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**Opinion Article**

# Secondary Education Chemistry Curriculum Implementation in Nigeria: Contending Issues and Innovative Approaches for the Future

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***ABSTRACT:*** *This paper examined certain contending issues inherent in the implementation of secondary education chemistry curriculum in Nigeria and possible innovative approaches for the future. Curriculum has been described as a programme of activity in or out of the school under the guidance of the school. The major and specific objectives of secondary school education and those of chemistry education were highlighted. The concept of curriculum implementation was also discussed. Basic conceptual issues that were regarded as being contending to the implementation of secondary education chemistry curriculum were highlighted. Certain approaches considered innovative to improvement for the implementation for brighter tomorrow were pointed out, such as chemistry teachers and their students contributing to the provision of instructional materials through improvisation; involving the teachers in decision-making and the planning of curriculum since they are the key factors in the implementation of the curriculum. The need for the government to employ adequate number of qualified chemistry teachers was equally mentioned. Furthermore, appropriate recommendations were made among which is that stakeholders of secondary school education; the government, chemistry teachers and Parent Teachers Association should work as a unit in actualizing the objectives of the secondary education chemistry programme, whether major or specific.*

***KEYWORDS:*** *Chemistry, Curriculum, Implementation, Issues, Secondary Education,*

## I. INTRODUCTION

There are three levels of education in Nigeria: Primary, Secondary and Tertiary; each with stated achievable objectives. These objectives at any level of education cannot be achieved if the planned programme for such a level of education is not properly implemented. This informs the view of [1] that no matter how well a curriculum of subject is planned, designed and documented, implementation is very important. This is because the problems of most programmes are evidenced at the implementation stage. [2] and [3] have also remarked that, it is at the implementation stage that many excellent curriculum plans and education policies are marred. This paper therefore tries to x-ray the contending implementation issues (problems) in secondary education chemistry curriculum in Nigeria and the possible innovative approaches for the future (prospects) at this level of education. The secondary education according to [4] refers to "education children receive after primary education and before the tertiary stage". It is made up of junior and senior levels. The junior level is both pre-vocational and academic while the senior level is comprehensive with core-curriculum designed to broaden students' knowledge and outlook. This means that the senior level has a tripartite look – the core, vocational and non-vocational. It is the senior secondary education level and the chemistry education programme that this paper has targeted. Concept of Curriculum Implementation Curriculum implementation has been defined by [3] as the task of

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translating the curriculum document into the operating curriculum by the combined efforts of the students, teachers and others concerned. [5] acknowledges curriculum implementation as the translation of the objectives of the curriculum from paper to practice. [6] sees curriculum implementation as the translation of theory into practice or proposal into action whereas [7] in [1] views curriculum implementation as the process of putting all that have been planned as a curriculum document into practice in the classroom through the combined efforts of teachers, learners, school administrators, parents as well as interaction with physical facilities, instructional materials, psychological and social environments. From the above definitions, it could be seen that curriculum implementation involves the interaction of teachers, learners and other stakeholders in education which is geared towards achieving the objectives of education at a particular level as enshrined in the Nigerian curriculum document (The National Policy on Education, NPE), whose fourth edition was published in 2004. Objectives of Secondary Education

The Federal Republic of Nigeria [4] identifies the major objectives of secondary education as to prepare the individual for:

-Useful living within the society; and Higher education. The policy document (2004:18) also and specifically noted some specific objectives of secondary education to include:

- provision of all primary school learners with opportunity for education of a higher level irrespective of sex, social studies, religious or ethnic background.
- Offer of diversified curriculum to cater for the differences in talents, opportunity and future roles.
- Provision of trained manpower in the applied science, teaching and commencement at sub-professional grades.
- Development and promotion of Nigerian languages, art and culture in the context of world's cultural heritage.
- To inspire students with a desire for self improvement and achievement of excellence
- To foster national unity with emphasis on common ties that write us in our diversity.
- To raise a generation of people who can think for themselves, respect the views and feelings of others, respect the dignity of labour, appreciate those values specified under our broad natural goals and live as good citizens and - provide technical knowledge and vocational skills necessary for agricultural, industrial, commercial and economic development.

It is on the realization of the above goals and the need to achieve them that the secondary education which is a six year programme is divided into two sets – the Junior Secondary School (JSS) and the Senior Secondary School (SSS), each level lasting for three year duration. It has to be noted that no matter how well articulated the objectives of secondary education curriculum are; they cannot be achievable if the prevailing problematic issues involved in the implementation are not properly addressed.

Objectives of Secondary Education Chemistry Curriculum Chemistry has been defined as a science of nature and one that deals with the properties of non-living substances, whose properties ranges from the preparation and changes that they undergo when such substances are subjected to adverse conditions of high temperature, high pressure, extreme cold and abnormal contact [1].Chemistry as a branch of natural sciences occupies an important place in the secondary school curriculum. As an academic discipline, it is highly admirable as it even creates a sense of excitement among learners. Its inclusion in the curricula of secondary schools, [8] and Technical Colleges of Education, [1] has been justified (for attracting youths to careers with chemistry options) and commended as innovative (for creating wealth of experience for the educated citizenry). Chemistry curriculum is designed in such a way as to show inter-relationships between the subject (chemistry) and other science subjects (biology and physics) and to satisfy requirements for

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senior secondary school programme in the National Policy on Education. Students are required to learn chemistry by understanding, which demands a mastery of reasoning capabilities of students at the formal operational stage. [9] contends that secondary school chemistry should be developed along basic chemical theory, importance and relevance to everyday life. The Comparative Education Study and Adaptation Center (CESAC) in December 1984 originally prepared the content of the chemistry curriculum. After the critique by the Federal Ministry of Education, Science and Technology (FMEST), it was moderated by the Joint Consultative Council (JCC) at the Reference Committee meeting in April, 1985 and subsequently approved for use in Nigeria for the senior secondary schools by the Federal Ministry of Education, Lagos. This was in 1987. The curriculum content is organized around major concepts of energy, periodicity and structure, which subsumed many other chemical concepts. The objectives of secondary school chemistry curriculum therefore, as specified in the Senior Secondary School syllable are as follows [1].

a) To facilitate transition in the use of scientific concepts and techniques acquired integrated science (now basic science) with chemistry.

b) To provide basic knowledge in chemistry concepts and principles through efficient selection of contents and sequencing.

c) To show inter-relationships between chemistry and other science subjects

d) To show chemistry and its link with the industry, everyday life, hazards and benefits, and

e) To provide students not proceeding for higher education with adequate foundation for other future careers.

The relevance of chemistry to national development is inestimable. The teaching of chemistry helps to imbibe scientific knowledge and stimulate science oriented attitude in learners. This attitude when directed to the world of work results in the development of the individual, the society and general standard of living of the citizenry. Therefore, the place of chemistry knowledge and skills in economic and industrial development in the Nigerian society cannot be underestimated. According to [10], chemistry is pre-occupied with the molecular transformation, which matter, manifests. Actually chemistry goes beyond processes in chemical industries to other industries such as fertilizers, petroleum, paper and pulp, iron and steel, cement, coal, glass, electronics and so on. It plays major roles in the vital sectors of the economy, execution of other professions and improvement of quality life. Chemistry contributes immensely also in the area of medicine, agriculture and criminology. All the above are indicators that chemistry plays an important role in the economy and national development of any nation and as such should be considered essential and hence, be fully involved in the task of national and human development of Nigeria. Contending Implementation Issues in Secondary Education Chemistry Curriculum There are many implementation issues in secondary education chemistry curriculum, which include: non-provision of classrooms and laboratory facilities, inadequacy of qualified chemistry teachers, lack of motivation to chemistry teachers, inadequate provision of instructional materials, paucity of funding, and chemistry teacher non-involvement in decision-making and curriculum planning

### 1.1 Non-Provision of Classrooms and Laboratory Facilities

Facilities are plants, equipment, buildings, items of furniture such as table, chairs, lockers and benches which enable chemistry teachers and students to perform their work effectively especially in the laboratory. [11] of the view that facilities are factors which enable production workers to achieve the goals of an organization. [12] also notes that the use of instructional facilities enhances learning experiences and could lead to interaction within the learning environment for better output among the students. The facilities for implementing chemistry curriculum include the laboratories, workshops, lockers, gas cylinders, water tanks and the preparatory rooms.

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The above facilities become issues of concern when we think and try to consider the extent to which these facilities are being provided for effective implementation of secondary education chemistry curriculum. The index is that this is very low as [13] has also observed that facilities are not adequately provided and in most secondary schools in Nigeria are commonly found dilapidated buildings, leaking roofs, broken chairs and tables for students and teachers to use. In most of them, there are no conventional laboratories but improvised classrooms used as laboratory. This situation surely challenges both teachers and students' performance. [14] points out that the public sector of secondary education level has witnessed great decay in terms of facilities. For him, most schools are a caricature of what schools should be in a modern state because of collapsing buildings, leaking roofs, unkempt surroundings, lack of public toilets, and disdain for aesthetics. It does appear that the schools are designed and run merely to present poor quality services for majority of the populace. The issue of lack of facilities indeed has negative effects on our secondary education in implementing chemistry curriculum and therefore must be adequately addressed because school facilities are the operational inputs of every instructional programme. The school is like a manufacturing organization where plants and equipment must be in a top operational shape to produce result. In support of this view, [6] notes that to ensure that curriculum is effectively implemented; infrastructures and facilities must be provided in adequate quantities.

### 1.2. Inadequacy of Qualified Chemistry Teachers

Lack of quality chemistry teachers is a critical issue in implementing secondary education chemistry curriculum. For any programme to be successfully implemented, the implementer must be adequate numerically (handy) as well as qualified. It is disheartening to note that in most secondary schools; due to paucity of chemistry teachers in existence, any available ones (teachers) are compelled to teach subjects that are not their areas of specialization. For example; a Chemical Engineer who has not yet found a greener pasture is recruited to teach chemistry and basic science at the secondary school, which is very inappropriate because such a teacher lacks both adequate content of secondary school chemistry as well as the pedagogy (methodology) accruable from specializing in education programme. One wonders the type of knowledge that is going to be transferred to learners since no teacher teaches what he does not know or gives knowledge he/she does not have. The big question is how can we raise adequate number of qualified chemistry teachers to handle the subject at the secondary education level? This is the issue to be addressed because as [15] observes, the teacher is a major hub around which the success of education revolves. It is also to this affect that Lassa [16] views the teacher as the key to proper development of the child and as such they are needed in greater number in all the secondary schools. The interest of the populace in embracing teacher education is a big issue that compounds the inadequacy of teachers at the secondary school level. [1] points out that lack of interest in applicants seeking admission to study pure sciences (biology, chemistry and physics) in education at the universities is an issue of concern. This is worrisome because it is in teacher education programmes that future teachers (chemistry inclusive) are prepared for the implementation of secondary school curriculum.

### 1.3. Lack of Motivation to Chemistry Teachers.

Motivation refers to the act of using something (cash or kind) to encourage an individual to perform his or her duty in an expected manner. To this author, motivation may include the needed environmental conditions in which the chemistry teacher will perform his/her duties. [17] is of the view that motivation is a force that is capable of reducing tension, stress, worries and frustration that spring up from a problematic situation in a person's life. Stress and worry are traceable to work situation where it is referred to as negative organizational motivation. From [17] definition, what constitute teacher's motivations are those factors that operate within the school system which if not

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available to the teacher would reduce performance, cause stress, discontent and frustration that subsequently reduce both teacher and student output qualitatively. This means that in order to improve performance on the part of students, teachers have to be adequately motivated so that he/she is gingered to do something in an expected manner. In support of the above, [18], notes that for a worker to live up to expectation in curriculum implementation, such a worker must be motivated. He/she must in addition to getting his salaries and entitlements, be given other incentives and necessary materials which will make his/her work easier and faster for him/her. The contending issue here is how are chemistry teachers being motivated so that they can do the work of implementing secondary education chemistry curriculum well? The chemistry teachers need to be motivated by all stake-holders in education by caring for them in terms of prompt payment of salaries, promotion and payment of hazard allowances, be provided conducive and well furnished offices and well equipped chemistry laboratories full of consumable materials (cotton wool, litmus papers, filter papers, reagents and indicators) as well as non-consumables (beakers, burettes, test tubes and test tube holders and weighing balances). They need to be sponsored to conferences and for in-service training programmes. Above all, only qualified students need to be admitted to ensure smooth flow of knowledge. Generally, motivating teachers is very important because without teachers, the educational objectives as specified in National policy on education for all levels of education will not be achieved. Reformers of education may establish new schools, effect changes on the structure of curriculum, recommend and prescribe teaching methods and aids but in end, the teacher will be responsible for applying them. When the applier is not happy, the application will be stalked or marred. This is the more reason, the chemistry teacher should be highly motivated. Government and employers failure to fulfill promises that border on labour matters often lead to industrial disputes that may last for months as witnessed with Nigerian Union of Teachers (NUT) in recent past over the issue of Teachers Salary Structure (TSS). This type is issue is non-motivational. In a situation such as this, how can a well designed chemistry curriculum be fully implemented? Teachers' monthly take-home salaries and allowances are very poor and unattractive, and as such, cannot sustain them in the face of the rising cost of living. Government must not therefore forget the notion of [19] that the prime motive of men engaging in some activities or going into a career is to obtain the resources to meet their psychological needs and support their families among others. The chemistry teacher is not an exception.

### 1.4. Inadequate Provision of Instructional Materials

This is another contending implementation issue in secondary education chemistry curriculum. Instructional materials according to [20] are alternative channels of communication which a teacher can use to compress and express information and make them more vivid to his learners. This implies that instructional materials are needed for effective implementation of secondary education chemistry curriculum. Due to the need to provide instructional materials for effective teaching and learning in Nigeria schools, [18] asserts that all learners in the various levels of the national educational system are expected to be provided with appropriate learning experience through the provision of instructional materials in sufficient quantity. A systematic integration of variety of resources in a teaching-learning process produces appropriate learning experiences, which in turn results in effective and meaningful learning. For a worthwhile learning experience to occur, the learners must see, hear, touch, taste, make, do and even try out things. In line with this view, [21] opines that curriculum materials are indispensable in the teaching-learning process/curriculum implementation. It is in this wise that [2] notes also that instructional materials are designed to promote and encourage effective teaching-learning experiences. For effective implementation of chemistry curriculum in senior secondary schools, the following materials are required: fume cupboard, weighing balances, spatula, test tubes and their holders, water supply, amply gas supply, water distillers, side lockers for storing chemical and equipment, and computers [1] These instructional materials make the teaching and learning processes easy, more meaningful and understandable. Sadly, the instructional materials are lacking in most Nigeria secondary schools and as a consequence, chemistry teachers take to chalk and talk method as they have no

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instructional materials (visual or audio-visual) which the students can see, touch, smell and hear in the process of teaching and learning. This must have informed [7] in [1] to observe that when instructional materials are not available learners do not do well.

### 1.5. Paucity of Funding

The biblical injunction states that money answereth all things (Ecclesiastics 10:19; King James Version). Hence, paucity of funding is yet another issue that affects implementation of secondary education chemistry curriculum. Fund refers to money. Every project of man in life requires money for its effective implementation and secondary school chemistry curriculum is not an exception. [7] in [1] notes that no organization can function effectively without adequate fund input. It is no argument that implementing science programme is capital intensive. All the facilities, equipment and laboratory materials earlier enumerated require huge capital input. Unfortunately, fund allocation for education is grossly inadequate. This situation hinders the implementation of a curriculum no matter how well designed and chemistry curriculum is not an exception. A situation where there is no money for payment of teachers salaries, building of standard laboratories, purchase of equipment, books, furniture items and other facilities makes the chemistry teachers' performance very ineffective. Inadequate funding indeed has negative effects on education in Nigeria as has been described by [14] who laments that the present level of under-funding by the state on the public sector of education ( secondary levels) has resulted into stagnation and decay of educational programmes and infrastructure. [22] observes that in Nigeria, education receives less per capita funding than many other African countries. This author sees this as most disheartening and not minding the paucity of funds, the education industry is usually the first and easiest victim of budget pruning in government economic reform strategies such as the austerity measures, structural adjustment programme, and economic meltdown recovery. This means that for the well designed chemistry curriculum of secondary education to be implemented, the issue of money has to be addressed properly.

### 1.6. Chemistry Teacher Non-Involvement in Decision-Making and Curriculum Planning

Generally, teachers should be involved in decision-making during the planning of curriculum in order to achieve the objectives of such curriculum at the secondary school level. The importance of teachers in decision-making and curriculum planning according to [23] hinges on the fact that no government policy on education can be realized if it does not first of all perceive the problems and opportunities before initiating decision-making process. It is hence the teacher who is in the best position and of course the most qualified facilitator to be consulted. It is also in realization of this that [3] observes that as the most important personnel in the programme of curriculum implementation, the teacher must be involved in all stages of the process. It then follows that when chemistry teachers are deliberately disregarded when major decisions on education are taken; the situation turns tragic and negatively consequential on the curriculum implementation. This is an implementation issue that needs to be properly addressed because the relevance of a curriculum is determined only when it is implemented. [24] also recognizes the fact that the success of any curriculum, significantly, depends on the extent to which the classroom teacher is able not only to interpret the curriculum but to implement it. [25] concludes this relevance when he stated that teacher characteristics can make or mar curriculum implementation since the responsibility of interpreting and putting the curriculum into use solely rests with the teacher. Sadly enough, the chemistry teachers are not involved in decision-making and curriculum planning of secondary education chemistry curriculum as the

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planners are university lecturers who have lost touch with secondary education, even if they had once taught at that level. This is a very big impediment to implementation of chemistry curriculum contents and learning experiences. This issue needs to be addressed because a situation where chemistry teachers who are the key implementers of chemistry curriculum are not involved in decision-making and planning of the curriculum, effective implementation of the contents and learning experiences will be very difficult. [26] agrees with the above assertion when he stated that simply because a curriculum has been planned to feature appropriate learning experiences does not imply that appropriate learning experiences will be realized because most of the activities required depend on the teacher.

1.7. Lack of Basic Knowledge of Information and Communication Technology

Information and Communication Technology (ICT) is an innovation that has proved very useful and effective in the teaching of secondary school subjects including chemistry. For instance, a teacher can demonstrate what he is going to teach through motion pictures. Therefore, a chemistry teacher can also type his lessons, save it in the system so that students can open it and use the information for their Personal studies whether he/she is there or not. A chemistry teacher can teach drawing molecular structures, calculation, writing and balancing of equations and spellings using prepared programmes (programmed instruction packages). However, the contending issue here is; does the chemistry teacher have basic knowledge of computer appreciation and application? This is one issue that militates against effective implementation of secondary education chemistry curriculum in Nigeria. Majority of secondary school teachers (chemistry inclusive) do not use computers and the computer assisted instruction in teaching their lessons either due to non-availability of computer hardware or lack of basic knowledge of computer appreciation. Another contending issue is the lack of electricity in most rural areas while the schools in the urban areas are either not connected to electricity facility or where they are connected, they witness most often power outages. It is [27] who observes that since ICT usage requires electricity, whenever there is power failure; users become stranded in their programme activities. These contending issues may have informed [1] and [28] to assert that the poor socio-economic condition in most developing countries of the world, including Nigeria, is due to lack of use of ICTs as well as governments and institutions show of little concern for the application of ICT in education. It is obvious that many secondary schools in Nigeria due to paucity of funding cannot afford to buy or have access to computers and even where computers are available or are purchased; there is lack of the human and material resources to use ICT facilities. Wherewithal the Prospects of the Implementation of Secondary Education Chemistry Curriculum; there are some prospects for smooth implementation of secondary education chemistry curriculum that point to a bright future for the subject in Nigeria. These include:

1. Parent Teachers' Association (PTA); Education Trust Fund (ETF), and Petroleum Trust +Development Fund (PTDF) and Universal Basic Education Board are now making tremendous inputs in the secondary education sector that would better chemistry education programme and enhance its implementation.
2. Seminars are being organized by Universal basic education Board and the secondary Education Board (SEB) to train teachers generally; of which chemistry teachers also participate to gain knowledge on the production and utilization of locally made instructional materials.
3. The Nigeria educational Research and Development Council (NERDC) has decided that experienced secondary school teachers will be involved in curriculum planning and development at that level. At least, they will be the second group of reviewers of the curriculum after the experts in curriculum have finished their. Chemistry teachers will definitely be involved in this review.
4. Teachers are now encouraged to go for in-service training to update their qualification; chemistry teachers are not left out. The Federal Teachers' Scheme for acquisition of NCE (the minimum qualification for teaching) is good innovation to improving on the methodology of teaching chemistry.

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a. The state governments in conjunction with some companies have started supplying computer and computer facilities to schools. For instance, banks in the various localities are now donating computers to secondary schools.

5. The government and unions can now start negotiation with each other through the industrial arbitration court on any industrial or labour dispute.
6. Workshops and annual conferences are being organized by Science Teachers Association of Nigeria (STAN) for members of chemistry teachers are actively involved. The workshops are organized on subject panel basis to favour every subject.

## II. CONCLUSION

The state government and other stakeholders (school administrators, chemistry teachers, students, parents and philanthropists) should join hands together towards addressing all the contending implementation issues concerning secondary education chemistry curriculum. This will definitely lead to improved students' output/performance in chemistry. At the same time, greater achievement of secondary education chemistry objectives will be made to greater growth of technology for socio-economic development of Nigeria.

## III. RECOMMENDATIONS

In order to effectively implement secondary education chemistry curriculum, the following recommendations are proffered:

1. Provision of laboratory facilities should be by a combined effort of the government, Parent Teachers' Association and other education stakeholders.
2. Chemistry teachers and students should improvise instructional materials especially those that involve the use of local materials.
3. The government should equally ensure adequate provision of both visual and audio-visual instructional materials.
4. Philanthropists should invest in the education needs of their community especially in the area of instructional material provision as well as fund assistance
5. Chemistry teachers should be involved in decision-making and the planning of chemistry curriculum.
6. State government should insist on employing adequate number and qualified chemistry teachers to handle secondary education chemistry curriculum.
7. State government should equally ensure that enough funds are allocated to education generally; so that purchase of instructional materials and provision of facilities will be made possible and easier.
8. State government should put in place monitoring strategy; to ensure that monies allotted for secondary education are judiciously used especially in the provision of laboratory facilities and instructional materials needed in the implementation of chemistry curriculum.
9. The government should ensure that information and communication technology facilities are made available in all secondary schools, which is known to be capital intensive.

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10. Awareness should be made to parents on the need of ICT during PTA meetings so that individual parents can donate computer and its accessories to schools, where possible.
11. Organizations like banks should assist schools in their domain with ICT facilities.
12. Above all, chemistry teachers' salaries, hazard allowances and other remunerations should be promptly paid. The state government should learn to keep promises made to teachers in order to motivate them to work and avert industrial disputes that lead to labour disharmony to the detriment of the students.

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