



## Research and Chemistry Education for National Development

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### ABSTRACT

This paper briefly looked at the importance, objectives of chemistry education in Nigeria. However, several factors have been also identified to have bedeviled the proper delivery of chemical knowledge at all levels of our educational system in Nigeria, these include agriculture, healthcare, potable water supply, clothing, energy supply. The paper discusses further the objectives of chemistry education in Nigeria, contributions of chemistry education to national development, the importance of chemistry education, the role of chemistry education in national development, role of chemistry education in wealth creation, waste management and wealth creation. In view of this, it was concluded that chemistry education enhances skill acquisition and application propagation of the teaching and learning of chemistry and empowers students by exposing them to entrepreneurship programmes in which they can make choices in life and become self-employed.

### 1. Introduction

Science and technology make 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 that are ready to acquire, adapt 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 Erinosh, 2005). However, despite the relevance of science to national development, science subjects are not interested in many students in our country. Certainly, in any country that wishes to attain scientific and technological advancement, all students of such a nation must have scientific skills.

Currently, science and technology which hinges strongly on chemistry is the key driver of development in modern society.

### 2. Objective of Chemistry Education in Nigeria

The national curriculum for senior secondary school science (1985) cited by Mohammed, (2009) stated that the chemistry curriculum is aimed at:

Chemistry as a science subject occupied a unique position in the scientific and technological advancement of any country in the world today (Bugaje, 2013; Ibrahim, Tairo, Aminu, Isah, Muhammad, 2017). The role and importance of chemistry are clearly seen and known in the scientific and technological development in Nigeria. Within the context of science education, chemistry has been identified as a major subject and its applications in the scientific and technological development of any nation have been widely reported (Adesoji, 2008). It was as a result of the recognition given to chemistry in the development of the individual and the nation that it was made a core subject among the natural sciences and other science-related courses in the Nigerian Education system such as medicine, biochemistry, pharmacy, pharmacognosy, agricultural science, laboratory technology, geology, toxicology, etc (Adesoji, 2008; Edomwonyi and Aava, 2011; Bugaje, 2013).

Chemistry affects the people of our planet, protecting and preserving our health, ecology, culture, heritage, and wealth. Its principles, theories, techniques, and effective applications are the pedals for many industrial processes, as well as the indispensable foundations of many disciplines (Chinyere, 2011).

1. Facilitating a transition from secondary to tertiary level of education in the use of scientific concepts and techniques acquired in chemistry.

2. Providing the students with basic knowledge in chemical concepts and principles, through an efficient selection of content and sequencing.
3. Showing chemistry and its link with industry, everyday life, hazards, and benefits
4. Providing a course that is complete for its pupils not proceeding to higher education while it is at the same time, a reasonably adequate foundation for a post-secondary course

### 3. Definition/Importance of Chemistry Education

Chemistry is a science of material at the atomic and molecular levels. The knowledge obtained is utilized for solving the problems of man and its environment. Chemistry occupies a central position in natural phenomena and in the processes that are the basis of technological development. Chemistry knowledge is a fundamental aspect of our general education because chemistry has a major influence on our daily lives and is the basis upon which many industries operate and upon which new technologies are being developed. Chemistry has contributed to technological revolutions in family planning, medicine, public health, agriculture, metallurgy, textiles, building materials, and a large number of other fields of the highest social relevance. Chemistry plays a central role in economic development and will be a key component in the industrial and agricultural development of Nigeria.

### 4. Contributions of Chemistry to National Development

Over the years chemistry has contributed through the following measures, which have helped in the economic development of many nations. These measures are:

#### 4.1. Skill Development.

Chemistry plays an important role in the development of human resources required in the economy. It improves an individual's skill or human capital thereby, increasing his employability, productivity, and earning power. National growth requires both middle and high-level manpower for innovation and modernization in every sector of the economy.

#### 4.2. Innovation and Modernisation

Technological innovation is dependent on chemistry education because, through chemistry researches, newer and better methods of production are discovered for improved productivity. In addition, chemistry stimulates motivation and widens inquisitiveness. Furthermore, chemistry liberates the mind from the vestige of ignorance and superstition and makes a man willing to accept change. Chemistry widens man's ideas and outlook; it breaks man conservatism and prepares the mind to accept modern and improved ideas and techniques. In the developed world, chemistry through its innovativeness has helped to transform indigenous technology for the holistic development of their countries.

#### 4.3. Income Distribution

Efficient income distribution is a prerequisite for equity, rapid national growth, social and political stability. These can only be achieved if chemistry plays its role not necessarily in bridging the gap between the rich and the poor but in the redistribution of income between the people in the country. Thurow in Kene and Oguji (1997) rightly observed that an

increase in the educational level of low-income workers is bound to have three beneficial effects. These are:

- a) Increase in productivity and a consequent increase in earning.
- b) Reduction in the number of low skill workers, which lead to an increase in their wages
- c) Increase in the number of high skill workers.

From the above, it is crystal clear that the greater the number of educated chemists, the greater the number in the high-income cadre, and the better the distribution of income.

### 5. The Role of Chemistry Education in National Development

Chemistry education will play a crucial role in meeting Nigeria's aspiration of becoming a developed nation if taken as paramount importance in an entrepreneurship program in our institutions. Chemistry education is a very important area as its knowledge will play a major role in the development of an entrepreneurship program. It is therefore important that students/people engaging in entrepreneurship programs should understand chemistry subjects so that they can apply their knowledge in creativity and technological development. The present system of education is unable to create employment opportunities and there is a need to develop a specific entrepreneurial culture among the students for the production of graduates that possess relevant skills for self-employment and self-reliance. It is, therefore, advisable that chemistry education be included in the school curriculum of all disciplines to enable the student to acquire the relevant entrepreneurial skills to become wealthy through vocational occupations and as well become self-relevant and self-sustaining in society. Chemistry is a discipline comprising knowledge, skills and is practical oriented. The integration of these three elements is very important in ensuring a quality entrepreneurship program. Chemistry education will ensure the acquisition of relevant knowledge and practical-oriented skills which is an essential prerequisite for human development and economic development of Nigerian society as a whole through the entrepreneurship program. Williams (2002) maintained that relevant entrepreneurial skills acquired by students will make them wealthy through vocational occupations and as well make them become self-employed. It will develop in students, a positive attitude to citizenship and the desire to make them useful to the nation by contributing to the creation of a United Nigeria by being self-reliant and self-employed. Chemistry education is aimed at producing students with skills that will be useful to them after living in school so as to contribute to the economic developments of the nation.

### 6. Concept of Chemistry Education

#### Chemistry Education, Waste Management and Wealth Creation

Chemistry Education is the study of the teaching and learning of chemistry in schools. It is concerned with the impartment of knowledge on properties, components, transformations, and interactions of matter. Chemistry Education fosters scientific literacy. Chemical knowledge and the application of chemical principles and products are important in problem-solving. Scientifically literate citizens are an asset to a nation. A chemically literate citizen knows the dangers associated with drugs and how to use them without occasioning harm. (Yusuf et al., 2018)

Some of the important goals of Chemistry Education include the propagation of the teaching and learning of chemistry; awareness of the role of chemistry and its relevance to nation building; fostering through acquisition and utilization of

chemical knowledge. To appreciate the crucial role Chemistry Education plays in creation, to examine some areas in our national economy where chemistry finds application.

### 6.1. Agriculture

Chemical principles and products have been utilized to control pests and weeds and in fertilizer production for increased food production.

Genetically improved crops based on pest protection via genes from *Bacillus thuringiensis* (a widespread soil bacterium that produces insecticidal proteins called Bt toxins, or herbicide tolerance, or a combination of both) is used to improve crop production. The herbicide tolerance (HT) crops are tolerant to certain broad-spectrum herbicides such as glyphosate and glufosinate, which are more effective, less toxic, and usually cheaper than selective herbicides. By cutting the costs and labor of weed or insect control, these first-generation commercial pests and/or herbicide-tolerant crops have been shown to provide a tangible economic benefit to farmers. It is therefore critical that chemistry students be exposed to appropriate knowledge of chemistry in the areas of agrochemicals and chemical-based technologies to boost agricultural production environmental and economic sustainability of food security.

### 6.2. Healthcare

Drugs, which are products of chemistry abound and are used for various purposes including prevention and treatment of various diseases.

Proserpine, a Yohimbe alkaloid, for example, has important clinical use in the treatment of high blood pressure (hypertension) and also as a tranquillizer for the emotionally disturbed.

Ergot alkaloids are used chemically to induce contraction of the uterus in the last stages of pregnancy.

Morphine and compounds are well-known pain relievers (Aniodoh, 2001).

### 6.3. Potable Water Supply

Water is chemically treated to kill germs, thus rendering it fit for human consumption and other domestic use. Chemical processes are exceptionally important in the treatment and delivery of drinking water and the treatment of wastewater. Analytical techniques (including the development of associated portable devices) are critical in verifying the quality of water, and where required chemicals and membranes are employed in simple disinfection treatment. Chemical science also plays a significant role in the remediation of the aquatic environment following pollution incidents. Chemistry research within the water sector is therefore playing a vital role in the transformations that are needed to achieve a sustainable freshwater supply, both domestically and on a global scale.

Fundamental chemistry research is a necessary condition to support strategies that will provide the technological solutions needed to deliver new and improved methods of optimizing water use, treating contaminated water, recycling water, desalination water and preserving water in the soil, and harvesting water for irrigation (Odedokun & Abubakar, 2017).

### 6.4. Clothing

Some textile fibers used as clothing are obtained by modifying natural fibers of agricultural origin such as viscose rayon and cellulose acetate from cellulose. Other fibers such as

nylons, terylene, and acrylic fibers are all chemical synthetic derivatives from petroleum sources and are used as clothing (Okenyi et al., 2011).

### 6.5. Energy Supply

Coal is fuel and a source of energy. Fuel derived from petroleum is used to power automobiles, airplanes and ships. Gaseous fuel such as butane is used as cooking gas.

Kerosene, a derivative of petroleum, is a household name and is used in heating, cooking and lighting (Aniodoh, 2001).

Chemistry Education provides solutions to our problems in the energy sector by developing sustainable biofuels (e.g. through optimization of biochemical conversion processes as well as thermochemical conversion and gasification process (Odedokun & Abubakar, 2017).

## 7. Role of Chemistry Education in Wealth Creation

Chemistry education plays important role in enhancing the quality of teaching and research as well as ensuring that students are equipped with good knowledge to produce intensive goods and services to meet human needs for food, health care products and other materials aimed at improving the quality of life. Every single material thing in the universe is a chemical and the ability to understand and manipulate these chemicals is responsible for everything from modern food and drugs to plastics and computers.

Chemistry can be used to find a solution to problems of everyday activities in science, industry, technology, government, educational sector and economics. Some of the industries that obviously cannot do without chemistry include; cosmetics industry, brewery industry, chemical industry, textile industry, food processing and technology industry, forestry, Agricultural industry, forestry, petroleum, pharmaceutical industry etc. Man's success in the different realms of chemistry provides one unquenchable source of hope for success in technology. It is argued that an improvement in this position requires the further development of the nature and quality of Chemistry Education to chemical industries through intensive and extensive research. Chemistry education is needed in the professional development of chemical industries required in the establishment of modern technology and operation of chemical industries (Emendu, 2014). Chemistry Education sensitizes the citizenry on the appropriate collection, transport, processing and disposal of waste materials that gain entrance into our environment. It equips one with the capability of waste recycling practices. The need for Chemistry Education is not only paramount but critical since every human activity leads to the generation of one type of waste or another.

Chemistry Education can expose one to the knowledge of energy properties in a waste matter that can be converted to generate energy using different chemical processes such as combustion, anaerobic digestion, pyrolysis, gasification etc. From this, the contribution is made to national development through increased energy supply from alternative sources and decreased dependence on fossil fuel, (Ngozi-Olehi, 2009). Valuable metals such as ferrous metal, aluminum and copper can be recovered and recycled from electronic wastes. It has been estimated that personal computers which are disposed of contain 4,400 tonnes of ferrous metal, 3,050 tonnes of aluminum and 1,500 tonnes of copper.

Knowledge from Chemistry will help in the recovery and re-use of these metals available in e-waste. Recycled metals create new parts and building structures both of which help our economy and lifestyles flourish. Chemistry Education can also

expose one to secondary recycling or down recycling which recycles materials into new and different products such as recycling used plastic milk cans to produce outdoor furniture.

The knowledge gained from chemistry can be employed in paper recycling. Recycling old papers uses 60% less energy than manufacturing from new materials and also consumes fewer chemicals as well as bleaches which is safer for the environment. This waste conversion means if harnessed, can lead to economic empowerment (Okenyi et al. 2011). The product obtained from the incineration of waste tyres (carbon black) could be used as raw material for small-scale industries in the production of printing ink, paint, shoe polish, dry cell and battery heads. It is also expected that the results can be used to design an industrially and environmentally friendly carbon black recovery plant from waste tyres and other solid waste of organic origin (Oriaku, 2013).

Insect pests, diseases, weeds and rodents are serious constraints to agricultural production. The production of pesticides has an important role in increasing agricultural production by tackling the problems posed by Insect pests, diseases, weeds and rodents. The waste such as palm fibers, nutshells, palm kernel and empty fruit bunches obtained from palm oil processing for oil extraction can be incinerated in the boiler and the ash produced at the bottom of the boiler known as boiler ash can be used to produce Construction material- Concrete and Brick, coating, a replacement for cement available in the market, refractory items and decorative materials. The

waste substances such as coconut shell, mango fruit shell, rice husk, etc. can be used to generate wealth by converting them to activated carbon using activating agents such as KOH, H<sub>3</sub>PO<sub>4</sub> and ZnCl<sub>2</sub>

## 8. Conclusion

This paper provides an insight into the role and importance of chemistry education for national development in Nigeria; Objectives of chemistry education in the Nigerian education system are also part of the discussion in this paper. Chemistry education is important for the production of manpower in Nigeria's labour market. Chemistry education is needed for development, technological emancipation and industrial expansion. Chemistry education enhances skill acquisition and application, Chemistry Education includes the propagation of the teaching and learning of chemistry and empowers students by exposing them to entrepreneurship programmes in which they can make choices in life and become self-employed.

## 9. Recommendation

It is therefore, advisable that chemistry education be included in the school curriculum of all disciplines to enable the student to acquire the relevant entrepreneurial skills to become wealthy through vocational occupations and as well become self-relevant and self-sustaining in the society.

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