

REFORMS IN SCIENCE EDUCATION CURRICULUM

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Abstract

A review of science education in Nigeria shows that performance has fallen below expectation despite the enthusiasm demonstrated by both the policy makers and the implementers. Hence Science educators have continuously sought avenues to make teaching and learning easy because of the awareness of the importance of science in raising the quality of life for mankind. Over the last two decades, there has been respected calls for reforms aimed at improving the science education curriculum with some positive changes, much work remain undone. This paper focuses on curriculum reforms with emphasis on instructional methods which have been well identified above others to providing meaningful learning for science. As a way forward, teachers in the field need to be exposed and retrained on new innovations in the teaching-learning of science and also the Government should make use of qualified science teachers. It was recommended that regular workshops, seminars and conferences should be organised and sponsored by Government to create awareness of these innovative teaching strategies, provision of facilities especially power for the utilization of these strategies.

Science Education may be explained as those methods employed in the teaching and investigation of Science. These methods directly influence the enhancement of scientific knowledge. A discipline concerned with the study of the interaction of science and society, that is the study of the impact of science upon society as well as the impact of society on science.

Science education received a boost in Nigeria in 1968 when Curriculum Development Committees were formed to provide a basis for the re-ordering of science teaching and learning in our secondary schools. Such complaints covered the curriculum content, instructional materials, teaching strategies and the provision of equipment. In effect the content and organisation of our secondary schools science curriculum were defective. Since Science Education at the tertiary level depends on the products of the secondary level, the effects of the defects on science teaching and learning at the secondary level have

The building of a good science education to give the required education in every field is thus justifiably evident; to promote the development of intellectual qualities and skills. In Nigeria toeing the lives of global trends in science teaching, and as a response to local cries coupled with the challenge to develop an indigenous science education programme, the stage was therefore set for curriculum development activities. This saw the emergence of bodies such as Science Teachers Association of Nigeria (STAN), Nigeria Integrated Science Project (NISIP), Comparative Education Study and Adaptation Centre (CESAC) United National Educational Scientific and Cultural Organisation (UNESCO), Physical Science Study Committee (PSSC), Biological Science Curriculum Study (BSCS), Chemical Bond Approach (CBA), Nigeria Secondary School Science Project (NSSSP), National Primary Science and Mathematics Project (NPSMP). All these bodies heralded the first national effort at science curriculum development to improve science education in Nigeria.

Objectives of Science Education

Generally, the primary objective of school science has been to develop skills in young people which enable them to make national choices in problem situations relating to their environment. Others include

- To rationalize curricula and render it more relevant for the African environment
- To establish scientific literacy among the population so as to minimize or abandon colonial exploitation
- To debunk myth and superstition, so as to rationalize peoples ideas and practice
- To effect change in philosophy, methodology and materials in science classroom.

- Through the use of local materials, the learners should be able to inquire into natural phenomena and nationalize his traditional practices.

Reforms in Science Curriculum Education

Reforms in science education could be in the area of curriculum, instructional methods and evaluation. However for the cause of this paper emphasis will be on reforms in instructional methods.

Since curriculum development is a dynamic process, changes in society and in the subject content do call for reviews in the form of reforms and improvement in curriculum. Because curriculum development itself is a very slow process, it often happens that while curriculum is being developed or reviewed or implemented, certain changes already make some of its components either obsolete or out of tune with time. While this does not invalidate the entire curriculum, it requires that it must be reviewed in order to bring it in line with current thinking or emphasis in education.

Because of the dynamics of social changes and the peculiarity of educational demands in different settings, the factors influencing curriculum reforms particularly in science education do vary from place to place. In Nigeria, as indeed in the developing countries, sporadic educational reforms have been witnessed because of the need to address the crisis in educational quality. The interaction among authority, community and school will continue to produce the outcome that calls for curriculum reform. But the focus is to produce a curriculum that is functional, effective and relevant to the demands of the constituent parts of the entire community. This is why the concept of curriculum reform in science education is important and the necessary skills needed to effect this need to be available to a large number of personnel within and outside the school system. The issue of who should develop or review curriculum is an unsettled one. Basically, everybody should contribute towards curriculum development/review since viewing education as democratic requires input from several sources. However, the issue is restricted to those professionally and statutorily qualified to handle the business. Professionally, teachers and specialists in curriculum and instruction are qualified to carry out reforms. Depending on the provision in a country, this function could be restricted to a body at the national level or dispersed to bodies at the State level or at smaller communities. Even when a body is statutorily so identified, others could take initiatives at varying degrees for specified purposes. The situation in Nigeria is straight forward. The Nigeria Educational Research and Development Council (NERDC) is statutorily responsible for curriculum development /reforms at all levels in the country. The import of this is that any curriculum proposal that needs the approval of government for national use must go through the council to the appropriate bodies for consideration and final approval of the National Council on Education (NCE). Of course, this arrangement holds for both primary and secondary schools. For tertiary institutions, the practice is different. The National Commission for Colleges of Education (NCCE), the National Board for Technical Education (NBTE) and the National Universities Commission (NUC) handle the curricula of Colleges of Education, Polytechnics and Universities respectively. Individual institutions have authorities to approve programmes so recommended by the appropriate academic committees/boards within the general guidelines provided by supervising agencies.

Despite the provision for school curriculum development/review, State ministries of Education do organise curriculum review activities mainly for the purpose of enrichment and stressing local peculiarities where necessary and as appropriate. This is because a national curriculum guideline is available and all activities and programmes are related to and derivable from it. The Teacher Resource Centre in each state is designated in the National Policy on Education to carry out such activities.

Process of Reforms in Science Education

Ughamadu (2006) identified six steps that are followed or arranged in chronological order for effective reforms

1. ***Identification of the area that needs reform and then agreement on the need for reform:***
This will involve the innovator and those concerned with the system to observe and study activities in the school and the society. From the study, acts that do not satisfy the needs of the learner, school and society can be identified. In this situation, suggestions for change will be made and agreement as to the area that needs change will be reached.

2. **Identification of direction of reform:** This means thinking out new objectives which invariably implies having one or more new practices (innovations) that will most probably meet the identified needs. It is at this stage that better alternatives to replace old ideas requiring change are thought out.
3. **Organisation of workshops:** Whereby relevant curriculum materials are produced and training of teachers and other personnel on the innovative practices or alternatives.
4. **Field testing and evaluation of new practices or alternatives:** This involves what is regarded as experimental try out or field testing of innovative ideas with a pilot group similar to the group that will eventually use the new package. Usually some selected schools are used as pilot schools for experimental tryout or field testing. Any defect detected at this stage is expected to be corrected.
5. **Dissemination and adoption of the innovation:** If the new practices or alternatives tried out in step 4 turn out to be successful, such new practices or alternatives will then be disseminated to schools to be adopted and put into operation
6. **Evaluation:** As the new practices or alternatives are being operationalised, they will be subjected to constant evaluation so as to establish to what extent they are achieving expected results.

Instructional Methods Reforms in Science Education

Instructional methods are perhaps one major segment of education that have undergone significant changes (reforms) in recent times. The choice of methods of teaching has multiplied greatly in recent yet some teachers have not embraced some of these methods.

Instructional methods can be easily explained as the identifiable systematized process of presenting any subject matter to learners often broken into a sequence of activities or steps or techniques (Inomiesa and Osakwe 1998). It is therefore an umbrella word embracing design and procedure in an interrelated matter. The effort to improve the teaching-learning process is a continuous one. It is this effort that has led to the various reforms in the teaching learning process. Science educators have in modern times emphasised the use of these reformed methods which have been well identified above others to provide meaningful learning for students (Gbamanja, 1991). Since scientific and technological knowledge are not static, researches are going on with the aim of improving the standard of education especially science education. Modern methods of instruction are also being formulated to facilitate easy comprehension by learners as a way of improving students' academic performance. Unfortunately, the performance of Nigerian candidates in the Senior Secondary School Certificate Examination conducted by the West African Examinations Council (WAEC) and the National Examination Council (NECO) have generated so much concern from the government and the general public over the years. Factors responsible for this poor performance include inadequate numbers of science teachers, poor motivation for teachers, inadequate laboratory materials, archaic instructional methods among others. Science educators have in modern times emphasised the use of these reformed methods which have been well identified above others to provide meaningful learning for students These include:

1. **Cooperative learning:** This is another contemporary method of achieving teaching/learning objectives among group of learners through cooperation rather than competition. Cooperative learning is defined as one in which the goals of separate individuals are so linked together that there is a positive correlation towards the attainment of set goals. This means that an individual can obtain his/her goals only if the other participants in the group can attain theirs. Umeoduagu (1995) notes that the concepts of cooperative learning stems from the prevailing principles that learners in a cohesive group work mutually together for the attainment of set educational objectives
2. **Concept Mapping:** Concept mapping is a learning strategy that many students find useful in understanding complex ideas and clarifying ambiguous relationships. Creating a graphic representation of a topic often can help you visualize key concepts and organise your knowledge more clearly than will other methods of study. A concept map is a two-dimensional representation of the relationship between key ideas. It shows us how we think and suggests affinities and associations that might not otherwise be obvious. At first glance a concept map

looks like a flow chart in which key terms are placed in boxes connected by directional arrows. Based on educational psychology theories of how we organise information, concept maps are hierarchical, with broader more general items at the top and more specific topics arranged in a cascade below them. They are metacognitive tools that empower the learner to take charge of his/her own learning in a highly organised and meaningful manner. Ausubel (1968) describes this type of learning as one which requires learners to relate new ideas to their existing conceptual knowledge.

3. **Independent Learning or Project Method:** In this method of learning, the student identifies a problem, carries out a study on the problem with the guidance of a teacher called the supervisor. The student carries out projects usually with minimum supervision and direction. Teachers encourage qualified students to participate and expose them to possible projects; approve appropriate ones, supervise as required and grade the completed project.
4. **Individualised or Programmed Instruction:** This was derived from Skinner's theory of operant conditioning. The major characteristics of individualised or programmed instruction include the following
 - i. An ordered sequence of items, either in the form of questions or statements to which students are asked to respond.
 - ii. The students responses and
 - iii. Provision for immediate response confirmation.Individualised or Programmed Instruction is an individualised activity and so requires only one person. Different students using the same programme progress at different rates and branches off differently when there are branches. Students respond to each stimulus on their own through checking a response or writing short answer and attending to positive reinforces provided by the correct answers. The teacher selects programmed materials for the student and monitors his progress through the material.
5. **Dalton plan or Assignment Method:** This is a method of teaching where the content of a course is analysed and broken down into monthly units and then weekly and daily activities and given to the class. The class members are given all the directions, instructions, books, other equipment and materials and asked to start off working on the activities. The students usually work at their own pace and speed. Usually after a period of time, a test is administered so as to see how far each child has done in the assignment. Any student who completes his assignment is given another one while the other who did not finish will continue working on them.
6. **Discovery Method:** This is another method of teaching in schools. The discovery method is also called the "Heuristic Method". This method as the name implies is a method by which the pupils discover things for themselves. The pupil is put in the position of a pioneer and he finds his way along the path of knowledge as did those who first discovered the facts, principles and laws which are now known to all. As a teaching method, it was first systematised by Professor Armstrong as method of teaching. The scientific method is not of necessity confined to the subject of science. The objective of teaching by the discovery method is not so much to teach facts in science but to teach how knowledge of facts may be obtained, how they can be systematized and of how they may be used. Pupils who are taught in this way learn to be observant, exact and to think for themselves.
7. **Team Teaching:** team teaching is one of the reform teaching model that aims to improve the teaching-learning process. Mkpa (1992) asserted that team teaching is a process involving two or more teachers who work together closely in planning, carrying out and evaluating the learning experiences of a group of students, usually the size of two to five conventional classes. When for instance we have a number of teachers coming together to plan, carry out or implement and evaluate the learning of a group of students, we can say that they are involved in team teaching. Team teaching has also been viewed as an arrangement between two or more teachers who combine their abilities and interest to complement each other and assume joint responsibility in instructing students, a "team leader" or "master teacher" is sometimes designated to provide leadership to the team. As an innovative reform teaching model in curriculum implementation, team teaching is becoming a common feature in tertiary institutions.

8. **Computer Assisted Instruction (CAI):** Umaru (2000) described Computer Assisted Instruction as a programme of Instructional material presented by means of a computer system. It is a way of individualising instruction by using the capabilities of the computer to provide interactive experiments. According to Okoye and Ughamadu (1998), CAI means an instructional design whereby computer system delivers instructional directly to learners by allowing them to interact and relate with design lesson that have been programmed into the system. Computer Assisted Instruction is usually designed and presented in such a way that the attention of the learner is generated right from the onset of the learning process. The attention is sustained and maintained through appropriate programming and the stimulus response chain of activities (Akinyemi 1998). The learner is an active participant and since science education is all about discovery and inquiry, the learner is at advantage of discovering new areas under the instructors' supervision.

The Way Forward

The following are put as the way forward:-

1. Since funding plays a vital role in the successful implementation of these innovative strategies, government should ensure proper and adequate provision of funds for meaningful realisation of these strategies.
2. Each science subjects must have separate well equipped laboratory in accordance with the standard of the Federal Ministry of Education(2002) were these strategies will be well implemented.
3. Science educators must take great care to properly identify the students and thereby utilise instructional strategies appropriate at every point in time.
4. Government in collaboration with other stakeholders should ensure adequate provision of instructional resources needed along side with the teaching-learning strategies to ensure effective realization of the aims and objectives of science education.
5. Making use of professionals in the teaching-learning of science at all level will enhance productivity. Professional knows what to provide, how to provide, how to go about his lessons, the strategies to be employed, which materials are needed and when to use the materials.

Conclusion

Students learn better when they are exposed to learning activities (reformed instructional methods) Nigeria therefore needs caring, competent, talented and dedicated science teachers for the 21st century because it is recognised that teachers are key individuals for all reform efforts and should be placed at the centre of all educational reforms.

Recommendations

The following are some recommendations:-

1. Regular workshops: Seminars and conferences need to be organised and sponsored by government to create awareness
2. Policy makers, school heads should ensure that research findings especially on these instructional methods are implemented in teaching rather than being abandoned
3. Provision of facilities especially power supply for the utilization of these methods
4. Most of the reformed instructional methods are student-centred. Teachers should have a good relationship with their students for effective utilization.

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