

## Challenges of Educational Development in Nigeria: Issues of Chemical Sciences

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**Abstract.** A wealth of research has revealed that scientific skill is crucial for national development and material well-being of any country. While lack of scientific knowledge is often a critical limitation to economic progress, hence, the importance of science in Nigeria Educational system cannot be over emphasized. So there is a need to improve on science subjects/courses in our schools and institutions if the country is to meet the rising expectation of people. This paper, discusses among other things the place of science in Nigeria Educational system as stated in the National Policy of Education. It brings into fore the importance of science programmes in the National development. However, the paper focuses more importantly on chemical sciences, because of the role it plays among the basic sciences, afterall, after God, the power of creation is given to chemists. The paper discusses further the challenges that are facing the effective teaching and learning chemistry in Nigerian schools. At the tail end of the paper it proffers likely solutions. Finally, the paper is ended with suggestions, recommendations and conclusion. It is important that government at all levels should fund education and increase annual budgetary allocation to minimum recommendation of United Nations Educational, scientific and cultural education (UNESCO) which is 26%.

**Keywords:** Science and Technology, Chemistry, Educational Development, Nigerian Schools.

### 1. Introduction

The 21<sup>st</sup> century is witnessing tremendous changes that require an importance of technological advances that benefit human kind. For example progress in science and technology has helped nations to promote efficiency, self reliance and overall well-being of human kind, through the inventions and innovations in telecommunication, transportation, health,

agriculture etc. (Erinosho, 2000:165). Every nation that intends to be scientific and technological advanced must strengthen the scientific and technological skills of its citizenry.

Science and technology makes immense contributions to the material well being of any country, if certain requisites are met. But in most developing countries, lack of scientific and technological knowledge is often a critical limitation to economic progress. This fact is borne out by the experiences of developing countries which are ready to acquire, adopt and apply techniques derived from scientific knowledge. There is a clear need to improve on science subjects in our schools, if the country is to meet the rising expectations of the people. With the goal to increase the materials well being of the expanding population, there is a need to improve in scientific knowledge. Therefore, all students at all levels of Education must have unrestricted access to the knowledge of science to gain insight into the foundation of many of the achievements of humanity (Lederman, 1992: in Erinosho, 2005). However, despite the relevance of science to national<sup>1</sup> development, science subjects are not interested to many students in our country. One may be compelled to know the factors that may account for this or serve as barriers against their interests in science. Certainly, any country that wishes to attain a scientific and technological advancement, all students of such nation must have scientific skills.

Consequently, quest for science and technology has now gained currency in our country. Hence, Nigeria as a nation is becoming increasingly concerned about science. She realises the role of science as a basis to National development and commits to Science and Technology, as this features prominently in the national Policy on Education.

### 1.2 Science Defined:

The word science is taken from the Latin word *Scio* or *Scientia* meaning knowledge or to know. The Encyclopedia Britannica defines science as any intellectual activity concerned with the physical world and entailing unbiased observations and systematic experimentation (2003:553, vol. 10). George Sarton defines science as a positive knowledge (Encyclopedia Americana, 1988). Science is also defined as body of knowledge and opinions which is systematically supported by formal proofs or by observational evidence (Encyclopedia of Science, 1977). Science is a systematic search for truth that offers a systematic basis for the derivation of technologies but cannot by itself lead to increase in production. In other words, there is a symbiotic relationship between them. Science, without the by-play of technology, becomes sterile, while technology does not exist without science.

### 1.3 Operational Definition of Chemistry

A working definition of Chemistry is important to serve as a guide for the approach that will be used to teach and learn the subject effectively. Modern definition of chemistry has transcended a picture of mere accumulation of facts, deductive reasoning based upon unceasing experimental work. Broadly speaking, chemistry is the scientific structure of substances, how they react when combined or in contact with one and other, and how they behave under different conditions (Advanced Learners' Dictionary, 2000:186). The Oxford Dictionary of Science defines chemistry as the study of the elements and the compounds with effects that depends on the outer electrons in atoms (2005:157). Becher (1669, in Bamgboye, 2006:3) describes chemists as a strange class of mortals, impelled by almost insane impulse to seek their pleasure among smoke and vapour, soot and flame, poison and poverty, yet among all these evils, I seem to live sweetly, that I may die if I may change places with the Persian King. (Bamgboye, 2006)

## 2. Issues of Science in National Policy on Education

Science and Technology Education has been enshrined in the National policy on Education of the Federal Republic of Nigeria since some decades now. Therefore, the school curricula at all levels embodied science subjects in its contents, with prominent status and lofty objectives. In real sense, science subjects are made compulsory for students at primary and secondary levels. The National Policy on Education,

(NPE) States that students at primary level are to offer science subjects as general science, as integrated science at junior secondary school and as specialized subjects at the senior secondary school. It is necessary to point out that students are to take at least one of the science subjects in writing West Africa Examination Council (W.A.E.C) and General Certificate of Education (G.C.E). Science subjects are also made compulsory for students at post secondary schools, student at university or polytechnic are also obliged to take science subjects under G.N.S. in their respective institutions in Nigeria. For examples at Olabisi Onabanjo University, students are exposed to science topics under G.N.S with course code G.N.S 104 and course title: History & Philosophy of Science (CESAP HAND BOOK, 2000:56). At the same time, students at University of Nigeria, (Nsuka) are to take science subjects as compulsory course under General Studies, (G.S. 105). Among the defined objective and scope runs thus: "The objective of the Natural Science is to stimulate students' interest in science, establish the inter-relationship between scientific disciplines and create an awareness of the services of science to man and the effects of science on human society. The course is offered to students who are majoring in the humanities and social sciences" (University of Nigeria Calendar, 2001 – 2004:193).

Apart from taking science subjects under G.N.S programmes in University, at least a science subject is compulsory for students in other disciplines. For example, Chemistry links with other subjects in scientific studies, students in physical science or those who are interested in Mathematics and Physics have to study Chemistry whether they like it or not. Likewise, Biological Science students, those who are interested in botany and Zoology have to take it, because of its importance to the study of biological science. Sequel to the above, the objectives set down for science subjects make necessary the need to provide an effective teaching-learning environment at all levels.

## 3. Relevance of Chemistry in Social Services

Poor Education is seen as among the factors that hinder the nation's scientific and technological advancement. Therefore, effective teaching and learning of science subjects needs certain prerequisites to present the subjects with different aptitudes and interests. At this juncture, it is necessary to delineate and limit our discussion only on one of the science subjects. However, because of the immediate and remote relevant of chemical sciences, it is pertinent to premise our discussion on chemistry. Rhetorically, the question that may

quickly come to our minds to ask is why is chemistry? As the old cliché goes “after God, the power of creation is given to the chemists” (Bamgboye, 2006:3).

Chemistry has a good role to play in scientific achievement in alleviating human sufferings, improving living conditions and in the control of population. Besides these, Chemistry, plays a central role within the basic sciences and is also the only scientific discipline that has developed into specific industry. Chemistry has its human dimension, it is about people and for people, and can be a bridge between men (SultanBawa, 1982:22). As Chemistry plays an important role in the production of materials for the industries. The quality of such materials needs chemical quality control. For example, production of cement, steel, etc. are all chemical in operation. Water is very important in the life of human beings. Purity of such water depends on chemical treatment at least chlorinated. Such as soaps, detergents, toothpaste, etc. are essential requirements for modern urban civilization.

Chemical sciences are given special priority in all academic programmes of educational institutions. More so, it's teaching and learning gives prominence to the activity aspect because chemistry is an experimental science and when it is studied at all levels from school to University, emphasis has to be placed on its experimental basis, if the subject is to be appreciated and understood. However, teaching it as an experimental subject requires the use of chemicals, glassware, etc., which have to be annually replaced and hence effectively teaching becomes expensive. Consequently, there is a considerable deterioration of the quality of teaching and students begin to fail to understand its value and importance in the whole area of science. The different curricula in the teaching of chemistry lay emphasis on experimental activities; as such views and opinions of chemistry teachers at all level are irrefutable (SultanBawa, 1982:2). A good knowledge of chemistry is the basic requirement for the medical sciences. While an understanding of all aspects of the soil needs a good knowledge of chemistry, thus an improvement of the soil by addition of fertilizer is chemical operation, whose function on growth is connected with the biochemistry of the plant. As chemistry plays an important role in the production of materials for industries. The composition of most material things in the universe is chemical in nature. A chemist is always at the core of the activities of finding cures for diseases, better waste, disposal, alternate and improved power source, space ship, fuels, environmental pollution, the analysis of the earth and extra-terrestrial minerals, sustainable food supply, shelter and clothing (Bamgboye, 2006:4)

chemists describe the composition of matter in terms of a limited range of atoms, which combine in precise numbers, and according to precise rules, to furnish a virtually limitless variety of the larger structural units which are called molecules .

#### 4. Major Challenges in Nigerian Educational System

A lot of challenges are faced in Nigerian Educational system which makes it difficult to achieve its stated objectives in the Federal Republic of Nigeria, National Policy on Education, especially in Science Education (NPE, 2004:23).

These include:

- **Curriculum Content:** A gap skill exists in the implementation of course content. Most of the content of Chemistry course at all levels are designed to develop students are not delivered. Evidence shows and anecdotes reveal that majority of students rely on notes of teachers and lecturers, moreso they are not deeply taken through the practical aspects of the course and students are more responsive to instructional methods that foster collaboration and cooperation that are content related.
- **Intermittent Strike Actions:** There are many strike actions embarked upon by teachers and lecturers in Nigerian schools at all levels. Therefore, most of these strike actions affects teaching quality which consequently affects students' performance or graduate output because there is no enough time for quality teaching and learning to take place.
- **Quality of Students Admitted:** Anecdotes report that majority of students admitted into university to read chemistry did not have adequate background in the course. Odiaka, (2011/2012:29) reports his experience in chemistry class, he was disturbed when a young lady from Lagos with A1 in Chemistry and four other science subjects and a score of 285 in JAMB could not tell what a burette is used for in the laboratory. She eventually confessed that her rich father paid someone to sit for the WASC and JAMB examinations for her.
- **Paucity of Funds:** Chemistry is an experimental science. The financial needs for consumable materials of a chemistry Department are much greater than in other Departments, but there are seldom enough funds available. Chemistry is an experimental science and when it is studied

at all levels from school to university, emphasis has to be placed on its experimental basis, if the subject is to be appreciated and understood. Therefore, teaching it as an experimental course requires the use of chemicals, glassware etc. which are to be annually replaced, hence effective teaching of chemistry, becomes expensive. Unfortunately, Nigerian governments have not been able to provide the financial resources necessary to maintain Teaching and learning quality of chemistry. By the end of the 1990s, university expenditure per student in Nigeria had fallen to \$360. In response, the government announced its decision in July 2000 to increase funding to \$970 per student and to encourage universities to generate an additional 100% of their recurrent budget from income producing activities (Adegbesan, 2012:275). Therefore, paucity of fund leads to a considerable deterioration of the quality of teaching and learning, and students begin to fail to understand its value and importance of chemistry.

- **Scarcity of Chemistry Teachers:** In many Nigerian schools and post secondary schools, most of chemistry departments are understaffed. Therefore, scarcity of chemistry teachers poses challenges to effective teaching and learning of chemistry subjects. Chemistry as a science subject divided into many units, these include: organic, inorganic, industrial, physical and Analytical chemistry, etc. It is necessary to note that each unit needs specialists to handle these aspects of chemistry. In his work, Odiaka (2011/2012:291) states that there are at least 30,000 academic vacancies in Nigerian Universities excluding the 9 new federal universities established by Jonathan's administration. There are not enough qualified lecturers to fill these vacancies. Therefore, chemistry courses are handled by unqualified teachers or left untaught at all. Those who are on ground could not handle the available courses, despite the fact that they already take more than necessary. The outcome performance of students; later deters them from choosing chemistry as a science subject. This leads to a serious deterioration and mass failure of students to have skill in chemistry course.
- **Lackadaisical Attitude of Students towards Chemistry:** Nigeria as a nation is becoming increasingly concerned about

science. Every nation that intends to be scientific and technological advanced must strengthen the scientific and technological skills of its citizenry. This is obvious in the Federal Republic of Nigeria, National Policy on Education, Government shall popularize the study of the sciences and production of adequate number of scientists to inspire and support national development (NPE, 2004:23). However, despite the relevance of science to nation's development, science subjects are not interested to many students in our country; students feel a dislike for the subject which is of considerable importance. Hence, many candidates prefer Arts subjects to science subjects, this reduces number of admission into chemical programmes in particular and other science programmes in general

- **Lack of Suitable Textbooks and Learning Materials for Students:** There is no doubt that access to textbooks and learning materials contribute greatly to students' performance. Availability of textbooks and learning materials is consistently a positive prediction of school achievement. Evidences over time show that many students have no access to chemistry's learning materials, hence students always depend solely on teachers. In a situation where the class is very large, teachers cannot do all. Most especially at university level where chemistry class is always over-crowded. The situation contributes to the poor performance in examinations.
- **Field Trips:** Field trips outside the school environment are very important in teaching-learning process of science subjects like chemistry. The trips will provide more realistic experiences, chemical sciences are real and phenomena must be observed outside the laboratory field trips will expose students to real principles out-of-the-classroom, exposing them to the grassroots. This will definitely have a salutary impact on their orientation for traditional science (Erinosho, 2005:31). It is very said that many students at all levels have never embarked, even on a single trip to enhance them realistic experiences before graduation, they are deficient in the real skills that are required from chemistry graduates.

## 5. Solutions to some Challenges against Educational Development in Nigeria

A wealth of research has revealed that improving access to chemical sciences is crucial for national development. For example chemistry links the two other science subjects (Physics and Biology) in the area of scientific studies. Physical and biological sciences. Students in physical science have to study chemistry whether they like it or not. Likewise, Biological Science students; those who are interested in Botany and Zoology have to take it, because of its importance to the study of Biological science. Therefore, teaching chemistry presents special difficulties at all levels which have constituted a lot of challenges to our Educational system in Nigeria. However, the followings are solutions to some of these challenges:

- **Good Teachers to Present the Subject to Students:** Teachers play an important role in making chemistry attractive to students, at the elementary, secondary and university levels. Teachers/lecturers need to present chemistry to students with different aptitudes and interests. Therefore, teachers must adopt teaching strategies that provide cooperative, hands-on and context-related learning. They must also put in place intense classroom interactions among the students and be responsive to students sensitive teaching and balanced overall assessment strategies.
- **Teachers should initiate collaborative/cooperative learning technique** that will help students to work and teach one another. This will facilitate discussion and encourage students to imbibe the spirit of doing chemistry. Thus, collaborative learning is effective for promoting group work, it also facilitates effective discussion and encourages students to imbibe other essential elements that are beneficial to teaching and learning (Lacomber, 1992 and Arends, (1991 in Erinosh, 2005:175), and finally, teachers of chemistry should write relevant and content related textbooks on chemistry.
- **Awakeness of Student's Interest:** Right from home, parents must be flexible and constructive in the upbringing of their children. They must support the interest of their children/wards in chemistry during their formative years. Although chemistry as a science subject is very costly, parents should make available to their children the

financial need to study chemistry. They should monitor the progress of their children in their Education at all levels and encourage them to read their works on the subject at all times.

- In other to retain the interests of students in chemistry, **there must be collaborative/cooperative efforts between the parents and teachers.** While students on the other hand, should see the beauty of chemistry among the science subjects and be proud to be a chemist, because after God, the power of creation is given to the chemists (Bamgboye, 2006:3). Therefore, students should be allowed to be more involved in thinking activities that stimulate their interest in chemistry.
- **Field Trips/Link with the Community:** Field Trips outside the school environment is very important in teaching – learning process of science subjects like chemistry. The trips will provide a link between the school environment and community and the link will provide more realistic experiences. Chemical sciences are real and phenomena must be observed outside the school laboratory. Field trips expose students to real applications of chemical concepts and principles outside the classroom, exposing them to the grassroots. This will definitely have a salutary impact on their orientation for traditional science. According to Erinosh, (2005:31) field work at gari or fufu production sites will give students direct practical experience of the different stages of fermentation and concept of pH and acidity changes. While a visit to the blacksmithery exposes chemistry students to flames, combustion and calorific values.
- **Government Policies:** Government at all levels must review their policies on science and technology, and put in place appropriate policies on Science and Technology, with appropriate policy implementation and monitoring frameworks. Chemistry like any other science subjects needs enough money to buy chemicals, glassware, test tubes, ion exchange apparatus, desiccators and glass vessels, and most of these are to be annually replaced for effective teaching and learning. Neither students nor teachers could have them all and embark on normal replacement. Government, therefore, has to increase on Science Education for quality assurance; and provide resources through loans and bursary for chemistry students. More so, there is a

need to establish science initiatives and Research unit in science and Technology ministries, at the State and Federal levels, that will coordinate among others, research and initiatives for implementation in schools. More also, Government, should give chemistry teachers motivation to make them to be responsive to changes in their classroom practices, consequently, chemistry teachers in particular and science teachers in general must receive special allowance that will enhance salary placement of chemistry teachers/lecturers. At the same time resources to develop their careers must be opened to them. On final note, all the understaffed chemistry Departments in Nigerian schools and institutions must be well staffed.

- **Review of Science Curricula:** Science education units in the ministries of Education need to be overhauled. Governments at all levels must put in place effective implementation and monitoring frame work. Current Science Curricular is overloaded with works which cannot be taught or learned by students within a limited time. Hence students rush to the examinations without deep understanding of the subjects, but only memorise some ideas that will assist them to pass the prescribed examination. Tertiary institutions should establish and support centre for Science subjects to monitor students in university curricula and to initiate mentoring programmes for chemistry students.
- **The laboratory and Laboratory Safety:** Chemistry as a science subject is an experimental subject that requires the use of laboratory for the effective teaching and learning. The use of laboratory promotes enabling environment for teaching and learning chemistry at all levels, laboratory, therefore should be equipped with the laboratory technicians, laboratory attendants, staff office, adequate consideration for large space that provides ventilation and illumination (light), good water, cupboards, machines for distilling water, shelves for storing tools demonstration benches, tables and chairs, fire extinguishers etc. chemistry laboratory also requires further an oven, cupboards for storing dangerous, poisonous and inflammable chemicals, fume, ion exchange apparatus, desiccators, flasks, test tubes and other glass vessels and individual students'

cabinets for keeping and storing materials (Alebiosu, 2000:186).

- **Improvisation for Teaching Chemistry:** Improvisation of materials is inevitable in teaching and learning chemistry in Nigerian schools. Teacher of chemistry is therefore responsible for materials that are not available. Improvisation is an attempt to make a replica of the real things in the process of providing for unavailable material. Locally, made materials may be used if commercial materials are not available because of financial implication to perform all functions of the original materials. The senior secondary schools curriculum for chemistry emphasizes the importance of students' activity in the teaching-learning process and stresses that basic elements of chemistry should not be compromised. Improvisation for chemistry teaching can be done in the following premises as listed in Bajah, (1998, in Alebiosu, 2000:188).

- (i) The use of dyes such as ink, for standard separation techniques.
- (ii) Preparation of charts to explain the arrangement of electrons
- (iii) Preparation of CO<sub>2</sub> from locally available materials, for example shells, potash etc.
- (iv) Titration using water from different sources of solvents e.g. tap, rain and well water in acid base reactions.
- (v) Demonstrating fermentation process from local industries to teach alkanols.
- (vi) The use of local alcohol and samples of local industrial products like sorghum, rubber, lime, paint, cement for demonstration in applied chemistry.
- (vii) Using tin from cans as electrodes to perform electrolytic experiments in electrolysis.
- (viii) Library: The importance and use of library as teaching and learning resources has long been realised in Nigeria and other countries. Therefore, effective teaching and learning chemistry requires a functional library that is filled with adequate instructional materials. For example, digital libraries, e-books and electronic publications are also important in teaching-learning chemistry. The library must also have technological learning materials, such as print, audiovisual and electronic resources for effective teaching.

(ix) Learning and Teaching Environment

There is no doubt that chemistry learning requires a comfortable classroom/laboratory environment that encourages students' activity that provides hands on and minds on experiences that challenge students initiatives and also creates room for normal interaction among students. Chemistry teachers in some cases face the problem of large chemistry classroom environment. a situation where classes are large, over crowdedness and deficiencies of basic resources are noted. A large class is any classroom that has more than recommended ratio 1:30 for primary schools and 1:35 for secondary school. classroom should provide floor space of at least 1m<sup>2</sup>/child (Onwu, 1998). However, at university level, where chemistry is taken by students of Biochemistry, medical sciences, Biology and Physics, lecture rooms are always over crowded because of the relevance of chemistry to these various disciplines. Under that situation effective teaching and learning will be difficult to achieve.

**6. Recommendations**

Sequel to the foregoing discussion, it remains for some recommendations to be offered as strategies to solve the identified problems and solutions to overcome the challenges identified. The following measures are suggested:

- *Quality of Students Admitted:* The University managements should continue to conduct the post JAMB examinations for intending candidates. This will reduce the number of rot candidates admitted into University who are not fit to be in the system.
- *Staffing and Staff Development:* It has been said that most of Chemistry Departments in Nigerian schools and institutions are understaffed. In this contemporary age, there is expansion in students' enrollment; therefore, the enrollments and programmes should match by equal rise in staff recruitment. This will reduce over workload on lecturers and enhance their opportunity. Therefore adequately trained and qualified staff should be recruited to match expansion in student intake programmes.
- Government at Federal and State levels should reduce the number of universities. And use the available funds to finance the remaining or existing universities appropriately, so the libraries and

laboratories will be equipped to world-class standard. Thus, chemistry and other science programmes are experimental courses, laboratories plays a vital role in education of science students.

- Government should increase her annual budgetary allocation to minimum recommendation of UNESCO in funding education. It is obvious that Nigerian Government has not even allocated 10% of its yearly budget to education. This is against the minimum recommendation of the United Nations Educational, Scientific and Cultural Organization (UNESCO) which is 26%.
- Government should reduce the huge wages spent on political office holders and direct the money to Nigerian Educational System, such money incurred can be used to equip libraries and science laboratories and put in place new structures and classrooms.
- Efforts should be intensified to raise and maintain the quality and standard of teaching, learning and grandaunts, to achieve this requires the readiness of government to eradicate all factors responsible for the identified challenges.
- The curricula of chemical sciences programmes should be reviewed from time to time. Lecturers must teach what is relevant as defined by the curricula.
- Conference attendance, at least, twice in a year should be made mandatory on all teaching staff and the institutions should sponsor the conferences. Moreso, opportunities for staff to undergo special refresher courses within or outside their institutions should be provided, so that lecturers could lecture at best.
- Sufficient commitment must be made towards regular and permanent stay of electricity. An epileptic power supply as we are experiencing in Nigeria cannot facilitate production of quality of staff and students, because intensive research and studies cannot take place.
- Nigerian Government should establish a chemical industry in Nigeria in collaboration with foreign investors. This will assist steady supply of chemicals and solvents need in the laboratory, some of the available ones are not enough to cater for the need, while the greater part of it are not original.
- A chemical research centre should be established by the government that will

make available to researcher grants to carry out the research work.

## 7. Conclusion

In this paper, an attempt has been made to examine the various challenges that are facing Educational System in Nigeria. The importance of science Education cannot be ignored in our educational system. Science has a potential to serve human resource developments, while chemical sciences plays a vital role within the basic science subjects.

The paper highlights some of the challenges that Nigeria educational system faces over the years, on the basis of the analysis made, solutions were made as measures through which existing problems will be solved and the future challenges will be tackled. Science has been used here as an example to refer to all types of programmes that exist in our educational system. However, discussion was focused mainly on chemical sciences, where various challenges were identified. It is hoped that the suggested solutions and recommendations when fully utilized, will assist to improve the state of our educational system to be in the best shape so as to meet the aspirations of the government and people of Nigeria in the 21<sup>st</sup> century.

It is necessary that Nigerian governments should accord science education in general and chemical sciences in particular maximum priority attention since chemical sciences is very relevant to industrial development in Nigeria, and other science courses are very important in inventions in communication, health, agriculture and other materials for well being of Nigerians in modern world.

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