

PAPER 15

WAY FORWARD FOR STEM EDUCATION

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Abstract

The evidence of science is seen all over the globe. The developing countries are yet to catch up with the advanced countries of the world. Teaching science in secondary schools is very necessary if Nigeria should advance particularly in science and technology. Reform is needed in science curricula, in guidance and counseling as well as in science teacher training. A number of recommendations are therefore presented in this paper as the way forward.

Introduction.

The most obvious effect of science has been its medical and technological applications, with the accompanying effects on health care, life styles, and social structures. But science also influences culture, in many modern societies, by playing a major role in shaping cultural world views, concepts, and thinking patterns. Despite the numerous usefulness of science in everyday life, it has the problem of students' performance in Physics, Chemistry and Biology and this has become a major concern in science education. One important aspect of concern is reform needed in the curricula in the science subjects. It is important to note that science and technology are useful in the world today. Almost all aspect of man's life is influenced by science either directly or indirectly (Eze, 2003). Man needs to be scientifically literate to exist comfortably well in his environment. This informs the need for inclusion of scientific literacy in the goals of education in Nigeria (FME, 2008)..

The National Curriculum Conference held in Lagos in September 1969 is one of the most significant efforts in curriculum change in Nigeria. The conference is unique for being the first type in which Nigerians from varying walks of life met to examine their colonial system of education and to determine the type of education which would reflect their needs, aspirations, culture, changing values and economic system. The conference has been followed by the establishment, as a statutory body, of the Nigeria Educational Research Council (NERC) responsible for the coordination of all curriculum activities at national level. Under the auspices of the NERC, (now known as Nigeria Educational Research and Development Council, NERDC),

various workshops including those on the secondary school curriculum (1973) have been organized. In these workshops, objectives at subject level have been considered in detail and outline syllabuses produced. The curriculum activities of the NERC are currently being supplemented by various subject associations such as the Science Teachers Association of Nigeria (STAN). In recent years, STAN has undertaken major subject revisions, developed various curriculum materials and familiarized school teachers with curriculum innovations by means of workshops and conferences.

School science (Physics, Chemistry and Biology) education reform has also been with us since shortly after science began to be a formal part of the school curriculum. Recent reforms curriculum have been focused on activities designed to modify, either gently or radically, the ways by which science teachers teach and students learn science (Staniski, 2005). In Nigeria, and following Nigeria's endorsement of International Protocols for Education for All (EFA) and the Millennium Development Goals (MDGs); and subsequent adoption of the National Economic empowerment and Development Strategies (NEEDS); it became imperative to update existing science curriculum to cater for contemporary needs of the nation as a country aspiring to be among the first economies in the world by the year 2020 (Obioma, 2007; NERDC, 2007).

According to Obioma (2007), the articulation of science education curriculum reform in Nigeria is to pay particular attention to the achievement of the Millennium Development Goals (MDGs) and the critical elements of the National Economic and Development Strategies (NEEDS). Such was variously matched in the UK, with the publications of the Deering Report Review of Qualifications for 16-19 year olds and the Department for Education and Employment Publications Qualifying for Success and Learning to Succeed, collectively known as Curriculum 2000; in South Africa with Curriculum 2005 (Rogan & Grayson, 2003), in Canada via the Pan-Canadian Framework of Science Learning Outcomes initiated by the Council of Ministers of Education, Canada (Hart, 2002). On a broad international scale across 23 countries, the reports by the Organization for Economic Cooperation and Development (OECD) resulted in the development programme of Science, Mathematics and Technology Education (SMTE) (James, Eijkelhof, Gaskell, Olson, Raizen and Saez, 1997). What each of these reports has in common is the need to engage all students throughout their schooling with science, irrespective of academic ability and social/economic background.

Reforms of Science Textual Materials

According to Staniski (2005), most general science curricula are driven by textbooks and workbooks. The availability of suitable textbooks in teaching and learning activities is central in achieving the revised objectives of the curriculum. According to the National Policy on Education, the present textbooks are unsuitable, inadequate or very expensive for students. The new science curricula require appropriate textbooks and reference books. In spite of the centrality of textbooks in the teaching and learning activities, teachers should not enslave themselves to particular textbooks or a set of materials. Science teachers must understand and use the freedom that they have to adapt and to supplement the materials to conform to the needs and interests of the learners. Design of textual materials should adopt an alternative approach to descriptive science that is different from a systematic coverage by scientific families of occurrence, properties, and uses of selected elements. The suggested alternative approach, should integrate socio-technological topics such as: global warming, stratospheric ozone depletion, and consumer-based products (synthetic polymers, solid-state electronics, petroleum-based energy, thermal expansion, wave propagation,

genetics, ecology radioactivity) as ways to illustrate and apply scientific principles throughout the textbook rather than in isolated chapters.

Implications for the Reforms of School Science Curriculum

From the foregoing paragraphs, it would seem that if success could be counted by the number of curriculum development projects and the number of syllabus changes, our record in Nigeria would be impressive. Despite the new syllabuses, new books, curriculum conferences, and international programmes, relatively little impact is actually being made on the general school curriculum. The process of curriculum reform and its success rely on informed teachers who themselves are responsible ultimately for the implementation of new curriculum, assessment practices and standards of student performance (Peers, Diezmann, Watters, 2003; Okunrotifa, 2008). Reforms also involve change to teachers' professional practice both in the classroom and in the reporting of student learning. For many teachers, change is difficult to achieve and sustain because of inadequate professional support and resources (Atkin & Black, 2003; Wallace & Loudon, 2003; White, 2004). Fundamental research on how students learn by constructing knowledge has shown that students have different learning styles. It is a fact with science education research today that, learning methods which encourage students to engage scientific concepts collaboratively have been shown to enhance science students' performance, persistence and attitude. This is so because, as students work with one another, they also learn from one another. (Landis, Ellis, Lisensky, Lorez, eeker & Wamser, 2001). Therefore, the need to build capacity of the teachers and support staff in the implementation of curriculum on continuing basis cannot be over-emphasized. Government and school proprietors also need to put in place the necessary facilities for effective implementation of the chemistry curriculum.

Also, to improve science education, Schmidt and others believe that secondary schools need to overhaul their current science curricula. One such plan for reform is the physics-first curriculum, a strategic plan that reverses the order in which schools teach science. In the physics-first curriculum, secondary school students learn the scientific process and explore real-world phenomena such as photosynthesis and gravity, giving them basic knowledge that will help them even if they do not pursue a career in the sciences. In addition to emphasizing scientific process, as its name suggests; the physics-first curriculum has students learn physics before chemistry and biology. Bardeen and Lederman say true understanding of biology requires knowledge of chemistry, which in turn requires physics knowledge. Bardeen believes that a physics-first curriculum fasters coherence in education, allowing students to build upon what they already known. For example, to fully understand chemical topics such as atomic structure, students need some grounding in electrostatics, a topic taught in physics.

With respect to biology, its numerous contributions to modern living have made it a popular subject. Students rush to offer it even though they fail to possess very good grasp of its fundamental principles. As a result the performance rate is poor. This is because of difficult topics in the subject which are often ignored by students and even teachers. Areas of difficulty in secondary school biology curriculum include ecology and genetics. Ugwandu (1984) observed that ecology and genetics concepts are difficult for teachers of biology. Reasons given for such difficulties include the fact that:

- (a). there is inadequacy of resources for teaching these concepts in biology
- (b). teachers generally use unsatisfactory resources and even when available they use it wrongly.
- (c). there is also the general unsatisfactory field and practical work in schools.

The above reasons have negatively influenced the teaching and learning of biology in schools. The reasons are still prevalent in our school system today. In addition to all the above, guidance and counseling is needed in schools to achieve balanced education. The three main domains of education (i.e. cognitive, affective and psychomotor) are essential and students need to be properly equipped to develop and acquire skills in the three main areas. Specifically, in area of science and technology, Nigeria requires citizens who are well equipped to meet the challenges of the modern developed in science and technology. To achieve this, there education reform is highly desirable. The following have been identified as some factors hindering effective performance of school counselors in Nigerian schools:

- (a). Non-availability or inadequate number of professional counselor in schools.
- (b). Due to inadequate number of counselors, the activities of most counselors are geared towards the average students or the neediest leading to inadequate support for other students.
- (c). as a result of inadequate number of professional counselors, career guidance is given little or no attention consequently many students are not properly guided on the choice of careers.
- (d). In most schools, other priorities (e.g. teaching and continuous assessment) take precedence over counselors; and
- (e). In schools where counselors are available they are usually assigned other duties other than counseling (Umoh, 2004).

The consequences of these lapses are that students are inadequately guided to take maximum benefit of education programmes. Also, cases of deviant behaviours among the youths continue to increase. There is, therefore, the need for the reform of the Nigerian educational policy especially as it relates to guidance and counseling in schools. The following are considered relevant:

- (a). The provision of guidance and counseling services should be strengthened in all levels of education in Nigeria. Counseling should not be limited to post-primary schools only because everybody at every level of education requires counseling.
- (b). Government should comply with 26 percent allocation to education as prescribed by the United Nations Education and Cultural Organization (UNESCO). If this is done, it will facilitate adequate provision of personnel and facilities for the Implementation of guidance and counseling programme in Nigerian schools.
- (c). Quality assurance should be enhanced in schools through effective supervision and monitoring of teacher's and counselor's job performance in schools; and
- (d). Counseling should be fully recognized as a profession and counselors well remunerated.
- (e). Counsellors should not engage in teaching at the secondary school level because they are not trained to teach.
- (f). There needs to be increase in the units of physics, chemistry and biology courses by science education students in the university.
- (g). The university should strengthen and enforce higher weighting to practicals to better equip science education graduates to carry out experimental researches and simulations.
- (h). The secondary school science teachers on the job need to be retrained in order to be abreast of development in education.

Conclusion

In conclusion, Nigeria has the option to remain undeveloped or to advance. It is not possible to have the required technical know-how without proper development of science education at the secondary level.

Science teaching in the secondary schools in Nigeria can be greatly improved upon if necessary reforms are made.

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ISBN 978-88-85813-56-4
ISSN 2420-9732
DOI: 10.26352/D321_2420-9732

First Edition March 2019

© Copyright 2019 Filodiritto Publisher
filodirittoeditore.com
inFOROmatica srl, Via Castiglione, 81, 40124 Bologna (Italy)
inforomatica.it
tel. 051 9843125 - Fax 051 9843529 - commerciale@filodiritto.com

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