pictures have limitations. As a medium of teaching in the learning process, still pictures have some disadvantages. These include: Emphasis on only eye perception, Size: some photographs are simply too small for use before a group or class, The two-dimensional nature and Inability to show motion.

Field trip method of teaching refers to a study trip taken outside the classroom to obtain direct experience of a natural environment. The trips are taken to areas that are unique and cannot be duplicated in the classrooms. Field trip offers opportunity for students to get firsthand information (Instructional strategies online, 2013). Field trip is planned for learners to experience theory in practice. Using field trip method of teaching enhances teacher-student interaction outside the classroom. These interactions take place in new learning environment and result in a meaningful teaching and learning process. This method of teaching brings about an effective learning of concepts such as environmental hazards components in the Basic science and Technology curriculum. Although, the disadvantages of this method such as being cost effective, time effective and exposing students to hazards cannot be ruled out. Although field trip is a viable method of teaching but, unfortunately teachers hardly apply it.

Basic Science and Technology is the bedrock on which the core science subjects such as physics, chemistry and biology at the senior secondary schools are laid. The curriculum was revised in 2012 as a result of the restructuring and integration of four primary and junior secondary science curricular in order to reduce the number of subjects offered in primary and secondary schools. The integration to prevents repetition and duplication of concepts that resulted in curriculum overload. In addition, to promoting the holistic view of science at this upper basic level for better understanding of a contemporary and changing world. Moreso, to infuse emergent issues that are of national and global concern. The curriculum places emphasis on guided inquiry, activity-based teaching and learning using locally – sourced materials. Other factors that can affect academic achievement and retention of students in Basic science and Technology as highlighted by Bosede (2011) in Ekong (2019) include cognitive ability level and gender. Cognitive ability according to Udo (2017) is a student's intelligent quotient (IQ) or level of assimilation of information. It is the capacity of students to engage themselves meaningfully in any task. Ekong (2019) stated that educational task requires higher cognitive functioning and this depends on certain factors which include reasoning ability. Adeyemo (2010) stressed that high ability learners are more intelligent than the average and low learners in solving tasks in science courses. Achor and Ejeh (2019) examined the effect of Cognitive

Acceleration Training Programme on cognitive ability and achievement of upper Basic II Home Economic students and maintained that there was a significant difference in the mean gains in cognitive and achievement scores among high, average and low cognitive ability students.

In the present study cognitive ability of students in basic science and technology is defined by the cumulative continuous assessment scores of the students involved in the study from their first term CA scores in Basic Science to the test/CA scores they achieved prior to this study. The process of putting students into high, average and low ability level could be done through the mean and standard deviation of all students in the study. Then high ability level would imply x + SD; Average Ability level would will imply – SD.

Gender refers to social and cultural construction and representative of being 'male' and 'female'. Okeke (2018) refers to gender as the social or cultural construct characteristics behaviors and roles which society ascribe to males and females. Educationist, psychologists and employers of labour have consistently advocated the need for gender of students to the complex problems gender pose in career aspirations and the provisions of appropriately qualified manpower.

Eze and Asogwa (2016) noted that there is no significant difference between the mean achievement scores of male and female students in Agricultural Science. This is in agreement with the findings of Dania (2014), Adigun *et al*. (2015) and Attah and Ita (2017) on effects of gender on students' academic achievement. In addition, Filgonali and Sababa (2017), noted that male and female students should be treated equally during teaching and learning and all students should be provided with equal opportunities and encouragement level and engagement irrespective of gender for better academic achievement. Based on the foregoing, this study therefore, seeks to determine influence of gender on mean achievement and retention scores of students taught environmental hazards using field trip method.

Statement of the Problem
Many teachers in the Junior Secondary Schools are not paying adequate attention to the teaching of the "environmental hazards" component of the Basic Science and Technology curriculum. The effect of this omission on students' achievement is that they (students) graduate from school without adequate knowledge of deforestation, soil erosion, flooding, ozone layer depletion, high farm yields among others. This students' inability to learn environmental hazards from school is further compounded with the fact that there is dearth of specialist teachers for Basic Science and Technology in schools, resulting in the deployment of teachers of physics, chemistry, biology, geography etc. to teach Basic Science and Technology. The method of teaching used by

the teacher is often not adequate. Most of the time the teachers lacked appropriate method of teaching environmental hazards such as field trip. The teachers mostly teach environmental hazards within the four corners of a classroom, the resultant effect of which is poor achievement in this aspect of the curriculum.

Objective of the Study
The main objective of this study is to investigate the effects of teaching environmental hazards components of Basic science and Technology using field trip method on students' achievement and retention in schools in the area of study.

Specifically, the study
1. Compared the academic achievement of high, average and low ability level students taught environmental hazards using field trip method;
2. Investigated students' retention when taught environmental hazards using field trip and
3. Compared the retention of high, average and low ability students when taught environmental hazards using field trips.

Research Questions
This study was guided by the following research questions.
1. What is the achievement mean scores of high, average and low ability level students taught environmental hazards using field trip method?
2. What is the mean retention mean scores of students taught environmental hazards using field trip and expository methods?
3. What is the mean retention scores of male and female students taught components of environmental hazards using field trip method?
4. What is the mean retention scores of high, average and low ability level students taught components of environmental hazards using field trip method?

Research Hypotheses
The following hypotheses were formulated to guide the study.
1. There is no significant difference ($p < .05$) between the mean retention scores of male and female students taught components of environmental hazards using field trip method
2. There is no significant difference ($p \leq .05$) between the mean retention scores of students taught environmental hazards using field trip and expository methods.
3. There is no significant difference ($p \leq .05$) between the mean retention scores of male and female students taught environmental hazards using field trip.
4. There is no significant difference ($p \leq .05$) among the mean retention scores of

high, average and low ability level students' taught environmental hazards using field trip method.

Scope of the Study
There are four themes in the curriculum. You and your environment are one of the themes. The other themes too contain several topics. However, the present study is delimited to environmental hazards. The reason is that it spells out aspects of danger to life in human environment which unfortunately teachers do not teach well. Moreover, the study is delimited to Junior Secondary School Two (JSS2) students in 21 co-educational secondary schools in Yala Local Government Area of Cross River State.

Literature Review and Theoretical Discourse
The literature is reviewed as follows:

Concept of Basic Science and Technology
Basic Science and Technology is the bedrock on which the core science subjects such as Biology, Physics and chemistry at the senior secondary schools are laid. Basic science and technology as a subject come into existence as a result of curriculum reform movement in Nigeria to make science education more functional for sustainable national development. The Curriculum of Basic Science and technology is a product of the restructuring and integration of four primary and junior secondary school science curricula namely: Basic Science, Basic Technology, Physical and Health Education and Computer Studies Communication Technology (FRN, 2012). Nigerian Education Research and Development Council (NERDC) (2012) posit that the need for integration of these science curricula became necessary for the following reasons: the recommendation of the presidential summit on education (2010) to reduce the number of subjects offered in primary and junior secondary schools; feedback from the implementation of the curricula in schools that identified repetition and duplication of concepts as the major cause of curriculum loaded; need to encourage innovative teaching and learning approaches and techniques that promotes creativity and critical thinking in science at the Basic Education level for better understanding of contemporary and changing world and need to fuse emergent issues that are of national and global concern such as gender sensitivity, globalization and entrepreneurship.

Emphasis is therefore placed on it to give the students the right foundation for higher endeavour in science and technology. Nations that are considered to be developed and civilized have achieved that through purposeful scientific education of her citizens (Ajayi and Ogbeda, 2017). In line with the importance of science and technology, Basic Science and Technology are taught in upper Basic Schools in Nigeria to prepare a base for any science and technological development. To achieve this

advancement, it is important to start planning or a firm basic scientific education foundation for the citizens from childhood. This is because children begin career exploration at a very young age. To move with this pace, Basic Science is taught at the primary level so as to catch the pupil's heart young. As a follow up, Basic Science is taught at the upper basic level to enable students to build and concretize the knowledge of science they had from primary school and lay foundation for the core science subjects at the senior secondary level of education. Basic science and technology expresses the fundamental unity of scientific thought (Maduabum, 2011). The objectives of Basic Science and Technology as stated by Nigerian Education Research and Development Council NERDC (2012) are to enable learners to develop interest in science and technology; acquire basic skills in science and technology; apply scientific and technological skills to meet contemporary societal needs, take advantage of the numerous career opportunities provided by science and technology, become prepared for further studies in science and technology; avoid drug abuse and related vices.

Basic science and technology curriculum is arranged in four themes namely: you and environment; living and non-living things, science and development and you and energy. The topics are arranged in theme and are spirally arranged from simple to complex across the nine (9) year of schooling in order to sustain the interest of the learners and promote meaningful learning and skill development. The curriculum promotes guided inquiry and activity-based teaching and learning using locally sourced materials (FME, 2012). Udo (2017) stated that Basic Science and Technology as an activity-based subject is the best avenue through which students can acquire the four pillars of learning which are: "learning to know", "learning to think critically", "learning to do and learning to live together in a group". These four pillars empower students with opportunities to develop imagination and creativity as they become active learners.

The Concept of Field Trip
Field trip is a visit to an outside area of the normal classroom made by a teacher and students for the purpose of firsthand observation. It is embarked on to places such as a museum, factory, geographical area of environment of certain plants and animals. Field trips may be planned for the following purposes; to provide first-hand experience, stimulate interest and motivation in science, add relevance to learning and interrelationship, strengthen observation and perception skills and promote personal (social) development (Michie, 1998 in Behrendt and Franklin, 2014). Field trips take students to location that are unique and cannot be duplicated in the classroom. Each student observes natural settings and creates personally relevant meaning to the experience. Interactive exhibits help students play with concepts, activities often not possible in the classroom. Earlier course content suddenly becomes relevant as

students assimilate and accommodate new understanding and cognition (Lei, 2010a). Although field trips have clear and proven benefits, there are several concerns that can compromise its effectiveness as an instructional medium. These include: large expenses, distractions, delays in academic, provide undue stress to teachers and can pose risks to students (Berer, 2016; Behrendt and Franklin, 2014).

Components of Environmental Hazards in Basic Science and Technology Curriculum for Junior Secondary School
Environmental hazard is a term used for any situation or state of event which possess a threat to the surrounding environment and adversely affect plants and animals. Components of environmental hazards in Basic Science and Technology curriculum for junior secondary school includes flooding, soil erosion, bush burning, deforestation and ozone layer depletion. The environmental hazards component is found in theme 1 (you and environment) of Basic science curriculum.

Methods of Teaching Basic Science and Technology in Schools
Some innovative teaching methods are used to enhance students' academic performance and retention of Basic Science and Technology includes. Hands on learning, role play project method, ICT enable learning, Reward discovery method, science Quiz and discussion Method.   The above stated teaching methods are student centered and enhance active participation of students to bring about better academic achievement. Literature has now indicated that field trip method of learning be used though may not be mentioned in the curriculum. A field trip involves an excursion taken outside the classroom for the purpose of making observations and also for obtaining some specific information. It includes visits to various existing places which can provide or enrich learning examples as eroded site, flooded areas and deforested forest. They are meant to broaden students' general knowledge. Students are supposed to observe the application of certain scientific concepts learnt in class or examine some process or special material in its natural environment. Such observations provide primary experience tov the leaner and this is very crucial in science teaching. During this process of primary experience, the leaner is kept observing, collecting, classifying, studying relationships and manipulating objects. This leads the acquisition of science process skills and also the scientific method of inquiry which form the basis for science teaching.

This teaching method is preferred by the researcher to teach environmental hazards due to the following reasons:
  a. They allow students to have real-world experience. This experience clearly illustrates and enhance information taught by the curriculum. Field trips also allow the students to learn new learning environment (outside the classroom).

b. Education trips promote team work among the students and foster teacher student relationship as they interact during the trips.

Instructional Material for Teaching Basic Science Technology in Schools
Instructional materials, also known as teaching/learning materials are any collection of materials including animate and inanimate objects and human and non-human resources that a teacher may use in teaching and learning situations to instructional materials are categories into:

i. Audio-visual aids: these are educational materials directed at both the sense of hearing and the sense of sight examples multimedia kits, film recordings, television, computers, VCD player and LCD projector.
ii. Visual aids: are those instructional devices which are used in the classroom to encourage learning and make it easier and motivating they are materials like charts, real objects, photographs, models and motion pictures.
iii. Print: these are material that are read. Examples textbooks, pamphlets, handouts study guides and manuals.
iv. Audio aids: are educational materials directed at the sense of hearing (Webster dictionary). Examples include radios, tape recorder, and audio cassette' players. Instructional materials or educational resources help to improve student cognitive abilities and skills, to enhance student's assimilation of information and stimulate and motivate students to learn Effiong and Igiri (2015).

Basic Science and Technology teaching and learning cannot be well accomplished without the use of instructional materials. Advancement in technology have brought instructional materials especially the projected and electronic materials to the forefront as the most radical tools of globalization and social development which have affected the classroom teaching learning situation positively. Therefore, the use of audiovisual materials such as multimedia kits, film recordings, LCD projector internet facilities are highly recommended in the teaching of basic science and technology in schools. The use of digital learning materials be used to help student learn at their pace and develop their own learning style. Examples of this digital learning material includes live videos, recorded lectures, PDFs and info graphic. In addition to the above, the use of real-life objects should be encouraged where students embark on field trips to obtain first-hand information should be accepted as this enhances learning and achievement in learners.

Empirical Studies
Several studies have been conducted on field trips-method as a way of enhancing student's achievement and retention in learning. They include: Zumyil (2019); Suwopoleme, Sababa and Filgona (2016); Eze and Asogwa (2016); Aromosele and

Ehokholuenetala (2016); Ukor and Abdulbajar (2019); Taneo (2017); Ezechi (2018); Ogbuluijah (2014); Omeodu and Abara (2018) and Amosa, Ogunlade and Atobatele (2015).

Field Trips Method and Student Academic Achievement
Zumyil (2019) investigated the effect of computer simulation and field trip methods on students' achievement and interest in ecology in Plateau Central Education Zone. The study was guided by six research questions while six hypotheses were formulated and tested at 0.05 level of significance. The study adopted the quasi-experimental design specifically the pre-test, post-test non-equivalent control group. The population of the study consisted of all the 5,207 SS I students in all the public schools in the study area. The sample consisted of 106 respondents selected through simple random sampling, stratified and purposive sampling techniques. The sample was assigned to two experimental groups and one control group. The data were collected using researcher-made Ecological Achievement Test (EAT) and an adopted Ecological Interest Inventory (EII). The research questions were answered using Mean and Standard Deviation while Analysis of Covariance (ANCOVA) was used to test the hypotheses. The result of the study indicated that the use of computer simulation and field trip methods enhanced students' achievement and interest in Ecology.

Suwopoleme *et al*. (2016) researched the effect of field trip method on senior secondary school students' academic achievement in Geography in Numan Educational Zone, Adamawa State, Nigeria. Two research questions and hypotheses were formulated and tested in the study. The study adopted the quasi-experimental research design. A sample of 138 senior secondary two (SS2) students from two public schools in Numan Education Zone was used for the study for an experimental and control group. The instrument for data collection was Geography Achievement Test (GAT) which consisted 36 items divided into two sections. The data collected was analyzed and the findings revealed that, students taught using field trip method achievement more significantly than those taught using conventional method. Eze and Asogwa (2016) carried out a research on the effects of actual field trip for environmental influence and video instruction methods on the undergraduate students' achievement and interest in crop production techniques. The design of the study was a quasi-pretest and posttest experimental research design. The population of the study was 145 undergraduate students on the Faculty of Agriculture, University of Nsukka. Three research questions and three null hypotheses tested at 0.05 probability level guided the research. The instrument used for data collection were Pretest and Posttest Achievement Scores Test (PPAST). Data analysis was done using means, standard deviation and co-variance (ANCOVA). The result indicated that students taught with field trip had slightly lower score in the achievement test than those taught with video instruction.

Aromosele and Ekholuenetala (2016) examined the effects of field-based experiences on students' understanding of ecological concepts and biology achievement in Faculty of Education, University of Benin, Edo State. The study employed the quasi-experimental (pre-test and post-test) and control group design. The intact classes were assigned to experimental and control groups respectively. Data was collected and analyzed using mean, standard deviation and ANCOVA. The results indicated that the achievement of students taught using field trip-base method was higher than those taught using the traditional method.

Ukor and Abdulbajar (2019) investigated the effects of field trip instructional strategy on students' interest and achievement in ecological concepts in University of Dustinma, Katsina State, Nigeria. The study adopted a pre-test, post-test quasi experimental design. Three research questions and four hypotheses guided the study. Two intact classes were used for experimental and control groups. The sample was 82 students. The experimental group was exposed to field trip while control group was exposed to expository method. Biology Interest Scale (BIS) and Ecology Achievement Test (EAT) were used to collect data. Mean, standard deviation and MANCOVA were used to analyze data. The result revealed that field trip method is more effective in enhancing student's interest and achievement in ecological concepts.

Field Trip Method and Student Academic Retention
Taneo (2017) carried out research to analyze the effect of field trip learning method toward the conceptual understanding of local History in improving the students'' learning and retention. Quasi experimental design was adopted. The population was all the students of History Education students in Faculty of Teacher Training and Educational science at Musa Cendana University, Kupang, Indonesia with the sample of 38 students of the fifth semester. Purposive-sampling technique was used. The result shows that there are effects of the implementation of field trip learning method towards the conceptual understanding to improve the student's learning outcome of local history. Ezechi (2018) carried out research on the influence of field trip in teaching and learning of Biology in Enugu East LGA of Enugu State, Nigeria. Three research questions and research hypotheses guided the study. Survey design was used for the study. The sample size was 100 senior secondary school two (SS2) students. A fifteen (15) item questionnaire was used for data collection. The instrument was validated by three experts. The reliability coefficient of 0.79 was obtained for the instrument using Cronbach Alpha. The findings revealed that field trip is an effective approach of teaching Biology since it helps students acquire useful knowledge while having fun and relaxation at the same time.

Ogbuluija (2014) investigated the effects of students' Agricultural field trips on their performances in Agricultural Science in selected secondary schools in Rivers State.

Three research questions and two hypotheses were postulated. An expost-facto design method was adopted, the sample size of 300 respondents were used. A validated questionnaire on a four-point Likert Scale was used for data collection with a reliability coefficient of 0.88. data collected was analyzed using descriptive statistics and chi-square at 0.05. the findings of the study revealed that learning experience in which Agricultural field trip is used broadens students' knowledge. Omeodu and Abara (2018) investigated the relevance of field trips teaching and learning of Physics in Port Harcourt Metropolis. Four research questions and four hypotheses guided the study. Structured questionnaire formed the research instrument. The questionnaires were administered to the students and teachers (respondents) from the target population. Mean and standard deviation was used to answer the research questions while the hypotheses were tested using z-test statistics. The findings showed that field trips encourage effective learning.mAmosa, Ogulade and Atobatele (2015) researched on the effect of field trip on students' academic retention in learning practical skills in Basic Technology in Ilorin, Nigeria. A pre-test, posttest and control group quasi experimental design were adopted for the study. Purposive two sampling techniques was used. Sampled upper basic schools comprised 50 students randomly selected were assigned to treatment 25 and control group 25. Analysis of Covariance (ANCOVA) was used to analyzed the collected data. The findings revealed that students taught using field trip retained better.

Expository Method and Students' Academic Achievement
Odutuyi (2019) investigated the effects of activity-based approach and expository method on students' academic achievement in Basic Science. The study adopted the pre-test, post-test, control group in quasi-experimental design. Eighty-Seven (87) junior secondary school two (JSS2) Basic Science students in their intact classes from two purposively selected co-educational schools in Ondo West Local Government Area of Ondo State. The instrument for data collection was Achievement Test in Basic Science (ATBS). The co-efficient of reliability of ATBS was 0.76 using a test-re-test technique. The data collected were analyzed using Analysis of Covariance (ANCOVA). The findings of the study showed that, significant difference existed between the achievement of students exposed to activity-based approach and those taught using the expository method group. Udo (2011) investigated the relative effectiveness of problem-solving, guided discovery and expository methods of instruction on students' achievement in redox reaction, considering their mathematics ability. It was quasi-experimental research using non-randomized-pre-test-post-test control group design with expository method as control. Two research questions and two hypotheses were formulated for answering and testing respectively. A sample of 120 SS2 chemistry students' drawn from three (3) co-educational public schools in Uyo Local Government Area of Akwa-Ibom State using criterion sampling technique. Two researcher-made tests Chemistry Achievement Test (CAT) and Mathematical Ability

Test (MAT) with reliability indices of 0.76 and 0.68 respectively determined using test-re-test method were used in collecting relevant data. The findings of the results showed that those taught using problem-solving method performed significantly better than those taught using expository method.

Gbenga and Effiong (2015) investigated the effects of guided inquiry and expository lecture methods on students' achievement in Junior secondary school Basic Science in Yakurr, Cross River State. The study adopted a pre-test-post-test non-randomized control groups design using one experimental and one control group. Four schools were randomly selected from Yakurr Local Government Area. JSS2 intact classes in each school were used. Two validated research instruments: Basic Science Achievement Test (BSAT) and Study Habit Inventory (SHI) were used. Four hypotheses were tested at 0.05 significant level. Data were analyzed using analysis of covariance (ANCOVA). There was a significant effect of treatment on students' achievement in Basic Science. Student in the guided inquiry method had a higher mean score than those exposed to expository lecture method.

Ability Level and Student's Academic Achievement
Unodiaku (2013) investigated the influence of sex and ability level on students' Mathematics Readiness in Enugu State. The sample for the study was 203 students which were randomly selected from Nsukka and Obollo-Affor Educational Zone in Enugu State. The instrument for data collection was mathematics readiness test (MATHRET) developed and validated by Unodiku (2012) and revalidated by the researcher in Enugu Educational zone. The collected data was analyzed using mean and analysis of variance (ANOVA). Mean was developed to answer the research questions while ANOVA was used to test the stated hypotheses at 0.05 significant level. The findings showed that the mean difference found between boys and girls was significant across the three ability levels (high, average and low). Ezeugwu *et al*. (2016) examined the influence of cognitive ability, gender and school location on students' achievement in senior secondary school financial accounting in Owerri Educational zone 1 of Imo State. A comparative design was used. A total of 284 senior secondary school students offering financial accounting in 2011/2012 academic session drawn from government schools participated in the study. Financial Accounting Achievement Test (FAAT) and test of logical thinking (TOL) were used for data collection. The reliability index was 0.91 and 0.81. Six research question and research hypotheses guided the study. The research questions were answered using mean and standard deviation while the hypotheses were tested using analysis of variance. The findings of the study revealed a higher and statistically significant difference in the achievement of male and female students in favour of rural and urban students, a higher but not statistically different difference in the achievement mean score of high average and low ability students in favour of high ability students.

Achor and Ejeh (2019) examined the effect of Cognitive Acceleration Training Programme (CATP) on cognitive ability and achievement of Upper Basic II Home Economics students in East Senatorial District of Kogi State, Nigeria. The study adopted quasi-experimental design of non-randomized pre-test posttest control type. The sample consisted 390 (196 males and 194 females) students drawn from eight schools using purposive sampling technique. CATP in addition to Home Economics Achievement Test (HEAT) and Australian Council for Education Research (ACER) test with reliability coefficients of 0.95 and 0.82 respectively were used for data collection. Data were analysed using mean and standard deviation to answer research questions and Analysis of Covariance (ANCOVA) to test the hypotheses at 0.05 alpha level. The findings revealed that students that were exposed to Cognitive Acceleration Training Programme (CATP) in addition to the conventional strategy of teaching exhibited higher achievement. The students with low cognitive ability level benefited more from CATP. There was a significant difference in the mean gains in cognitive and achievement scores among low, average and high cognitive ability study exposed to cognitive acceleration training programme.

Gender and Students' Academic Achievement
Dania (2014) investigated the effect of gender on students' academic achievement in secondary school Social Studies in Delta State University, Abraka, Nigeria. The study adopted a quasi-experimental design (2X2 non-randomized pre-test, post-test control group) comprising six groups and two control groups. Six schools and one hundred and eighty (180) upper basic 2 students in Delta and Edo state made up the sample for the study. Six intact classes were randomly selected and assigned to experimental and control groups. The instrument used in data collection was the achievement instrument tagged "Social Studies Achievement Test" (SSAT). The reliability was established using Pearson Product Moment Correlation Coefficient (r) and the reliability obtained was 0.79. Mean, standard Deviation, Analysis of covariance (ANCOVA) were used for data analysis. Result revealed that gender (male/female) had no significant effect on students' achievement in social studies. Attah and Ita (2017) examined the influence of gender on academic achievement in English Language among senior secondary school students in Calabar Metropolis, Cross River State, Nigeria. The research adopted survey design for the study. The sample comprised of 660 senior secondary school two (SS2) students drawn from 22 public secondary schools in Calabar Municipality and seven (7) public secondary schools in Calabar South Local Government, Area, Cross River State using stratified Random and Purposive sampling techniques. Data were collected using "English Language Academic Achievement Rating Scale" (ELAARS). A reliability index of 0.75 was realized using Cronbach's alpha. The data generated were analyzed using independent t-test at 0.05 level of significance. The result of the findings showed that gender has no significant influence on academic achievement in English Language

among senior secondary school students in Calabar Metropolis.

Adigun *et al*. (2015) studied the relationship between students' gender and academic achievement in Computer Science in New Bussa, Borgu Local Government of Niger State, Nigeria. Questionnaire which consists of 30 multiple-choice items drawn from senior secondary school certificate examination past questions as set by the West Africa Examination council in 2014 multiple choice past questions was used as research instrument. The questionnaire was administered to 275 students from both private and public schools in the study area. The students' responses were marked and scored, analyzed using independent t-test. The results of the study showed that even though the male students had slightly better achievement compared to the female students, it was not significant.

Summary of Literature Review and Discourse
The theories of learning that provided foundation for the use of field trip method of learning were discussed. It was noted that what the learners see, touch and hear can stimulate their ability to recall important facts and principles. Emphasis was placed on the need for students to construct their own knowledge as they engage on minds-on, hand-on activities. Constructivism theory advocates a learners' interest and conceptual development.

The concept of environmental hazards, field trips and achievement were discussed in detail. It was observed that from the diverse reviewed literature the field trip method of learning enhances leaning among learners both in Nigeria and other western countries. There was no significant difference in the achievement of male and female students. Different studies have been done on field trips in different subject areas but from the empirical studies no study has been carried out on the effects of field trip on students' academic achievement and retention in Basic Science and Technology. The only study done in this area (Basic Science and Technology) was not carried out in Yala Local Government Area. Besides, none of the study on field trips considered its effect on component   of environmental hazards. This study therefore, endeavor to fill the gap by considering the effects of field trips on student achievement and retention when taught components of environmental hazards in Yala Local Government Area. number of learning theories have been put forward to explain learning as a process of acquisition of skills, knowledge and values.

A number of learning theories have been put forward to explain learning as a process of acquisition of skills, knowledge and values.

1. **Jeans Piaget's Theory of Cognitive Development**
Jeans Piaget, a Swiss psychologist (1980) posits from his theory of cognitive

development that every individual passes through the process of accommodation and 'assimilation'. He is of the view that individuals construct new knowledge from their experiences, under his view assimilation is said to have occurred when individual's experience aligns with his/her internal representation of the world. Accommodation entail reforming one's mental representation of the external world to fit into new experiences. Piaget's theory of cognitive development is a comprehensive theory about the nature and development of human intelligent. Knowledge is acquired by active process that requires an interaction between the student and the world around him. In this study, students are deliberately taken on field trip to interact with environment.

2. Jerome Brunner's Theory of Constructivism (1966)

A major theme in the theory is that learning is an active process in which learners construct new ideas or concepts based on their current/past knowledge. The learners select and transform information, construct hypotheses and make decision based on a cognitive structure. Cognitive structure provides meaning and organization to experiences and allows the individual to "go beyond the information provided". Brunner (1966) states that the instructor should encourage students to discover principles by themselves. Brunner also outlined that; the task of the instructor is to translate information to be learnt into a format appropriate to the learner's current state of understanding. Constructivism theory is relevant to this study because the learners construct their own knowledge as they embark on educational field trips in Basic Science and Technology, it is hoped that learners will be involved in creative and collaborative leaning and their cognitive development will be improved.

3. Social Learning Theory – Albert Bandura (1962)

Albert Bandura, a Canadian-born American Psychologist and originator of social cognitive theory, the concept of self-efficacy and his famous Bobo doll experiments. Bandura states that learning every single thing from personal experience is hard and could be potentially dangerous. He claims that much of person's life is rooted in social experiences, thus observing others is naturally advantageous to gaining knowledge and skills. He concludes that, observation plays a very powerful role in learning. It does not only help to teach students but help them to successfully understand, retain and apply their learning to their lives so they can learn and achieve more. This theory relates to the present study in that, as the students interact with the natural environment, they understand and retain much longer.

Methodology

A quasi-experimental design was employed in this study, using a non-randomized pre-test post-test control group because intact classes was used throughout the investigation. The study was carried out in Yala local government area. Currently

there are about twenty-one (21) public co-educational secondary schools, private schools and two (2) missionary secondary schools (single sex) in the area. The population size of this study is 3,546. This consisted all of JSS 2 students in the 21 co-educational public secondary schools in Yala Local Government Area in the 2019/2020 academic session. The sample size of the study was 100. This was achieved by Simple random sampling. A researcher-made instrument titled: Basic Science and Technology Achievement Test (BSTAT) was used for data collection. The face and content validity of the instrument as well as item analysis was done. The test-retest reliability was used to determine the reliability coefficient of 0.78. The Mean and standard deviation were used to answer the research questions while Analysis of covariance (ANCOVA) was used to test the research hypotheses at 0.05 level of significance.

Results

The four (4) research questions raised to guide the study were answered using mean and standard deviation.
Research Question One

What is the achievement mean scores of high, average and low ability level students taught environmental hazards using field trip method?

Table 1: Mean and Standard Deviation of Students' Achievement Scores by Ability Levels in the Experimental Group

	Ability level	N		SD	Differences		
					A-B	A-C	B-C
A.	High	14	15.264[a]	.557			
					1.001	1.019	0.018
B.	Average	19	14.263[a]	.507			
C.	Low	17	14.245[a]	.485			

a. covariates appearing in the model are evaluated at pretest scores of mean 4.63.

Table 1 shows that the mean score of 14 high level ability student is 15.264 with a standard deviation of .557. On the other hand, the mean score of 19 average ability level students is 14.263 with a standard deviation of .507. Furthermore, the mean score of 17 low ability level students is 14.245 with a standard deviation of .485. In other words, the differences among means of students' ability levels are A-B is 1.001, A-C is 1.09 and B-C is 0.018.

Research Question Two

What is the mean retention scores of students taught environmental hazards using field trip and expository method? Table 4.4 is used to answer this research question.

Table 2:   Mean and Standard Deviation of Students' Retention Score by Group

Method	N	$\bar{x}$	SD	Difference between group
Field trip	50	14.083a	.417	
				1.138
Expository	50	12.845a	.399	

a. covariates appearing in the model are evaluated at pretest scores of mean 4.63.

Table 2 shows the mean retention scores of students taught environmental hazards using field trip is 14.083 and those taught using expository method is 12.845 having difference of 1.138. In other words, students taught environmental hazards using field trip achieved higher than those taught using expository method. The standard deviations for students in the field trip and expository groups are 0.417 and 0.399 respectively. The two groups of students are equally homogeneous, by virtue of the closeness of the standard deviations.

Research Question Three

What is the mean retention scores of male and female students taught component of environmental hazards using field trip method?

Table 3:   Mean and Standard Deviation of Student's Retention Scores by Group in Experimental Group

Gender	N	$\bar{x}$	SD	Difference between group
Male	26	13.261a	.401	
				0.407
Female	24	13.668a	.424	

a. covariates appearing in the model are evaluated at pretest scores of mean 4.63.

Table 3 indicates that the mean retention score of the male students was 13.261 and that of their female counterpart was 13.668 with a mean retention score difference of 0.407. This shows that the female students achieved higher than their male counterpart using the mean retention scores.

Research Question Four

What is the mean retention scores of high, average and low ability level of students taught component of environmental hazards using field trip method?

Table 4. Mean and Standard Deviation of Students' Retention Scores by Ability Levels in the Experimental Group

Ability level		N	x̄	SD	Difference between group		
					A – B	A – C	B-C
A.	High	14	14.254a	.537			
B.	Average	19	13.089a	.494	1.165	0.009	1.156
C.	Low	17	14.245a	.485			

a. covariates appearing in the model are evaluated at pretest scores of mean 4.63.

Table 4 shows that the mean retention score of the 14 high level ability student is 14.254 with a standard deviation of .537. On the other hand, the mean score of the 19 average ability level student is 13.089 with a standard deviation of 0.494. Furthermore, the mean score of 17 low ability level student is 14.245 with a standard deviation of 0 .485. This implies that students with high ability level achieved higher than those with average and low levels of ability.

Testing of Null Hypotheses

Table below for testing hypothesis one

Table 5: Analysis of Covariance of Students' Mean Achievement Scores by Ability Level, Gender and Method

Source	Type III sum of square	Df	Mean square	F	Sig p≤.05	Decision
Corrected model	167.201	12	13.833	1.773	.065	
Intercept	1632.100	1	1632.100	207.653	.000	
Pretest	109.496	1	109.496	13.931	.000	
Ability	18.787	2	9.394	1.195	.308	NS
Gender	4.953	1	4.953	.630	.429	NS
Method	15.092	1	15.092	1.920	1.69	NS
Ability * gender	1.839	2	.920	.117	.890	
Ability *method	.929	2	.465	.059	.943	
Gender* Method	.676	1	.676	.086	.770	
Ability *Gender	3.922	2	1.961	.249	.780	
Method error	683.799	87	7.860	.		
Total	21876.00	100				
Corrected Total	851.00	99				

Hypothesis One

There is no significant difference (p ≤ .05) among the mean scores of high, average and low ability level students taught environmental hazards using field trip. Table 5 shows that the computed F-value for 1.195 with a corresponding P-value of .308. The null hypothesis could not be rejected (p≤.05). Therefore, there is no significant difference among the mean achievement score of high, average and low ability level students taught environmental hazards using field trip. This however, did not cover

two- or three-way interaction effects.

Hypothesis Two
There is no significant difference (p ≤ .05) between the mean retention scores of students taught environmental hazards using field trip and expository methods.
Table 6 is used to test hypotheses two, three and four.

Table 6: Analysis of Covariance of Students' Mean Retention Scores by Method, Gender and Abilities Level.

Source	Type III sum of square	Df	Mean square	F	p≤.05sig	Decision
Corrected model	196.237	12	16.355	2.192	.019	
Intercept	1322.682	1	1322.682	117.289	.000	
Pretest	112.733	1	112.733	15.110	.000	
Ability	25.881	2	12.941	1.735	.183	NS
Gender	3.563	1	3.563	.478	.491	NS
Method	34.222	1	34.223	4.587	.035	S
Ability gender	2.085	2	1.043	.140	.870	
Ability *method	13.055	2	6.527	.875	.421	
Gender* Method	.126	1	.126	.017	.897	
Ability *Gender Method	10.210	2	5.105	.684	.507	
Error	649.073	87	7.461			
Total	18721.000	100				
Corrected Total	845.310	99				

R^2= 232 (Adjusted R. squared = 126)
*Significant at .05 alpha level
a. covariates appearing in the model are evaluated at pretest scores of mean 4.63.

As shown in Table 6, the computed F-value for method of teaching is 4.587 with a corresponding P-value of .035. Method is therefore significant (p≤.05). The null hypothesis is rejected. This implies that there exists a significant difference between the mean retention scores of students taught environmental hazards using field trip and expository methods.

Hypothesis Three
There is no significant difference (p ≤.05) between the mean retention score of female and male students taught environmental hazards using field trip. Table 6 shows that the F-value for gender is .478 with a corresponding P-value of .491. Therefore, the null hypothesis five could not be rejected. This implies that there is no significant difference between the mean retention score of male and female students taught environmental hazards using field trip.

Hypothesis Four
There is no significant difference (p ≤ .05) among the mean retention scores of high,

average and low ability level students taught environmental hazards using field trip method. Table 6 indicates that the computed F-value of students' ability level is 1.735 with a corresponding P-value of .183. Therefore, the null hypothesis six could not be rejected. This implies that there is no significant difference among the mean retention scores of high, average and low ability level students taught environmental hazards using field trip method.

Findings
The summary of the findings of this study are:
  i.   There is no significant difference among the achievement scores of high, average and low ability level students taught environmental hazards using field trip
  ii. There is significant difference between the mean retention scores of students taught environmental hazards using field trip and expository methods.
  iii. There is no significant difference between the mean retention scores of male and female students taught environmental hazards using field trip.
  iv. There is no significant difference among the mean retention scores of high, average and low ability level students taught environmental hazards using field trip method.

Discussion of Findings
This discussion is organized according to the order of the research questions.

Effect of Field Trip Method of Teaching on Students' Achievement by Gender and Ability level
The result of this study showed that there is no significant difference between the achievement scores of male and female students taught environmental hazards using field trip. This is in line with the findings of Dania (2014), Attah and Ita (2017), and Adigum *et al*. (2015). It also showed that there is no significant difference between the achievement scores of high, average and low ability level of students taught environmental hazards using field trip. The field trip has enabled the initial gaps between levels had been filled. This finding is in line with Ezeugwu *et al*. (2016) who reported not statistically difference in the achievement mean score of high, average and low ability. However, the study disagrees with Achor and Ejeh (2014) and Unodiaku (2013) who reported that there was a significant difference in the mean gains in cognitive and achievement scores among low, average and high cognitive ability study exposed to cognitive acceleration training program.

Effect of Field Trip Method of Teaching on Students Retention of knowledge
The result of this study shows that there is significant difference between the mean retention scores of students taught environmental hazards using field trip and

expository methods. This is in line with the findings of Omeodu and Abara (2018); Ogbulujiah (2014); Ezechi (2018) and Taneo (2017), all these authors reported that the field trip is an effective approach of teaching and help student acquire useful knowledge while having fun and relaxation at the same time.

Effect of Field Trip Method of Teaching on Students' Retention by Gender
The result of the fifth hypothesis shows that there is no significant difference between mean retention scores of male and female students taught environmental hazards using field trip. The findings are in line with Edoho *et al*. (2020) who reported that there was no significant difference between the mean achievement scores of male and female students taught using discussion method. However, the finding differ with that of Owodunnni and Ogundola (2013) and Ogundola *et al*. (2013) and Ogundola *et al*. (2020) who reported that there was a significant difference in the mean interest and retention scores of students based on gender. The major difference about the study may be as a result of sample size or geographical location.

Effects of Field Trip Method of Teaching on Students Retention by Ability Level
The findings of the sixth hypothesis shows that there is no significant difference between the mean retention score of high, average and low abilities level of students taught environmental hazards using field trip method. The initial gaps have been bridged by the field trip. This finding is in line with Ezeano (2008), Eze *et al*. (2020) who reported that there was no significant difference in the mean retention ability level of students is in agreement with the study. However, Omwirhiren (2015) disagree with the result of the finding as reported that there is significant difference between the mean retention ability levels of students. The major difference between these findings is because of sample and geographical location of two studies.

Educational Implications of the Findings
The findings of this study have the following educational implications:
  i.   This study has implications for Basic Science and Technology teachers. Teachers should take this as an opportunity to enhance their students' academic achievement and retention in the concept of environmental hazards through the use of field trip as this will encourage scientific development in the continent.
  ii.   The non-significance effect of gender in this study implies that gender is not a significant determinant of students' academic achievement and retention in Basic Science and Technology. Teachers should therefore not discriminate among their students because both males and females can benefit equally in Basic Science and Technology provided appropriate instructional methods and materials are employed by the teacher.

iii. Teachers of Basic Science and Technology should always investigate the gaps existing between higher, average and low ability level students in Basic Science and Technology, with the view of closing the gaps at the end of lessons.

Conclusion

This study has indicated that there is no significant difference between the mean achievements scores of learners taught with the two methods studied. It is a surprising result. One would have expected that the field method will bring about a difference. However, the results showed that there was a significant difference between the mean retention scores of those who were taught with the field trip and the expository methods. We therefore conclude that the field trip method is better on the long run thereby helping learners to retain knowledge for very much longer time.

Furthermore, the field trip method did not have effect on gender. Finally, the study showed that the initial gaps observed between achievement of students of high, average and low ability levels were bridged. This bridging of gaps can only be attributed to the effect of the field trip method.

Recommendations

Based on the findings of the study, the following recommendations were made.
   i.   Teachers of Basic Science and Technology should use field trip method to teach environmental hazards component of the subject curriculum as this will to science and technology development in Nigeria and Africa in general.
   ii. Parents and teachers should encourage both male and female students towards excellence in science since gender is not a significant determinant of students' achievement and retention in Basic Science and Technology.
   iii. The Federal Government should in collaboration with the ministry of education include educational field trip as a method for teaching environmental hazards in Basic Science and Technology Curriculum for Junior Secondary Schools.

Seminars, workshops, and conferences should be organized more frequently for Basic Science and Technology teachers to update their knowledge of various methods of teaching, including field trip method.

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Chapter 3

Impact of Climate Change on Rainfall Patterns and Implications for Agricultural Production and Adaptation Strategies

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Abstract

Climate change has adversely impacted natural resources, food, security, human health, the environment, physical structures, among others. The impacts are evident in the threats posed by drastic changes in rainfall patterns, temperature, relative humidity, radiation and general alteration in the trends of climatic elements. The purpose of this research was to access data/information on rainfall patterns for the period (1972-2003) and (2016-2017). The data/information were sourced from secondary sources. The data/information sourced were analyzed using descriptive statistics. The result shows that there have been deviations from the patterns of rainfall. The result also shows that rainfall was experienced more in the period (2016-2017) as compared to the period (1972-2003). Adaptation strategies, among others include shifting planting dates and cultivating short cycle seeds. Recommendations, among others, included that there should be shift in the planting dates of some crops, timely planting of crops, planting of short cycled seeds during short periods of rainfall and cultivating "edible" cover crops as "must crops" during the cropping session.

Keywords: *Climate change, Rainfall patterns, Implications, Agricultural production, Adaptation strategies.*

Introduction

In Nigeria, like other developing countries, agriculture remains the most viable economic sector and considerably contributes towards production and employment (Suleiman, Yakubu and Yusuf, 2018). According to Jifin (2017), agriculture for decades

has been associated with the production of basic food crops and animals. At present, agriculture in Nigeria, besides farming includes forestry, fruit cultivation, dairy, poultry, mushroom, beekeeping and marketing, procession and distribution of agricultural products.

In effort to achieve the desired level and targets in agriculture, in terms of adequate food production and provision of substantial support for the local industries, the practice of agriculture requires adequate and fertile land and supply of vital inputs such as improved seeds, among others. The farmers, according to Olaniyi and Ogunkunle (2018) should be assisted by Extension Organizations to access current knowledge of improved sources of information and have a class to all inputs needed for effective production. In the opinion of Mashroofa and Senenvirathne (2014), farmers need information to identify the cost, storage usage of varieties of newly introduced seeds, pesticides and weather conditions in order to obtain maximum yields and best production. There is also the need for favourable climate as an all important ingredient or input in agriculture (Emedo, Maduka and Oranekwulu, 1995) and (Oga, 2014). The effect of climate, a major requirement in agriculture is important in agricultural production. This is in consideration of the crucial roles of its various elements, especially, rainfall, which is considered a major source of water resource use in agriculture by farming households.

Rainfall, a very essential element of climate has numerous implications for agricultural production (Oga, 2014). This is because its nature (i.e. time of commencement in a given period, frequency, amount, duration, intensity and distribution) in a given period, to a high degree determines the types of farming systems, the level of agricultural practice and production.

Nowadays records have shown that the patterns and distribution of rainfall have not been favourable and encouraging. According to Nigeria Meteorological Agency (NIMET), 2016), there has been deviation from the usual pattern of rainfall. The current unfavorable nature of rainfall widely experienced is as a result of global warming and subsequently climate change (Jifin, 2017). This situation does not portend good for agricultural production and this has multiplier effects. Often, it has been observed and even available records have shown that the rains do not commence when it is usually expected. This situation corroborates the position of Anam and Antai (2015). The rains when eventually experienced, may be fair (drizzle), moderate or torrential and in the process may not be adequate for agricultural production or may even be very destructive to agricultural produce and also farm physical structures. This calls for all hands to be on deck in order to come up with various assistances to forestall vagaries of weather conditions.

Consequently, there is need to access data/information on the patterns of rainfall and distribution with which to guide farmers on their farming operations. With the foregoing, there is also the need to help farmers come up with measures (smart practices) that will enable them adapt to the vagaries of global warming and climate change and these formed the basis of this research effort. The main objective of this research is to access data/information on patterns of rainfall for two distinctive periods (1972-2003) and (2016 - 2017) and attain specific objectives.

Statement of the Research Problem
Currently, among the global topical issues are global warming and climate change. These have impacted, among others, agriculture due to their influence on weather elements, especially, on patterns and distribution of rainfall. Over the years, farmers carried out their farming activities with good background knowledge of the weather conditions of their immediate environment, especially, in relation to the patterns and distribution of rainfall. With this knowledge, they considerably understood their immediate environment and on this premise planned their farming activities effectively with minimal loses on the farm. But nowadays, this knowledge appears to have been eroded due to influence of global warming and climate change. This has caused considerable changes in the pattern and distribution of rainfall.

Consequently, farmers can no longer understand the prevailing weather conditions of their immediate environment and this has affected the planning of their farming activities and has equally resulted to some huge loses of their farm produce and other resources. As a result of the inability of farmers to predict the future of rainfall accurately, there are varying amounts of risk and uncertainty in all their farm management decisions. This position is supported by Oladele (2015) and Mohammed (2017). In the latter's assertion, if everything is known with certainty, decisions would be relatively easy. However, in the real world, a more successful farmer is the one with the ability to make the best possible decisions and the courage to make them when surrounded by risk and uncertainty. Sequel to this, farmers need assistance in this regard. This assistance may be in the form of providing them with current basic data/information on these changes and also suggest smart practices (adaptation measures) to enable them cope with the effects of global warming and climate change. The data/information provided on changes on rainfall patterns and distribution will provide guidance for the farmers and enable them to effectively plan their farming activities and subsequently minimize the effects of the present vagaries of weather conditions as they concern their farming activities and water management. This is in agreement with the position of Thomas and Sanyaolu (2017), who asserted that seeking information on agro-meteorological services will help to minimize losses associated with the effect of climate change. They also assert that this type of research, if carried out routinely, will provide, among others, seasonal rainfall predictions and

early warning messages and preparedness attempt to face crop or cropping seasons, probably in future.

The main objective of this research was to access data/information on rainfall patterns between the periods (1972-2003) and (2016-2017). Specific objectives included: to determine the number of raining days in each of the months of the years 1972-2003; to determine the amount of rainfall in each month of the period 1972-2003; to determine the number of raining days in each of the months in the years (2017-2018); to determine the amount of rainfall in each of months of the years (2017-2018); to make recommendations. This research tends to provide solution(s) to the following research questions; what was the number of rainy days in the months of the period (1972-2003), what were the amounts of rainfall in the months of the period (1972-2003), what was the number of rainy days in the months of the period (2016-2017) and what were the amounts of rainfall in the months of the period (2016-2017).

The Study Area
Materials and method
The materials used for this research were sourced from the Agromet Unit of the National Root Crops Research Institute (NRCRI) Umudike. Umudike is located about 8km East of Umuahia town along Umuahia – Ikot Ekpene road with latitude $05^0 29^1$N, longitude $07^0 33^1$E and at an altitude of 122m above the mean sea level (Emeka – Chris, 2011). Umudike is 140km north of Port Harcourt International Airport and 135km south of Enugu Airport and only 80km east of Owerri Airport in Imo State. It is within the subequatorial climatic belt characterized by two major seasons; the wet and dry seasons. The wet season starts in April and ends in September with a peak in June and July, while the dry season lasts from October to March. However, recent global climatic change has affected the durations of these seasons. Rainfall is high in the area, with an annual average of about 2,217.86mm. Relative humidity is also high and generally over 70%, while mean annual temperature is about 27^0C.

Data Collection and Analysis
The basic data required for this research was rainfall data for some weather elements for the period (1972 – 2003) and (2016 – 2017). The source of the data is the Agromet Unit of the National Root Crops Research institute (NRCRI), Umudike. The data was analyzed using descriptive statistics.

Results and Discussion
1. Determination of the Number of Raining Days in the period 1972 - 2003

Table 1: Summary of Monthly Distribution of Raining Days, Amount of Rainfall (mm) and Temperature (^{0}C) for the period, 1972 – 2003

1972 - 2003	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct.	Nov.	Dec.	Total
Number of Raining Days	1	2	8	12	19	18	22	22	21	27	5	1	158
Rainfall amount (mm)	13.6	30.8	123.9	188.9	265.2	285.9	294.2	308.6	341.2	250.9	54.7	26.9	2184.8
Mean of Air Temp^{0}C	27	28	28	28	27	26	26	25	26	26	27	26	

Source: Agromet Unit of National Root Crops Research Institute, Umudike, Abia State

The information as reflected in Table 1 shows that all the months of the period 1972 - 2003 experienced rainfall. The months of May – October recorded more number of days of rainfall. The month of October recorded the highest number of rainy days for the period.

2. Determination of Amount of Rainfall in the period 1972 – 2003

Table 1 shows that all the months of the period (1972 – 2003) recorded some amount of rainfall. The months of May – October recorded high amounts of rainfall. The month of August recorded the highest amount of rainfall of 308.6mm for the period.
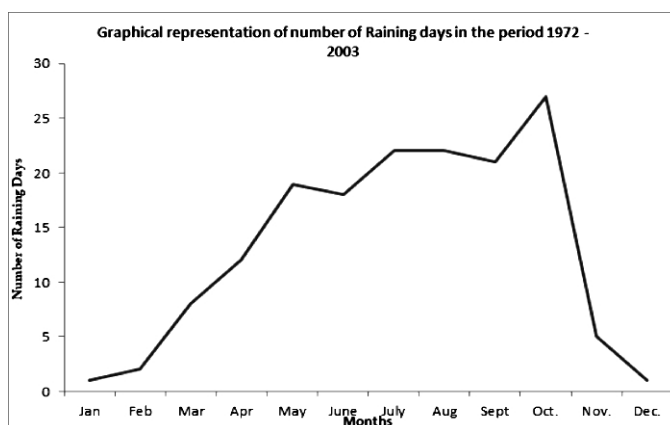

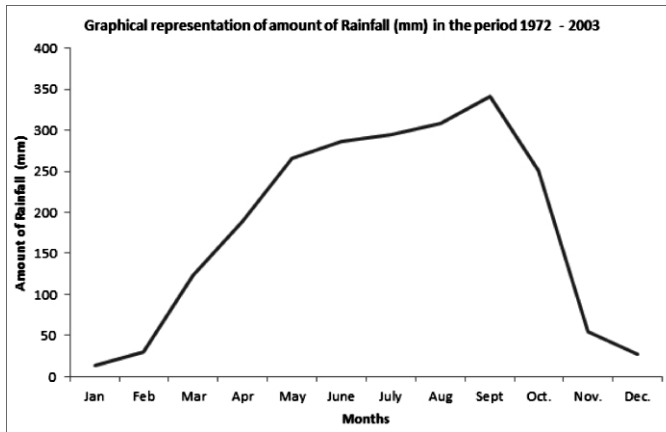**Fig. 1: Frequency of Rainfall in the period, 1972 – 2003**

Fig. 2: Pattern of Rainfall in the period, 1972 – 2003

Table 2: Summary of Monthly Distribution of Raining Days, Amount of Rainfall (mm) and Temperature (^{0}C) for the year, 2016

2016	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct.	Nov.	Dec.	Total
Variables													
Number of Raining Days	0	0	10	8	16	16	15	22	15	7	2	1	112
Rainfall amount (mm)	0	0	266.6	129.3	277.8	324.9	265.1	308.3	312.8	273.4	45	4.1	2207.3
Mean of Air Temp ^{0}C	28.5	30	29	29	28.5	26	26.5	26.5	26.5	27.5	28	30	

Source: Agromet Unit of National Root Crops Research Institute, Umudike, Abia State

Table 3: Summary of Monthly Distribution of Raining Days, Amount of Rainfall (mm) and Temperature (^{o}C) for the year, 2017

2017	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct.	Nov.	Dec.	Total
Variables													
Number of Raining Days	2	0	4	8	11	15	18	10	12	12	7	0	99
Rainfall amount (mm)	51	0	74.4	114.5	138.8	274.4	710.4	130.1	264.7	215.4	39.8	0	2013.5
Mean of Air Temp ^{0}C	28.5	29.5	29.5	28.5	28	27.5	29.5	26	26.5	27.5	28	29	

Source: Agromet Unit of National Root Crops Research Institute, Umudike, Abia State

3. Determination of the number of rainy days in the period (2016 – 2017)

Information in Table 2 shows that rain fell in all the months of the year, 2016 (10 months of rainfall). For the year, 2017, rainfall was not experienced in the months of February and December and also (10 months of rainfall) but with much varied intensity and frequency. The month of August recorded the highest number of rainy days contrary to popular opinion.

4. Determination of amount of rainfall for the period (2016 – 2017)

Table 3 shows that the months of February and December did not record any amount of rainfall. The months of June, July and September recorded high amounts of rainfall. The highest amount of rainfall (710.4mm) was recorded in the month of July in the year, 2017. See Table 3 and Figure 6.
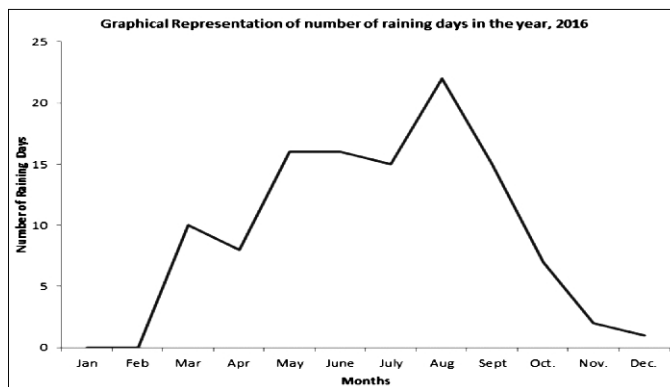

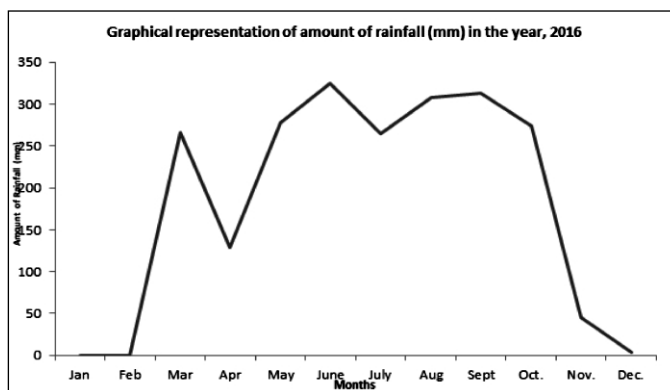**Fig. 3: Pattern of Rainfall in the year, 2016**

Fig. 4: Pattern of Rainfall in the year, 2016
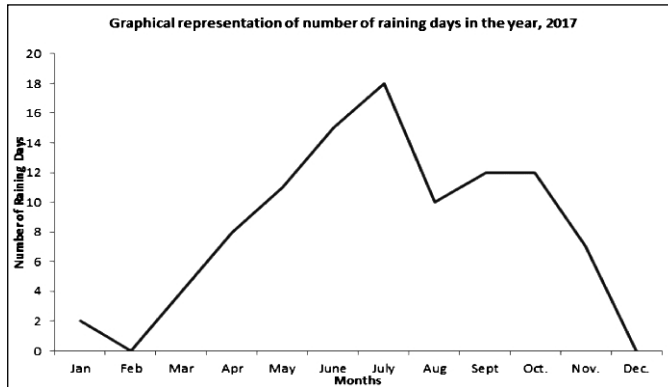
Fig. 5: Pattern of Rainfall in the year, 2017
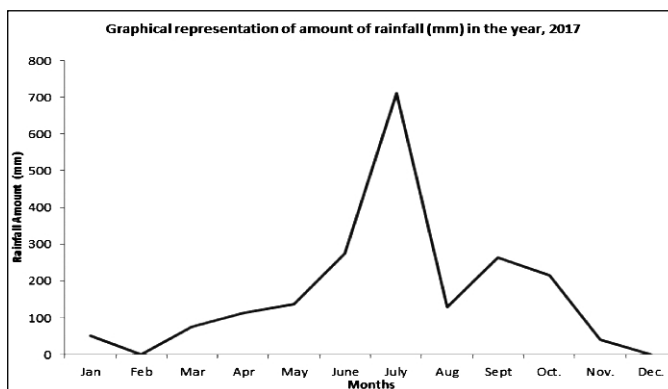
Fig. 6: Pattern of Rainfall in the year, 2017

Implications for Agricultural Production

Considering the patterns of rainfall in the period 1972-2003 as shown in Figures 1 and 2, rainfall commenced early in the years concerned and continued to rise gradually up to the month of October where it peaked. This trend provided a regular pattern to some extent considered favourable which enabled farming activities without much problems. The implication to this regard was that farming activities were carried out with some level of convincing assurances. This agrees with the position of Emedo, et al, (1995) that regular pattern of rainfall guarantees the production of both food and cash crops. The patterns of rainfall as reflected in the period 2016 - 2017 and as shown in Figures 3,4, 5 and 6 provide pronounced contrast as compared to the patterns in the period 1972-2003. In the year, 2016, rainfall started early in the year and rose drastically in the month of March and thereafter dropped in the month of April, see Figure 3.

It commenced again in the month of May and continued to rise and fluctuated up to the month of September and dropped very sharply after the month of September. In the year, 2017, the pattern of rainfall can be considered very poor as compared to the pattern in the year, 2016. Rainfall commenced early in the year, 2017 in the month of January, dropped in the month of February after which it started to rise poorly up to the month of June after which it rose very sharply in the month of July and thereafter dropped very sharply in the month of August. See Figure 6. After this sharp drop, it rose a little in the month of September and after this month, started to drop gradually up to the month of November, see also Figure 6. This situation agrees with the position of Nwaiwu *et al,* (2014) that climate change has caused drastic changes in rainfall pattern.

The implications, with the foregoing, are that seeds of crops of short cycle should be cultivated between the months of February and May. Crops that may not require much water to thrive should be cultivated between the months of March and June. Also crops that require much water to thrive should be cultivated between the months of May and September. The prevailing situation may not guarantee the usual two periods of cropping for some crops, for example, the two periods of maize cultivation in a year (i.e. early maize and late maize). As well, the implication is that crops, such as rice, may not thrive well due to poor fluctuations in the pattern of rainfall, especially, between the months of September and October during which it requires water for the last lap of its cycle. Within these months, there have been sharp drops in rainfall. The implication is that upland rice should be supported with irrigation, especially, during the period of water shortage (April-June) and (September to November). Such crops as cassava and yam suffer on the farm during the months of June and August due to excessive rainfall resulting to great flood which stay up to 3 - 4 days before it recedes and in the process cause rottening of these crops. During this period flood also destroys and carries away farm produce and structures. This situation agrees with the position of Dembele, Akinbile and Aminu (2019) that climate change affect agricultural production. In the case of livestock, especially, poultry and pigs, should be provided with adequate shade to prevent heat stress and sufficient water provided for them between the moths of February and June. See Figure 6.

Adaptation/Adaptation Strategies
According to Iduma, Owombo and Adesina (2014) adaptation refers to actions and adjustments put in place to main the capacity to deal with stresses induced by current and future external charges. On the other hand, adaptation strategies are those measures engaged to heap maintain the capacity to deal with stress induced by current and future external changes.

Adaptation to climate change refers to any adjustment that occurs naturally within

ecosystems or human systems in response to climate change that either moderates, harm or exploits beneficial opportunities in response to actual or expected climate related environmental changes (Intergo 2007) Fourth Assessment Report. It is obvious that farmers are innovating through indigenous adaptive measures. Though efforts are presently being channeled into more scientific ways of adapting to climate change, these are not yet accessible or available to the farmers who are the end users of such innovations (Agwu and Irohibe, 2013).

Results of some research on the type of adaptation measures employed by farmers in some African countries shows that, though, farmers may not have the financial capacity to use some adaption strategies that can bring about significant increase in their production, they may employ the use of some adaptation strategies that can bring about significant increase in their production, they may employ the use of some adaption strategies within their financial power, though, the level of use might not be optimal.

According to the results of the research carried out by Dembele, Akinbile and Aminu (2019), most farmers engage the following measures as adaptation strategies in some African countries:

1.   **Timely planting of crop seeds**
This means sowing seeds of crops at the appropriate time/period when the conditions are suitable for them. The exercise should not be before or after the actual time of sowing the crop seeds. Delay in this exercise should be out of place. Most farmers engage this strategy and in order that this measure be effective, the farmers should adequately understand the seasonality of crops produced as they have been producing the same crops over the years.

2.   **Planting of short cycle seeds of crops**
Farmers should cultivate this type of crop seeds in the face of current vagaries of weather and climate. Short cycle crop seeds are of those crops that do not stay long on the farm. In other words, they thrive and mature within a very short time, say, between 2-4 months on the farm land, especially during periods of water scarcity. Most annual crops dominant this group of crops.

3.   **Rotation of crop land**
This practice may seem similar to shifting cultivation. It actually involves moving from one piece of land to another when the former's fertility status has reduced. In this regard, land is not left uncultivated for a long time but for about 2-3 years during which fast growing and maturing leguminous plants are cultivated on the land, to among others, protect the soil from erosion, enrich the soil and to absorb nitrogen

elements or compounds left untapped by previous plants and in the process reduce the emissions of some greenhouses gases (GHGs) into the atmosphere which cause global warming. After the period of abandonment, the farmer can then revert back to the initial piece of land for better result of production.

4.   Use of Agro-meteorological and management information

This involves helping farmers to access and use information on the day-day changes of the environmental conditions. This will help them adapt to changing environmental conditions. Farmers need to have access to land this kind of information be it climatic information, forecasts, adaptive technology innovations, or markets through extension and information systems. Some processionals, such as agricultural extension personal need to share knowledge with farmers on cropping and management systems that are resilient to changing climate conditions such as agro forestry, intercropping, sequential cropping and no-till agriculture. These, no doubt, will guarantee successful adaptation.

5.   Shifting planting dates of crops' seeds

Prior to the realities of climate change and its effects, especially in relation to agricultural production, farmers understood the patterns of rainfall which were considered relatively regular and this guided farmers in the cultivation of the farm land and cultivation of certain crops at the right time. Climate change, at present, has caused irregularity in the patterns of rainfall and has affected the usual planting dates of crops' seeds. Consequently, farmers should understand the present trend of rainfall and judiciously follow it such as to know when it will be appropriate (time) to cultivate certain crops. To be precise, farmers should shift-planting dates of crops' seeds to when favourable environmental conditions will be suitable for such activity.

6.   Irrigation practices

Water is very essential for crop production. To this regard, water is not always available for this operation and even when available, may not be sufficient to support crop growth and development. There is no doubt that agricultural production in some places is rainfed (i.e. source of water) and climate change has impacted the time of commencement of rainfall and its pattern such that rainfall pattern has drastically changed. As a result, the rains do not come when expected and this has caused shortage of water supply to the farms for crop use and has equally affected the planning of farm operations. Consequently, farmers should source water from rivers, streams, lakes, ponds and even boreholes, as the situation may warrant in order to provide water for crop plant use during periods of water scarcity.

Conclusion

Climate change has caused some drastic changes in the patterns of rainfall and impacted other weather elements and human endeavours among which is agriculture and calls for adaptation measures. As a result, the main purpose of this work, was to access data/information on rainfall patterns for the (1972 – 2003) and (2016 – 2017) and attain some specific objectives.

The practice of agriculture is influenced by various factors, especially, climate. The effect of climate in agriculture is felt through one of its potential elements, rainfall. Nowadays, the nature of rainfall in relation to agricultural production has not been encouraging due to climate change. Consequently, there is need to access data/information on the pattern of rainfall for some periods. In order that agriculture may continue to support related human endeavour and livelihood, there is need for adaptation strategies to the effect of climate change. Strategies to be engaged in this regard, in the opinion of this research are, among others, shifting the planting dates of some crops, cultivating short cycle seeds, constructing water channels on the farm for irrigation purposes and disseminating information on weather changes to farmers.

Recommendations

i. Creating more awareness on the realities of global warming and climate change
ii. Farmers to shift planting dates of some crops following the pattern of rainfall
iii. Cultivating short cycle seeds
iv. Farmers through co-operative efforts should construct water channels (irrigation) for use on the farm during periods of water scarcity.
v. Local weather stations should be established in rural localities to help support Nigeria Meteorological Agency (NIMET) in their activities of providing information on current weather changes to farmers, especially, as they concern patterns of rainfall.

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Chapter 4

An Application of Multivariate Statistical Techniques to Evaluate Water Quality Across Dumpsites Along Otamiri-Ochie River, Etche

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Abstract

The status of water quality in rural areas is attracting a great deal of attention on how suitable it is for public consumption, recreation and other purposes. There is however a lack of studies on water quality using multivariate statistical techniques to predict the sources of pollutant along Otamiri-Ochie River. Multivariate statistical approaches, including principal component analysis (PCA) and cluster analysis (CA) were employed to evaluate the water quality of the River. In this study, eight physico-chemical parameters were analysed in each water sample collected from four sampling sites surrounded by dumpsites along the River. Exploratory analysis of the dataset involved use of PCA, CA and water quality index (WQI) in attempt to identify the sources of variation measured in the samples. PCA was used to reduce the dataset to three components with predominantly dissolved oxygen (DO), total dissolved solids (TDS) and total suspended solids (TSS) contributing to over 55% of the total variance. CA classified the sites into two distinct groups identified as the upstream and downstream of the River. Chokocho (CHR) axis of the River was identified as being closer to the pollutant source and hence it is the most heavily polluted portion of the River. WQI value suggests that the water is unsuitable for drinking and may likely not be fit for domestic uses. The results prove multivariate statistics to be a powerful tool in identifying pollutant sources, which can be applied to both urban and rural water bodies.

Introduction

The availability of good quality water is a major concern to life since it is directly linked to human health and the environment. The most important sources of water are unfortunately under severe threat due to human activities. Human activities such as commercial, agricultural practices and recreation have generated various waste materials (both domestic and industrial wastes) that are released into surface water bodies (Sadiq et al., 2010; Grupta et al., 2003; Sincock et al., Al-Mutairi et al., 2014). These materials have potential negative impact on aquatic ecosystems, which may result to poor water quality and an overall decrease in quality of life for the residents.

Although, standard quality of water suitable for domestic and agricultural purposes is well known, investigations into water bodies within the rural areas are necessary (Zhao et al., 2012; Dhhou et al., 2016; Kumar and Alappat, 2009). Otamiri-Ochie River connects different communities where this water body serves as means of irrigation. Whilst the presence of pollutants in surface water poses a great risk to human health and the ecosystem, identifying its source has always been a challenge in previous studies (Miller and Hutchins, 2017). However, a study by Howladar et al. (2017), has investigated the influence of mining activities on water quality around mining industrial areas using multivariate statistical techniques.

Since water is essential to life, less attention has been paid to assessing the status of water quality within certain geographical areas. In contrast, it is not clear whether pollutant sources of water bodies can be easily identified by applying statistical analyses. Therefore, additional studies on water bodies are needed in order to provide better understanding on water quality with respect to the sources of contamination. The overall aim of this study is to evaluate the water quality along Otamiri-Ochie River using multivariate statistical approaches, which include principal component analysis and cluster analysis. With these techniques, it is hoped that the outcomes will be used as an evaluation of water bodies in rural and urban environments with specific reference to its suitability.

Materials and Methods

Study Area

Otamiri-Ochie River is situated within Etche Local Government Area in North-East of Rivers State (between $05^0 08^{''}$ and $04^0 45'$North latitude and between $06^0 05^{''}$ and $07^0 14'$ East Longitude). The area is rich in agricultural produce where the small river body serves as source of water. For this present study, four sampling sites were chosen along the Otamiri-Ochie River as shown in Figure 1.
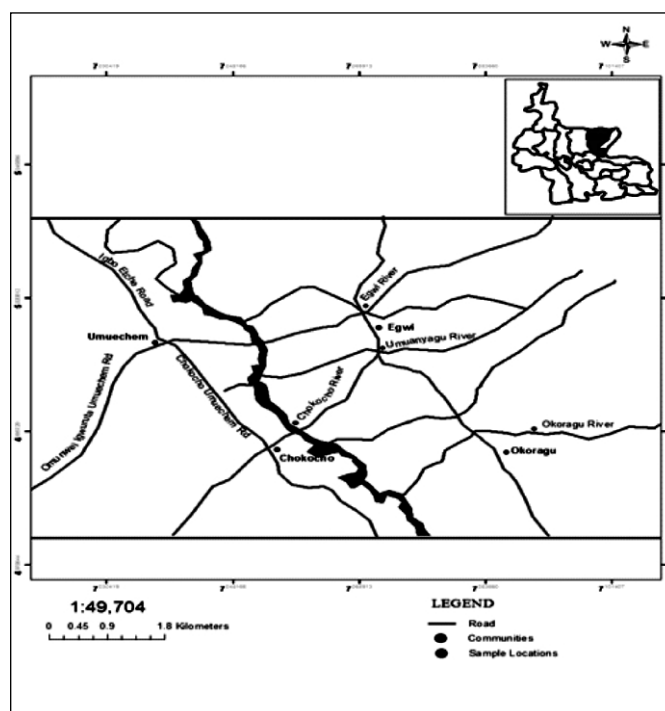
Figure 1: Location map of sampling sites across Otamiri-Ochie River

This water body practically receives domestic wastes and drainage water from residential areas throughout the year.

Sample Analyses

Water samples from four locations were collected from the surface (<30 cm) and analysed for eight physicochemical parameters using an established procedure. Samples were collected between August and September, 2017 and transferred into different amber bottles from the sampling locations. The laboratory analysis was carried out in Anal Concept Limited Laboratory according to standard procedures of APHA methods (1995). The APHA methods were adopted to determine the following parameters: pH, total dissolved solids (TDS), electrical conductivity (EC), total alkalinity (TA), total hardness (TH), total suspended solids, dissolved oxygen (DO) and biological oxygen demand (BOD) per sample. The occurrence of seasonal variation was not considered because of the cost implication.

Water Quality Index (WQI)

The water quality index (WQI) analysis provides a clear picture of the quality of the surface and ground water used for domestic purposes. It summaries multiple water quality parameters to single numerical value (Yogendra and Puttaiah, 2008). In this study, eight (8) most important parameters were determined for the calculation of water quality index (WQI). The WQI was calculated by using standards for drinking water recommended by World Health Organisation (WHO), India Council for Medical Research (ICMR) and Bureau of India Standards (BSI).

Multivariate Statistical Analysis

Multivariate statistical analysis is a tool employed to assess the water quality where a lot of variables are contributing to influence the water quality. The most common approach used to identify the dominating component and sources that account for the variations responsible for the environmental impact on water quality are the hierarchical cluster analysis, principal component analysis and correlation matrix analysis. Cluster analysis involves multivariate methods of grouping samples into clusters based on their similarity. Principal component analysis is a powerful technique for pattern recognition in which the variance of a large set of data is reduced into a smaller set of uncorrelated variables. The multivariate statistical analysis was performed using Minitab statistical package (16.2 Version).

Results and Discussion
Analysis of Water Parameters

Table 1 shows the results of physicochemical parameters of water obtained from four (4) locations along the Otamiri-Ochie River in Etche. A total of eight parameters were determined including the pH, electrical conductivity (EC), total dissolved solids (TDS), dissolved oxygen (DO), biological oxygen demand (BOD), total suspended solids (TSS), total alkalinity (TA) and total hardness (TH) in each of the water samples. Except pH measurement, all other parameters are measured in mg/L, while the EC is expressed in μS/cm.

Table 1: Physicochemical parameters of water obtained from different locations

Sampling location	pH	EC (μS/cm)	TDS (mg/l)	TA (mg/l)	TH (mV)	TSS (mg/l)	DO (mg/l)	BOD (mg/l)
CHR	6.36	428.5	20.3	8.36	68.4	160.2	20.3	28.3
UMR	6.85	760.4	18.8	14.6	35.6	118.1	18.8	11.4
OKR	6.38	574.3	16.3	12.4	24.4	256.3	15.6	64.3
EGR	6.77	114.2	34.8	18.7	35.3	412.2	35.7	38.2

Note: Chokocho River (CHR), Umuanyagu River (UMR), Okomoko River (OKR) and Egwi River (EGR).

pH ranges from 6.36 to 6.77 and is thus slightly acidic. TDS, TA and TH vary from 16.3 – 34.8, 8.36 – 18.7, 118.1 – 412.2 mg/L, respectively. DO and BOD in the samples indicated a wide range of values from15.6 – 35.7 and 11.4 – 64.3 mg/L, respectively. While, EC ranges between 114.2 and 760.4 μS/cm. Data obtained are similar to investigations performed on water parameters from river basins previously reported by many researchers (Zhao et al., 2012; Al-mutairi et al., 2014; Diamantini et al., 2017). Similarities amongst the data appeared as a results of the high DO obtained in all the water samples. The agricultural land use and population of the sampling locations may contribute to the variations in the data set. The highest pH, EC and TH is observed in one of sampling locations (UMR) likely caused by several human activities that occurred within this area. This area based on the available data may have poor water quality because of the population density and other anthropogenic activities in the environment. Due to agricultural land use and population, the water quality is of major concern to the residents within the area.

Water Quality Index (WQI)
The quality of Water bodies can be grouped based on the following classification presented in Table 2. The water samples obtained across the studied areas is considered to be unsuitable for drinking based on the WQI calculation**.**

Table 2: Water Quality Index (WQI) and Status of Water Quality (Chatterji and Raziuddin, 2002)

Water Quality Index level	Water quality status
0 – 25	Excellent water quality
26 -50	Good water quality
51 -75	Poor water quality
76 – 100	Very poor water quality
>100	Unsuitable for drinking

Following the analysis of water by using the eight physiochemical parameters, four sampling locations were combined together to obtain the WQI for the area. Although, the parameters showed wide variability with respect to the acceptable standard range, results from the studied area suggest the presence of pollutants. Yogendra and Puttaiah (2008) observed that changes in WQI values could be due to weather conditions being reported for rainy, winter and summer seasons. The water quality at the studied areas was not considered according to the seasonal variations over a period of time.

Although, the sampling locations are close to a dump site, the flow of the river along the area has influenced the WQI value. Application of WQI value to each location across the sampling sites may not be relevant because the river is flowing in a particular direction which could generally affect quality of the water from time to time. These results suggest that further investigations are necessary in order to determine the effect of seasonal changes on the water quality.

Principal Component Analysis (PCA)

The results of the PCA analysis based on the correlation matrix of various parameters are presented in Table 3.Three components of PCA showed 100% of variance in the data in which the eigenvector classified the 8 parameters into four groups. The first components include the most significant variables which explain 55.1% of the total variance dominated by TDS and DO having the highest contribution. Second and third components contribute 24.2 and 20.8% of total variance in the data set, respectively.

Table 3: Summary of PCA loading for water parameters

Variables	PCA 1	PCA 2	PCA 3
pH	0.251	-0.242	0.208
EC	-0.388	-0.295	-0.319
TDS	0.457	-0.028	0.217
TA	0.409	-0.225	-0.314
TH	-0.140	0.003	0.741
TSS	0.427	0.309	-0.090
DO	0.455	-0.043	0.227
BOD	0.042	-0.043	0.227
Eigenvalue	4.407	1.932	1.661
Proportion (%)	55.1	24.2	20.8
Cumulative (%)	55.1	79.2	100

These results are consistent with those reported previously for water quality around granite mining area in Bangladesh (Howladar et al. 2017). In the second component of the PCA, TSS and BOD indicated positive and moderate correlation. Positive and moderate correlation of TDS and TSS observed in PCA 1 is an indication that the water contained a wide variety of materials such as industrial wastes, decayed plant and

wastes as well as sewage (Null et al., 2017, Sincock et al., 2003). In this study, PCA helps to provide a better understanding of the major parameters that influence the quality of water across the investigated areas.

Cluster Analysis (CA)

A dendrogram of sampling locations obtained by Ward Method is shown in Figure 2**.** Four sampling locations were investigated and subjected to a cluster analysis so that the sites with similar results are divided into two groups. Cluster 1 consists of two sites (CHR and OKR) that are similar, located to the downstream of the river. Cluster 2 contains a site located at EGR, which represents the upstream of the river. The results are consistent with previously reported study that uses a cluster analysis to group sampling sites with respect to physical and chemical variables (Zhao et al. 2012). The two groups identified by the cluster analysis reveal that these sites vary according to natural background features.
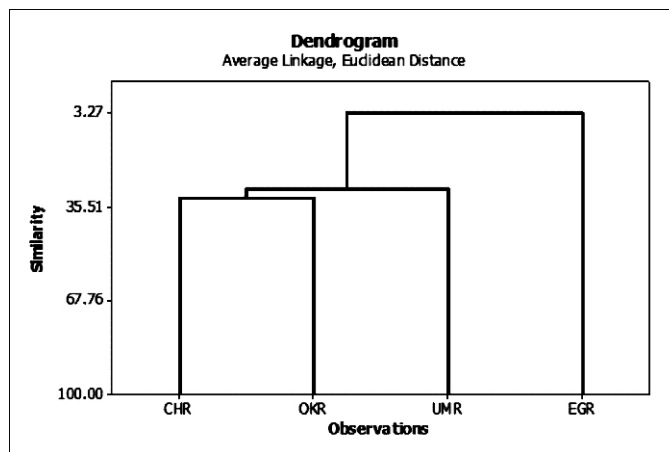
Figure 2: Dendrogram based on average linkage clustering of sampling site

The dump site being the major source of pollutants is located at CHR and is closer to OKR, these areas are likely most heavily polluted sampling sites. Water quality from UMR and EGR may have been influenced by non-point source of the pollutants from the River. This suggests that EGR site can be described as the least polluted area of all the sampling sites as at the time of the study (Figure 2).

Conclusion

The use of multivariate statistical techniques gives a clear insight into identification of pollutant sources along the Otamiri-Ochie River. From cluster analysis, two locations were identified to be severely polluted due to dumping of waste materials generated

from various human activities. The results from principal component analysis (PCA) showed that over 55.1% of the total variance tends to greatly influence the overall water quality. In addition to information on the status of the water quality, the study also illustrates how water quality index (WQI) was applied to determine the suitability of the water. The WQI value suggests that the water is unsuitable for drinking and would most likely be unfit for domestic purposes. This was further explained by the presence of potential contaminants dispersed across the water way.

This study provides a better understanding to quantitative measure of the water quality around the Otamiri-Ochie River, which suggests that there is need for remediation actions to mitigate the pollutant sources in order to keep the water safe and clean for present and future use. Furthermore, this work will be helpful to monitor and manage the water quality to prevent pollution in surrounding areas.

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Chapter 5

Social Media and the Prevention of Covid 19: Study of Sa'adatu Rimi College of Education Kano State

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Abstract

The study examine the significant role played by social media platforms in preventing the occurrence of COVID 19. According to the World Health Organization (WHO), COVID-19 is an infectious disease that causes respiratory infections ranging from the common cold to more severe respiratory difficulties. One cannot deny the role of social media in facilitating information for individuals and groups. The study used perception theory and survey research methods. The findings revealed that social media plays an important role, particularly in health promotion. The majority of respondents attested to the gigantic role of social media in preventing and managing COVID-19 in Kano State. Based on the findings, the study therefore recommends that social media platforms should always be used to inform people about health prevention. An educational forum should be formed via social media where people will receive useful messages about COVID 19.

Keywords: *Social media, Covid 19, Health promotion, Health prevention.*

Introduction

Social media are interactive Web 2.0 internet-based applications that facilitate online interactions and the development of online social networks by connecting a user's profile with those of other individuals or groups. One cannot deny the role of social media in facilitating information for individuals and groups. Social media is used as an important platform to inform people about the dangers of COVID 19. It enlightens people about any infections or diseases and how they can take precautions (Zhong, Huang, and Liu, 2021). The use of social media has had a positive impact, especially on health-related issues. Nigeria has responded to the use of social media with public health campaigns on the pandemic. It has been observed that social media has a

positive impact on people's health worldwide. (Boonstra and Langley, 2016)

In his study, Elmahdawy (2017) investigated the experiences of the victims of Ebola viruses as they pertained to health systems and the effect this virus had on the economies of African countries. It was discovered that there is sufficient information dissemination and the need to involve donor agencies in order to combat the virus's spread. According to him, it is unfortunately true that African countries are still managing when it comes to pandemic outbreaks. And most of their primary health care infrastructure was still lacking economic and medical support. Also, Oleribe (2015) discovered that most of the African countries were unprepared to handle the outbreak of the Ebola virus, just as with the outbreak of COVID 19, Nigeria inclusive, in which he stated that there was no preemptive measure. Closure of borders until the index Italian case, forces panic and a stringent lockdown of the major epicenters of Lagos and Abuja, which led to the shutdown of all sectors. However, the World Health Organization (WHO, 2020) is putting more effort into communication by properly addressing the public spreading rumors obtained through social media channels and also about the pandemic. On the other hand, communication plays a significant role in educating people about their health (Alexander, 2005). The media perform several functions in providing necessary and valuable information on health risks, disease outbreaks, and healthy living.

According to Lav, Pham, Hom, and Nguyen, media perform several functions in providing necessary and valuable information on health risks, disease outbreaks, and healthy living. According to Lav, Pham, Hom, and Nguyen Uong, 2020, social media serve as a vehicle where public health issues are discussed. Given the importance of social media, this study will investigate its role in the fight against COVID 19. Coronavirus (Covid 19) is an infectious disease that causes respiratory infections ranging from the common cold to more severe respiratory difficulties. and originated from the human sea food market at Huwan, China, where world-wide animals were sold in December 2019 (Zhong, Huang, and Liu, 2021). This was declared a global pandemic by the World Health Organization on March 11, 2020 (Wito, 2020).

Problem Statement
Social media, especially WhatsApp and email, has gone on the internet and is changing the way people benefit from different perspectives. The impact of information is directly related to the use of social media. Social media has a significant impact on health promotion and prevention, particularly during the COVID-19 lockdown. Many people around the world rely on social media for health-related issues, particularly during the COVID-19 lockdown.

Research Objectives
1. To examine the role of social media in preventing Covid 19 among the students of Sa'adtu Rimi College Kano State.
2. To examine the perception of students in Sa'adatu Rimi College Kano State about the campaign through social media.
3. To determine the extent to which the campaign create positive impact on the students of Sa'adatu Rimi College Kano State.

Research Question
1. To what extent does social media prevent the spread of Covid 19 among students of Sa'adatu Rimi College in Kano State about the campaign through social media.
2. What is the perception of students of Sa'adatu Rimi College Kano State about the campaign through social media.
3. How does the campaign create positive impact on the students of Sa'adatu Rimi College Kano State.

Literature Review
Social media are interactive computer-mediated technologies that facilitate the creation of shared information, ideas, career interests, and other forms of expression via virtual communication networks. Users typically access social media services via web-based technologies on desktops and laptops or download services that offer social media functionality to their mobile devices. They introduce substantial and pervasive changes to the way individuals and large organizations communicate. Social media outlets operate in a dialogical transmission system. This is in contrast to traditional media, which operates under a monologic transmission model. Some of the social media websites are Facebook, Instagram, WhatsApp, Google+, MySpace, Twitter, Viber, and so on. (Lee, 2013).

Social media refers to the environment in which social networking has changed the way people gather information. Social media can also be described as a group of applications powered by the internet and organized around the same ideas as the foundations of the Web. 2.0 technology. This will allow for the exchange of information and other materials generated by the users of such media. According to the World Health Organization (WHO, 2020), the overall worldwide pandemic (Covid 19) was identified in December 2019 and caused more than 148,000 deaths and infected millions of individuals worldwide (WHO, 2020). In countries such as Italy, Spain, and the United States, widespread dissemination of information or misinformation has already had a significant impact on understanding and interpreting the outbreak (Barel et al. 2020). Countries across the world have responded with various public health campaigns about the pandemic, especially via

social media.

Social media platforms have been managed for information outlet to the public. Its importance cannot be over emphasized because it gained more recognition owing to the fact that governments imposed and implemented a lockdown policy to control the spread of the virus. They made the social media to be a significant tool for communicating (Ani et. al., 2020). During the spread of covid 19, the United States of America (USA) economy has tremendously proved the abrupt changes between the natural disaster and the normal fluctuations. These abrupt changes along with studios conducted since 1918 influenza pandemic shows the modern-day pandemic which will not only affect the economy but will also have more deaths related to race, income and place of residence despite advances in medicine and health coverage (Garnett, 2007). In a research carried out by Araz Ramazan Hersh Rasoul Murad on the impact of social media on panic during the Covid 19 pandemic in Iraqi discovered that the panic caused by widespread information about Covid 19 in the Kurdistan Region of Iraqi is worse than the number of Covid 19 cases and will have a longer lasting effect. They finally recommend that to communicate with professionals on health in the region and the media experts is very important and it is important to engage with the ministry of health and the Ministry of Education to be prepared for future epidemic or health situation. Covid 19 has developed a global world public crisis, many people in the world faced similar problem especially hospital nurses and even health emergency (Abbas and Khoramu, 2020).

According to Abbott (2021), after the lockdown and restrictions on social media distancing in December 2020, the telephone services received 43,000 people's data and found that more than 9% of people had anxiety systems. 4% of individuals had depression, and more than 12% of individuals reported stress related to the COVID-19 pandemic. People all over the world can find social support content on social media platforms. Social media has played a gigantic role in providing health information and a platform of updated information for the people who seek health-related information about the pandemic (Agius, Grech, 2020). Many people in the world mostly rely on social media for health-related issues. According to WHO's 2020 report on the COVID-19 pandemic, young people are less at risk of COVID-19 and also a key group in the pandemic's content. They are key groups to help stop the transmission and spread of the virus. Because of the active online interaction with an average of five digital platforms (WGO, 2020), More than 3.5 billion people around the world use social media, and they receive a significant amount of information through these platforms. And with the emergence of information and media technology, health care workers are able to communicate with each other and with different stakeholder groups in the field of medicine. The role of social media in our lives cannot be overemphasized because we use it to cope with social distancing and it can give opportunities for better

communication.

According to Stephen (2021), health information seeking behaviors on social media during the COVID-19 pandemic among American social networking site users suggest that health professionals will need to be both strategic and proactive when engaging with health consumers on social media to successfully meet the positive outcome. Immediately respond to the situation, especially on social media, where the information is. The theory is relevant to the study because of the believability of COVID.

Theoretical Framework
The study is within the framework of perception theory. Perception theory was proposed by Barelson and Steiner in 1964. The theory explains the complex role of sense organs in people's behavioral responses to issues. According to the theory, humans are endowed with sense (perceptual) organs (eyes, ears, and nose). These organs help them recognize and process information in the environment, and such organs serve as inputs to the brain for information processing. They see perception as the complex process by which people select, organize, and interpret sensory stimulations into a meaningful and coherent picture of the world (Anaeto and Osifeso, 2008). Perception involves two types of influences, namely structural influence and functional influence. Structural is the direct influence on perception as derived from the physical exposure to certain stimuli. While functional influence arises from indirect factors like the belief system and other variables that influence exposure and introduce bias, (Anaeto, Onabaje, and Osifeso, 2008). The theory is relevant to this study because the behavior of COVID-19 has to do with individual perceptions. People perceive what they believe and prefer to perceive what they want based on structural and functional influences. These worlds help them with their perceptions.

Methodology
The study adopts descriptive research design. The instrument for the study is Questionnaire. The Questionnaire consists of section "A" and "B". Section "A" consists of the demographic information of the respondents while section "B" consists of the questions to be answered by the respondents. The population of the study consisted of the entire students of Sa'adatu Rimi College. Two Hundred students were sampled from the Department of Social Studies. Simple random sampling technique was used for choosing the respondents. The data was collected through the use of a well-structured questionnaire which was administered to the students of Sa'adatu Rimi Department of Social Studies. Survey research is a method use to get information about certain groups of people who are representative of some larger group of people of interest to them (Asika, 2009, Babbie, 2001).

Discussion of Findings

The study used hundred (200) questionnaires but only one hundred and eighty-five (185) questionnaires were returned. The various responses were grouped and tabulated towards ensuring an objective analysis and interpretation of the findings. The simple percentage was used to analyse the responses gathered from the questionnaires.

Table 1: Gender of the Respondents

Gender	Respondents	Percentage (%)
Male	112	50.54%
Female	73	39.46%
Total	185	100%

Field survey 2002

Table one shows the gender of respondents 60.54 representing male and 39.46 representing female

Table 2: Age of Respondents

Age range	Frequency	Percentage (%)
15 – 20	43	23.24%
21 – 25	102	55.14%
26 – 30	18	9.73%
31 – above	22	11.89%
Total		100%

Field survey 2002

Table 2 shows the age of respondents 15–20 were within the age of 43 representing 23.24% and 21 –25 represent 55.14% and 26–30 represent 9. 73% while 31 above represent 11.89%

Table 3: Do you use social media?

	Frequency	Percentage (%)
Yes	155	83.78%
No	30	16.22%

Field survey 2002

Table 3 shows that 155 respondents represent 83.78% are users of social media. While 30 respondents representing 16.22% are not social media users

Table 4: How often do you use social media during Covid 19?

	Frequency	Percentage (%)
Daily	126	68.11%
Weekly	49	26.49%
Montly	10	5.40%

Field survey 2002

The above table shows 126 respondents representing 68.11% uses social media Daily. While 49 respondents representing 26.49% and 10 respondents representing 5.40% uses social media monthly.

Table 5: Do you trust the messages via social media on Covid 19?

	Frequency	Percentage (%)
Yes	178	96.22%
No	07	3.78%
Total	185	100%

Field survey 2002

The above table shows that 178 respondents representing 96.22% trust the messages via social media on covid 19. Only 7 respondents representing 3.78% did not trust the messages. They saw on any of the social media platforms.

Table 6: Did the information on social media about covid 19 affected you positively or negatively?

	Frequency	Percentage (%)
Positively	181	97.84%
Negatively	04	2.16%
Total	185	100%

Field survey 2002

Table 7: Did you access fake information attached to the social on covid 19?

	Frequency	Percentage (%)
Yes	15	8. 11%
No	170	91.89%
Total	175	100%

Field survey 2002

Table 8: Which social media platform do you always access?

	Frequency	Percentage (%)
WhatsApp	102	58.14%
Facebook	43	23.24%
Instagram	31	16.76%
Others	09	4.86%
Total	185	100%

Field survey 2002

The above table shows that respondents representing are WhatsApp users representing are Facebook users representing are Instagram users while representing do use other social media like. Linkedin and Snapchat

Table 9: Which social media do you mostly rely on for covid 19 messages

	Frequency	Percentage (%)
WhatsApp	112	60.54%
Facebook	48	25.54%
Instagram	15	8.11%
Others	10	5.40%
Total		

Field survey 2002

Table 9 shows that 112 respondents representing 60.54% mostly rely on WhatsApp 48 respondents representing 25.95% rely on Facebook 15 respondents representing 8.11% only 10 respondents representing 5.40% do use on other platforms

Table 10: Do you come across covid 19 related messages on any of the social media platforms?

	Frequency	Percentage (%)
Yes	179	96.76%
No	06	3.24%
Total	185	

Field survey 2002

Table 10 shows that 179 respondents representing 96.76% received several messages via social media on covid 19 only 6 respondents representing 3.24% said No

Findings

Findings of the study shows that majority of respondents are male representing 60.54% and are within the age bracket of 21 – 25 representing 55.14% of the questions on whether they use social media. Table 3 shows that 155 respondents, representing 83.78%, are users of social media, while 30 respondents, representing 16.22%, are not social media users. Table 4 shows the frequency of using social media among the respondents, with 126 respondents, or 68.11%, using social media. Daily, 49 respondents, representing 26.49%, use social media weekly, while only 10 respondents, representing 5.40%, use social media monthly. Table 5 shows the respondents' views on whether they trust the messages via social media on COVID 19. Of the 178 respondents, representing 96.22%, who do not trust the messages via social media on COVID 19, only 7 respondents, representing 3.78%, do not trust the messages they see on any of the social media platforms.

Findings also revealed that the majority of respondents, representing 97.84%, are affected positively by the messages they received on COVID-19 via social media, and 91.89% of respondents did not come across any fake information attached to the social media on COVID-19 and received several messages on COVID-19 via social media. These examples demonstrate social media's enormous role in disseminating information to diverse groups of people, particularly on health issues, where it aids in improving people's health worldwide. According to the World Health Organization (WHO, 2020), Young people are less likely to contract COVID-19 and are also a critical group in the context of the pandemic. They are the key groups to help stop the transmission and spread of the virus. because of the active online interaction with an average of five digital platforms. The role of social media in our lives cannot be overemphasized because we use it to cope with social distancing and because it can provide opportunities for better communication. The study's findings are related to

the theory used, the perception theory. Osuagwu (2020) explains the complex role of sense organs in people's behavioral responses. Humans are endowed with sense organs (perceptual organs: eyes, ears, and nose) to help them recognize and process valuable information in the environment. These organs help them understand the danger of COVID 19.

Conclusion
Social media plays a significant role, especially in health promotion. One cannot deny the role of social media. in facilitating information for individuals and groups. Findings of the study show how social media helps in managing and preventing the occurrence of COVID 19, which is an infectious disease that causes respiratory infections ranging from the common cold to more severe respiratory difficulties. The majority of respondents attested to the influence of social media in facilitating information on how to take precautions.

Recommendations
Based on the findings, the following recommendations are offered:
1. Social media platforms should always be used to enlighten people about their promotion and health prevention.
2. Educational forums should be formed via social media where people will receive useful messages about COVID 19.

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Chapter 6

Appraisal of Some Motivational Strategies that Enhance Learning and Students Achievement in Biology in Plateau State, Nigeria

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Abstract

This study appraised some motivational strategies that are being used by Biology teachers to enhance the learning of Biology and student's achievement in the subject. The study was a survey and some motivational strategies were listed. A questionnaire was developed and the respondents were required to assess the efficacy of the motivational strategies vis-à-vis the learning of Biology and its effect on student's achievement. Stratified random sampling technique was used to select the respondents for the study which comprised 192 students and 10 Biology teachers selected from 3 public secondary schools in Jos South Local Government Area of Plateau State, Nigeria. The questionnaires were administered and results from the study revealed that motivation strategies enhance learning and positively impact students' achievement in Biology. It was therefore recommended that motivational strategies should be inculcated into the instructional strategies used in pedagogy in Biology.

Keywords: Motivational strategies, Learning, Achievement

Introduction

Motivation can be seen as a force within an education setting which encourages students learning and understanding in class (Filgona, Sakiyo, Gwany and Okoronka, 2020). Motivation, learning and achievement are very important factors to consider in instruction as variables that are interwoven to promote meaningful learning in students as asserted by Ozen (2017). Adjei and Amofa (2014) wrote that most problems that teachers face in the classroom is the seemingly lack of interest from the students especially in the sciences and Agbo (2013) wrote that most teachers shy away from innovative, activity oriented, learner centered teaching methods to teach

biology. Adjei and Amofa further wrote that educators are expected to arouse or stimulate interest of students in the subjects being taught and this could be a herculean task. Bakar (2014) added that the productive competencies of high school students is hinged on the student's attitude and interest in the subject, therefore every effort should be put into the education enterprise to devote more resources and energy to motivate students to learn if at all the goals of education are to be met.

Chan and Norlizah (2017), in a study to identify student's motivation towards science learning and students' achievement wrote that students were moderately motivated towards science learning and emphasized that motivating students to learn is a key component that should be inculcated in instruction. In contemporary times, it is not surprising to see a decline in student's achievement in Biology as occasioned by the student's attitude to learning. Also, for a nation like Nigeria which wants to progress towards a developed nation status among the committee of developed nations, it is imperative to ginger instruction with revolutionary strategies that could enhance the instruction for meaningful learning. Thus, motivational strategies have become imperative to be fused into instructional strategies to meet that goal.

Instructional strategies for teaching and learning vary among teachers and so motivational strategies will also vary depending on which type a teacher finds suitable and convenient. Motivation can be intrinsic or extrinsic and motivation strategies could be a combination of the two. Some motivational packages were identified as being already in use during instruction by some teachers and this study was carried out to amplify, emphasize and appraise them. The motivational strategies identified were woven into the questions in the questionnaires to appraise their efficacy in enhancing learning and student's achievement in Biology.

Motivation has been defined in several ways, but has been related to the amount of intellectual energy used in learning activities (Filgona et al, 2020). Taasoobshirazi and Sinatra (2011) wrote that motivation is a complex multidimensional construct that interacts with cognition to influence learning while opining that motivation is an inner state or force that energizes, directs and sustains behaviour towards achievement of a goal. Motivation is what causes a person to want to know, act and understand particular skills; it is also a drive to satisfy individual needs for example, learning to read so as not to be cheated. These definitions and the plethora of definitions of motivation by many scholars make it difficult to describe motivation in one context. Therefore, in the context of this study, motivation strategies refer to a set of strategies that students are exposed to which will guide, push or compel them to accomplish a given task in the biology classroom.

Achievement could be described as how well a student meets the standards set out by the institution of learning (Maikano, 2014). When achievement in Biology declines as a very important subject in Science Technology Education (STE), it becomes worrisome for government, teachers, parents and the society in general. Based on the above concern, it is imperative to assess the current trend and prospects in other to enhance the interest in learners in Biology.

Problem Statement
Student's achievement in Biology has been linked with motivation to learn but emphasis has not been put on motivation by some teachers and as a consequence student's achievement in the subject has witnessed a steady decline. Some Biology teachers have attempted to motivate students to learn and some of the strategies used in motivating students were listed in this study and appraised for efficacy.

Research Objectives
The purpose of the study is to appraise some motivation strategies for efficacy in enhancing learning and student's achievement in Biology. The objective of this study was to appraise some motivational strategies and the effects on learning and achievement of students in Biology.

Methodology
The research design was a survey aimed at appraising the influence of motivation strategies in enhancing learning and student's achievement in Biology. The target population for the study was senior secondary two Biology students and Biology teachers in the education zone of northern Plateau State, Nigeria. The stratified random sampling technique was used to select the population sample of 192 students and 10 Biology teachers who were administered the questionnaires comprising 10 questions on motivation strategies that enhance learning and student's achievement in Biology. Two questionnaires were used for the study, A questionnaire for teachers titled "Motivation Strategies towards Enhancing Students Achievement in Biology" (MSTESAB) and a questionnaire for students titled "Motivation Strategies that Enhance Students Achievement in Biology" (MSESAB). Descriptive statistics was used to analyze the results obtained from the questionnaires.

Motivation strategies in this study are a set of strategies that students are exposed to which will guide, push or compel them to accomplish a given task in the biology classroom. Some of the motivation strategies discussed in the study which formed the questionnaire includes the under listed;

Motivational Strategies

1. Giving students a sense of control. Let students believe they are stakeholders in the pedagogy
2. Defining the objectives of the topic: Let the students know what is expected of them and the goals you want to achieve
3. Creating a free environment in class: Allow students to move freely from time to time instead of making them sit all day on a desk
4. Offering varied experiences to students: Allow students to explore other ways of finding solutions to problems instead of sticking to text book solutions
5. Use of positive competition: Engage students in small competitions in the classroom either in groups or individually
6. Offering rewards: Give students reward for performance
7. Giving students responsibility: This will help students to meet expectations because of involvement
8. Allowing students to work together: This excites students and encourages problem solving
9. Encouraging self-reflection: Help students to examine themselves, their strengths and weaknesses and critique themselves by themselves
10. Knowing your students personally: Letting students know that you are interested in them and their success will motivate them to do more
11. Harnessing students' interests: Relate classroom material to the things that the students are interested in or have experience about
12. Helping students to find intrinsic motivation-Encourage students to motivate themselves by finding personal reasons for working hard in school
13. Making goals high but attainable: Challenge students to aim for higher goals by making them see these goals within their reach
14. Giving feedback and offering students chances to improve: Let students know where they are wrong in a task and how they can improve next time. Allow the students to choose different methods or approaches to find solutions to problems
15. Making things fun in class: Class should be enjoyable by adding fun activities to help students relax and participate in class
16. Providing students the opportunities for success: Create an environment of inclusiveness to carry all students along especially those who are struggling. When the students feel valued, they will be motivated to learn.

The motivation strategies were woven into intrinsic and extrinsic motivation and developed into two questionnaires with 10 questions each which were administered, retrieved and analyzed and the results of the analysis are presented and discussed.

Results and Discussion

Table 1: Percentage responses from the respondents
Motivation strategies enhance students learning and achievement

Respondents	Teachers	Students
Percentage	69.1% (n=6)	61.8% (n=114)

Motivation strategies Do Not enhance students learning and achievement

Respondents	Teachers	students
Percentage	23.2 % (n=3)	37.0 % (n=78)

Motivation strategies have no link with students learning and achievement

The findings from the study reveal that most of the teachers agree that the motivation strategies enhance students learning and achievement in Biology. For the teachers, 69.1% (n=6) agreed that motivation strategies enhance students learning and achievement in Biology. 23.2% (n=3) of the teachers are of the opinion that motivation strategies do not enhance students learning and achievement in Biology while 7.7% (n=1) are of the opinion that motivation strategies have no links with students learning and achievement in Biology. Results collated from the students' responses reveal that 61.8% (n=114) of the students agree that motivation package enhances learning and achievement in Biology. 37.0 % (n=78) of the respondents opined that motivation strategies do not enhance learning and achievement in Biology while no respondent answered that motivation strategies do not have any links with learning and achievement of Biology students.

The findings of the present study that motivation strategies enhance students learning and achievement in Biology are consistent with findings of studies conducted by Bakar (2014), Kingful and Nusenu (2015) and Sevince, Ozmen and Yigit (2011), which opine that, motivation influences students achievement in science and that a significant relationship exists between levels of motivation and science achievement. The findings of this study also corroborate the ideas of Simmons (2014), Kamaei and Weisani (2013) and Afolakemi and Adebisi (2014) who in their various studies established significant relationships between motivation and student's achievement while going further to assert that motivation enhances learning.

Implications of the Study

The findings of this study shall help to provide an understanding of the place of motivation strategies in learning and achievement of students. Through the study, motivation strategies that enhance learning and achievement in Biology were identified and appraised and their efficacy established to be effective. The findings of the study shall accord teachers the understanding of the motivation strategies which could be used in pedagogy to enhance learning and achievement in Biology, the findings will also help students to understand better about motivation strategies and how motivation levels towards learning relates to their achievement in Biology.

The findings showed that there was a significant relation between motivation strategies and learning and students achievement in Biology. On the whole, the findings have implications on Biology teachers and students; where Biology teachers will identify the motivation strategies suitable for the instructional strategies to enhance learning and achievement in Biology and for students to realize that there is a link between their motivation towards learning and their achievement in Biology. Therefore, teaching strategies should be laced with motivation strategies to enhance learning and achievement of students so as to meet the desired goals of education.

Future Study

This study did not find out if any difference exists between male and female students when motivation strategies are applied to enhance learning and achievement in Biology. A relatively small sample was used for this study, a larger sample could be used to assess if there would be a difference in the responses in terms of percentages. The study also was limited to Biology as a subject therefore further studies could be conducted using other science subjects. Other factors like parental influence, school location and interactions of different environmental and social factors were not considered when conducting the study thereby giving room for further research in the area.

Conclusion

It is essential that stakeholders in the teaching and learning enterprise get abreast with strategies that can improve teaching and learning in the classroom so as to meet the goals of education. This study was able to identify some motivation strategies which enhance learning and achievement in Biology using a sample population, therefore teachers are expected to identify what motivation strategies they can utilize in pedagogy to enhance learning and achievement of students so that the goals of education which are expected to meet the needs of the society can be met.

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