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INNOVATIONS IN PRIMARY SCIENCE CURRICULUM IN NIGERIA, A PIVOT FOR SUSTAINABLE SCIENCEAND TECHNOLOGY IN THE 21ST CENTURY

Dr. (Mrs.) Maduagwu Ukamaka Martha
Department of Educational Foundations, School Of Education and General Studies, Federal College of Education Technical, Isu, Ebonyi State
E-mail: ukamakamaduagwu@mail.com
&
Dr. Lawrence Otusinkama
Examination Development Center, Ministry Of Education, Abakaliki Ebonyi State E-mail: lawrenceotusinkama@gmail.com

ABSTRACT
In the Nigerian educational system so many innovations or change have been introduced. Examples are the universal basic education and the 6-3-3-4 system of education, the 9-3-4 system of education, 6-5-4sytem etc. In our primary school system, curriculum innovations have been introduced mostly in the area of primary science and mathematics. This paper therefore examines the various primary science curriculum innovations in line with the various theories of innovation identified by Havelock and how they have influenced the contemporary primary science curriculum content. It was observed that the government effort towards the teaching of science is very good on paper but its practicability is not yet evident. The objectives of our educational system, which is based on the principles of self-reliance, can only be achieved through the implementation of a good foundation of qualitative science education at the primary school level.

Keywords: Innovation; Primary Science; Curriculum; Sustainable Science, and Technology.

Introduction
The National policy on education (2013), which is the brainchild of the 1969 curriculum conference defined primary education as "education given in an institution to children between 6 and 11 years and above". The Policy went further to describe primary education as the "Bedrock of Education" as such the success or failure of the entire system depends on this key level of our educational system. One of the objectives of primary education as documented in the National Policy on Education is to lay a solid foundation for scientific and reflective thinking. Scientific thinking according to Joseph (2002) "is the sequential organization of activities that may normally lead to a logical conclusion." Such an objective cannot be achieved without a strong scientific base at the primary school level. Going by the Policy statement of primary education, Jeremiah (2004) is of the view that the dwarfed growth in science and technology breakthrough in Nigeria can be attributed to the defective implementation of science education curriculum in our primary schools. Wokocha (2000) in his view also indicated that the fact that there is the need for developing nations like Nigeria to catch up with the developed nation calls for rapid improvement in the teaching of science in our schools starting from primary school level.Over the years the

Federal Government and some States of the Federation have identified the importance of primary science and come up with different curriculum innovations to improve the teaching and learning of primary science. It is ironical to observe that most of such innovations did not stand the test of time but to a large extent contributed to the sustenance of the present primary science curriculum package. The focal point of this work is therefore on the analysis of such primary science curriculum innovations and how they can be used to improve on our present primary science curriculum content for a sustainable science education in the 21st century.

Concept of innovation and change

The curriculum is planned for a given society, which is never static but dynamic. Because of the dynamic nature of the society, which the curriculum is meant to serve, the changes occur either in the objective of education, this also, results to the changes .on the learning experience presented to the learners as well as the methodology and the evaluation process. Curriculum innovation is the deliberate introduction of novelties into the curriculum. Innovation means to create something new different from the existing ones. Unruh and Alexander (1974) view innovation "as the introduction of a novel factor perceived-as new by a given school or community supported by a driving force and implemented as a practical advance that deviates from established traditional forms." Innovations can be seen as an introduction, of new planned idea into a system or a given society.

For instance the traditional chalk and talk methods of teaching has changed in many countries to the use of modern methods of teaching such as the use of audio-visual aids, simulation, computer assisted instructions and mastery learning. Rogers and Shoemaker (1971) are of the view that structures and functions of social systems are bound to alter in the course change even though they are collective units, with common goals. Every education system is made up of different units, which work to achieve common goal, the goal being the integration of the individual into the society as a useful and purposeful member.

The researcher is of the opinion that curriculum innovation is the various changes, which are introduced into the Nigerian school system that is capable of affecting the curriculum package positively. For instance the 6-3-3-4 (six years of primary school, three years of junior secondary school, three years of senior secondary school, and four years of University education) system of education, 9-3-4 system; which is one of the greatest innovations in our educational system was introduced to replace the old system of 6-5-2-3 (six year of primary school, five years of secondary school, two years of higher school, and three years of university education). This change has affected the entire school system including the curriculum content at all levels. In the line of the above views innovation or change, which has been used interchangeably can be summarized as a departure from the old order. This departure could be gradual or sudden. In other words, it could be transitional or revolution, minor or major whichever be the case, change should involve growth and bring about novel ideas (Egbe & John, 1991).

Reasons for Curriculum Innovation

*1. **The society is not static:*** It changes from time to time. The changes may occur in the areas of cultural beliefs, values, ideas and the philosophy of society. When all these changes are experienced, the curriculum of the schools has to change in line with it.

Any time the curriculum is lacking in achieving the desired goal of the society either some aspect of the curriculum or the entire curriculum, change should be affected or modification should be done.

2. Knowledge is dynamic:

There is a continuous growth in knowledge. There may be new discoveries in the society, for example, the knowledge about computer has introduced computer education in the curriculum which is an innovation. This has changed this aspect of education, which was based on old knowledge. It has made the curriculum to reflect the new knowledge.

***3.* Increase in teaching and learning facilities**

As new teaching and learning facilities are introduced into the education system, some curriculum innovations should be effected to accommodate the new teaching materials in teaching and learning.

4. Research findings

Research in education gives new insight on how teaching/learning occurs. Researches and findings help to dictate areas that should be changed or improved in teaching and learning. This also leads to the discoveries of new teaching methods. These have influenced the structure of the classroom seething (Ezenwa, 2020).

Theories of innovation

Havelock (1971) after an extensive study on dissemination of innovation concluded that the innovations can be grouped according to how their authors view the dissemination and utilization process. He therefore offered three models or theories of innovation such as Social Interaction, (S.I.); Problem Solving (P.S); and Research Development and Diffusion (R.D. & D) model (Ezenwa, 2020).

1. **Problem Solving Model (P.S.)**

   According to Ezenwa,(2020), this model presupposes the presence of a problem and the determination to find a solution to the problem. In the problem-solving model the receiver (individual or group) initiates the process of change by identifying an area of concern or by sensing a need for change. Once the problem area is identified, the receiver under-takes to alter the situation either through his own effort, or recruiting suitable outside assistance. In this situation, the receiver of the innovation in this model is active rather than passive as will be identified in the other two models. Relating this model to the Nigerian educational system, shortly after the attainment of independence, it was observed that the Nigerian educational system was no more relevant to the needs and aspirations of the people. Thus a National Curriculum Conference was called in 1969, which comprised of people from different sectors of the Nigerian society so that they could contribute their ideas to the development of Nigerian education. The outcome of the conference led to the emergence of a new National Policy on education called the 6-3-3-4 system. In reviewing the educational system, Nigeria also invited foreign agencies such as U.N.E.S.C.O, U.N.D.P. and U.N.I.C.E.F. Nigeria in this process adapted the

problem-solving model of curriculum innovation.

2. Social Interaction Model (S.I.)

In the social interaction model, innovations are presented or brought to the attention of a potential receiver population. The receiver and the receiver needs are determined exclusively by the sender.

The social interaction model emphasizes on the use of communication ideas. It focuses on the use of human relationships as the most efficient strategies for the dissemination and adoption processes of innovation. It places a lot of emphasis on the social interaction among the members of the adopting groups and focuses on the diffusion of the ideas and flow of messages from person to person rather than the marketing of products.

In this model of innovation, the diffusion of the innovation depends greatly upon the channels of communication within the receivers group, since information about the innovation is transmitted primarily through the social interest of the group members. In Nigeria the social interaction model have been widely used in our educational system in the areas of the introduction of sexuality education, population and family life education and the education of people with special needs such as the migrant fishermen education, the nomadic education, and women education.

3. the Center- periphery Model

This model was proposed by Schon (1971) as an organisational alternative for the dissemination of innovation. The model postulate that the dissemination of curriculum change can be conducted from a single curriculum from where all the activities are directed and monitored by a curriculum development team. This arrangement is hierarchical whereby the national team coordinates the activities of the regional off which then coordinate the schools under them. The model rests on the following assumptions:

1. the innovation to be implemented exists, fully realised in its essentials, prio to its function
2. diffusion is the movement of the new ideas from a center out to its ultimate users.
3. Directed diffusion is a centrally managed process of dissemination, training, and provision of resources and incentives.

In this model the innovation or programme are developed by experts like examiners, research institutes, ministry officials and so on at the center and made available to schools for implementation. In this model innovation is linear. Ideas and resources are communicated from the development team to the teachers in the classroom.

The factors which are considered vital for the success of this model includes the level of resources and energy at the center, the number of points at the periphery, the length of the radii or spokes via which diffusion takes place, and the energy required to gain a new adoption. The success of this model depends on the ways information moves from the periphery back to the center.

4. Research Development and Diffusion Model (R.D.& D)

This model looks at the process of change from the point of view of the originator of an innovation and begins with the formulation of a problem on the process of presumed receiver need. This model sees the process of change as an orderly sequence, which must begin with the identification of problem, proceeds through activities, which are directed towards

finding or producing solution to the problem, and ends with diffusion of this solution to a target group or groups. This initiative in this case is taken by the researcher, the developers and the disseminator. The receiver remains essentially passive. America utilized the research development and diffusion model in 1957 in its curriculum reform movement. The American Government set up a central curriculum center charged with the responsibility of designing National Curricular and enforced its acceptance without any form of alteration or adaptation. Back home in Nigeria, the National Teachers Institute Kaduna adopts this model in providing instructions through distance learning service to its students. Primary Science Curriculum Innovations in Nigeria A number of external influences motivated many of the curriculum innovations in science at the primary school level. Some of the foreign curricular influences include the following. Elementary Study of Science (ESS) of 1960, Science a Process Approach (SAPA) of 1962; Science Education Project of 1970. Adewole (1999). As a result of these influences many primary science curriculum projects were put into place in Nigeria. Some of those primary science projects are identified by Mkpa (1987). Adewole (1999) and Jeremiah (2004).The African Primary Science Project (A.P.S.P). This was one of the earliest curriculum innovation projects in science at the primary school level. It was launched in Kano in January 1965 by the Ford foundation of Africa and educational development center Massachusetts. The program was later changed to Science Education Project for Africa (SEPA). This project takes into consideration the interest of the African child in learning science by utilizing African environment. With this approach, the child is able to develop the habit of looking at his environment in a way that would elicit questions while answer to such questions could be found through experimentation. The cardinal objectives of this project was to bring within the reach of every child the benefit of relevant and excellent education, by utilizing the accumulated knowledge and technique of science as a vehicle to furnish him with the requisite skills, which will enable him to make rational judgment about his total environment. SEPA produced many materials mostly in the form of teachers guide or handbook. This is because SEPA saw the teachers' role as crucial in the preparation of learning materials and diagnosing of people's needs and difficulties. SEPA therefore devoted sufficient time and energy in training and retraining of teachers because the teachers are the ones to diagnose and appraise the pupils' efforts, their imagination, excitement and frustration .Adewole (1999). The Bendel Primary Science Project (BPSP).

Science Programme of the Primary Education Improvement Project (Sppeip) Primary education improvement project was initiated in 1970 at the Institute of Education. Ahmadu Bello University Zaria. The project was developed with financial and technical assistance from UNESCO, UNICEF, USAID and the British Council. The curriculum materials produced from the project were series of pupils' text books (bks.1-6) and teachers guide, which provides detailed information for the teachers to carry out science activities, which must have been specified in the pupils' text. Mkpa (1987). The project aimed at making children think and

study science like scientist thus it adopted the philosophy of the American Association for the Advancement of Science (AAAS) process and skills for achieving this aim with emphasis on the following processes of science such as observation, measuring, classification, using number, manipulating, communicating, predicting, informing, interpreting, formulating hypothesis and experimenting. "Sayensi" Ife six years Yoruba Primary Science Project This was part of an enlarged Ife six years Yoruba primary education project initiated in 1970 at the University of Ife under the chairmanship of Professor Aliu Babatunde Fafunwa, then Director of the Institute of Education University of Ife. The project takes into consideration the use of the mother tongue in the teaching and learning of the following primary school subjects such as English, Mathematics, Yoruba, Cultural and Creative Arts, Social Studies, Family Living and Physical Education.

The main component of the project were comprehensive syllabus for each subject, scheme of work, pupils texts, pupils work book, teachers guide, language medium serving text, visual aids and examination data bank. The "Sayensi" writing group of the curriculum development team did a lot of work as the group has to battle with writing science concepts in Yoruba as none of the group member learnt or taught science in Yoruba before. The group therefore has to set up a lexical committee especially to select the right choice of words and concept that would correctly express in Yoruba those science concepts and expressions not easily identifiable with Yoruba language. The purpose was to borrow the foreign words using Yoruba orthography. It is pertinent to note that the use of the mother tongue (Yoruba) in the teaching of science was indeed a unique pioneering effort, which unfortunately has neither been further adopted for use in all Yoruba schools and beyond nor has there been further research effort over the years to vigorously explore the teaching of science in mother tongue. Today, virtually all primary schools in Nigeria still teach science in English Language to pupils thereby creating to them a concentric circle of difficulties in understanding science, which they later carry on to secondary schools. National Primary School Science Project (N.P.S.S.P) The idea of having a core-curriculum for primary science led to the National Primary Science Project (N.P.S.S.P) later called National Primary Science and Mathematics Project (N.P.S.M.P). This project was initiated in 1978 under the direct supervision of the Federal Ministry of Education and coordinated by the Nigerian Education Research Council (NERC). A primary school science curriculum panel was earlier set up under the chairmanship of Dr. B.C.E. Nwosu, the Chief Education Officer in the Federal Ministry of Education with representatives from NERC, Universities of Ife, Abu, Lagos, Nsukka and representatives from the following states; Ondo. Lagos, Sokoto, Imo, Benue and Bauchi States. The panel was given some terms of reference as observed by Jeremiah (2004) and set up to work immediately by reviewing the various objectives of the primary science program operating in different states of the Federation with a view of identifying the common or core elements among them and therefore checking whether such elements are consistent with the objectives of primary science education as stipulated in the National Policy on Education. After much deliberation, the panel recommended

that science education at the primary school level should enable the child to:

i. Observe and explore the environment
ii. ii. Develop basic science process skills
iii. iii. Develop functional knowledge of science concepts and principles iv. Develop a scientific attitude; such as curiosity, critical reflection and objectivity. To apply the skills and knowledge gained through science to solving every day problem in his environment.
iv. v. Develop confidence and self-reliance through problem solving activities in science.vi. Develop functional awareness and sensitivity to the orderliness and beauty in nature.In summary the panel produced a core curriculum syllabus for primary science with instructional units organized into six columns of topic, performance objectives, content, activities, materials and evaluation. Adewole (1999) reported that this is the first time in the history of science teaching in Nigeria that emphasis was laid on these six areas. Jeremiah (2004) provides details of the core-content syllabus, which is currently in use in primary schools of the Federation. Missing Links in Contemporary Primary Science Curriculum Project Having examined the various primary science curriculum projects as identified in this work, it is pertinent to note that the national primary science was to borrow from the various science projects in order to have a comprehensive science education.

One major area that was to be considered as a missing link in the contemporary primary science curriculum project is in the utilization of the African environment in the teaching and learning of science. African environment in this regard simply means the child's immediate environment. For example, the African primary science project (A.P.S.P.) which was launched in Kano in 1965 by the Ford Foundation emphasized on the use of African environment in the teaching of science. By doing this, the present primary science curriculum should have laid emphasize on the use of field trip and provision of local materials in the teaching of science. Through this, some science concepts will be more real to life situation.

Another area that calls for proper attention has to do with the training and retraining of teachers. The National Policy on Education (2004) contend that no nation can rise above the quality of its teachers. As a result of the crucial role of teachers in the implementation process of any curriculum, their training and retraining becomes imperative. It was however observed that most of the primary science curriculum projects, such as the Bendel State primary science project (BSPSP), African primary science project (APSP) and the Yoruba science project emphasized on adequate training and retraining of science teachers. For Nigeria to attain a sustainable science education, the contemporary primary science curriculum should emphasize on the training and retraining of science teachers in part time courses, seminars, workshops, conferences,

sandwich programmes and in-service programmes. Such training will help to produce the high calibre of teachers that can be used in the implementation of the Basic Science Curriculum. The uses and application of appropriate teaching methods should also be seen as another missing link in the contemporary primary science curriculum, which need to be borrowed from the various primary science curriculum projects, as well as from the international contemporary on-going curriculum projects in science teaching. This is with a view on constructivist approach to curriculum development. (Driver, 1988; Duschl and Gitomer, !991) which emphasizes active learner participation in the construction and explanation of knowledge. Wokocha (2000) observed that even with their training, most primary school teachers lack the skill in observation, practical investigation and inquiry aspect of science. Ogunuyi (1981) referred to the method used in teaching primary science as mainly informational and memory question. Primary science should adopt the discovery method used in teaching primary science. The use of such method will help develop in the children the spirit of curiosity and critical thinking, which are vital instruments in the development of scientific attitude in children.

In a similar view, the provision and utilization of adequate pupils text and teachers guide in the revised edition of the primary science curriculum is grossly inadequate. Maduwesi (2005) reports that after the review of the contemporary primary science curriculum in 2004, none of the States in the Federation has taken the bold step to distribute the curriculum to the primary school teachers not to talk of teacher's guide and pupil's workbook. The implication is that aspects of the content of primary science taught in our school system may be obsolete and outdated. The Yoruba six years primary science project has identified the importance and utilization of pupil's text, pupils' workbook and examination data bank in its effort in the teaching of primary science.

Another significant area that needs to be emphasized in the present primary science curriculum is the use of mother tongue as a medium of primary science instruction. Jeremiah (2004); and Ajewole, &Badejo, (2004) report that the teaching of primary science with mother tongue (Yoruba) was a pioneering effort, which unfortunately has neither been further developed nor adopted for the use in primary schools in Nigeria. Today, instruction in primary schools is still carried out in English Language thereby creating in pupils' concentric circle of difficulties in understanding science, which they later carry into the secondary schools. Nigeria has to borrow a lot from this curriculum project and utilize the child's immediate language in primary science instructional process. Lastly is the issue of laboratory and school facilities. No meaningful science teaching can be carried out without a good science laboratory and related equipment. Igwe (2002) contends that none of the one thousand and thirty three (1,033) public primary schools in Rivers State can boast of a good science laboratory. In a situation such as this, it means that experimental and discovery methods of teaching cannot be applied and children cannot be made to do science as scientist as recommended by the science programme of primary education improvement project (SPPEIP).

Primary Science and sustainable Science Education in Nigeria A critical assessment of the various primary science curriculum innovations indicates Nigerian efforts towards the improvement of science teaching and learning at the primary school level. It also indicates that the present primary science education curriculum borrowed a lot from the various primary science projects introduced in different states of the country at different times. Government efforts towards the teaching of science in primary schools in Nigeria looks very good on paper but its actual implementation does not seem to be taken with seriousness. This therefore calls for the need for a re-thinking and re-educating ourselves on the importance of primary science as it affects our science education at the other levels of education. (Alamina, 1987; Jeremiah, 2004) commenting on importance of science as it affects our national life have stressed that science education when properly implemented at the primary school level will enable the development of science skills and attitude in children. Such science skills and attitude will be useful in the study of various fields of science and technology, trades and occupations people might later in life find themselves.. In another view science education at the primary school level will help to breed a crop of scientist and technologist that will man our industries. Elule (2002) contends that with a strong background in science and technology, the Nigerian workforce will improve thereby leading to high productivity and economic empowerment of its citizens. The foreign reserve, which hitherto has been used for importation of technology and manpower, could be channeled to the needed basic welfare of the citizens such as health, education, shelter and agriculture.15

Today our educational system is built on the philosophy of promoting a united, strong and self-reliance nation, a great and dynamic economy, a just and egalitarian society, a land of bright opportunities for all citizens and a free and democratic society. Nigeria cannot attain this philosophy as documented in the National Policy on Education (FRN, 2004) without a strong scientific and technological base.

Conclusion

This work has examined the various primary science curriculum projects and how they have affected the National primary science curriculum. The study observes that government efforts towards the teaching and learning of science at the primary school level looks very good on paper, but its actual implementation has not been evident. This paper therefore suggests that the practicability of the principle of self-reliance will greatly depend on a well-articulated and implemented qualitative primary science education which will give a sound base for the breeding of the needed crop of scientist and technologist who will man the nation's industries.

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