Lagos State University, Ojo, Lagos State, Nigeria

From the Selected Works of Bolanle Danmole

Spring 2013

Road Map to Technological Development in Nigeria: The Place of Science Education

Bolanle T. Danmole, (Ph.D), Lagos State University, Ojo, Lagos State, Nigeria

This work is licensed under a Creative Commons CC_BY-NC-SA International License.

Available at: https://works.bepress.com/bolanle-danmole/
Introduction

More than anything else, a nation’s development in all spectra is a function of its quality of education. Similarly, a country determined to elevate itself into the league of the science-and-technology giants of this world must give adequate attention to the quality of its science and technology education. There is no gainsaying the fact that science teachers are the backbone of the Science technology and mathematics (S.T.M.) education in the country, and consequently the indispensible human-resource tool required to achieve the goals of
science education. Science and technology has for been pre-eminent for long as the instruments par excellence for nation-building, and every country today craves for their advancement (Bybee 1993; Nwagbo 2000; Opara 2004).

According to Acquaye (2001), today, apart from raising the people's standard of living, science has enabled developing nations improve on their aspirations to match the fact of advancement made in industrialized countries in all facets of development—agriculture, shelter, communication, transportation, health, sources of energy, and environment. In the last decade alone, new societal and economic policies and priorities have been borne as a result of globalization. Many countries, therefore, in the search of a new world order to compete effectively and profit maximally from the global village emerging, are redefining their priorities. There seems to be a paradigm shift from industrialization to technological development and advancement brought about by knowledge-explosion and information-management.

We all are aware of an increasing number of science-and-technology-related problems as well as increasing benefits to society. Because science and technology is central to our personal and cultural welfare and to many societal problems, we must ensure appropriate science education for all citizens, a scientific literacy programme is basic for living, working and decision-making (N.S.T.A., 1980).

This chapter tracks the history and development of science education over the years (1859 through 2011), and an overview of science education in Nigeria today, with challenges identified. We also discuss government's provision and support for science, technology and mathematics education and its impact on
the technological landscape, reiterating its pre-eminence in the technological development of Nigeria.

Development of Science Education in Nigeria

Like many African countries, the entry of science into the schools dates back to the era of the colonialism. According to Abdullahi (1990), science was first introduced into the Nigerian curriculum in 1859 in the C.M.S. (Church Missionary Society) Grammar School in Lagos, as rudiment of Nature Study. Bajah (1982) describes the science introduced as that of environment and hygiene. Other schools such as St. Gregory’s College, Lagos, Hope Waddell Institute, Calabar, and Baptist Training College, Ogbomosho, followed later in teaching the subject, Nature Study. A rural-science syllabus and curriculum was later formulated for teaching science in the primary schools, with the simple objectives of developing clean and healthy habits, a knowledge of nature, especially of plants and animals, and the principles and techniques of farming.

At the secondary-school level, biology-related subjects were introduced, such as Botany, Physiology and Agriculture. The enthusiasm for teaching nature study did not last long and by about 1920 it had lost its attraction and many teachers had begun to show their dissatisfaction (Igwe 2003). Following the recommendation of an African education commission sponsored by the Phelps-Stokes Fund in the United States to tour British colonies in West Africa, the teaching of science began as “general science,” and after 1950, was elevated from to physics, chemistry and biology.

With Independence in 1960, a number of international conferences were held in the sixties which focused attention on de-
developing countries, especially in Africa, on the need for Science and Technology education, prominent among which was the 1969 Curriculum Conference. After the conference, local initiatives at developing curricular commenced and a number of science-based ones emerged for the primary and secondary schools in the North and South. These curricular had guiding principles and objectives for establishing them and emphasis on inquiry and science teaching. A list of the different projects developed is presented below.

### Table 1: History and Development of Science Education (1859–2011)

<table>
<thead>
<tr>
<th>Date</th>
<th>Science Education Curriculum</th>
<th>General Principles</th>
<th>Challenges</th>
</tr>
</thead>
<tbody>
<tr>
<td>1922–1969</td>
<td>Physics, chemistry and biology as separate subjects as reviewed by WAEC. General science.</td>
<td>Realization that modern times were operating in the realm of physical sciences for revolutioing industrial and social activities.</td>
<td>Rote-learning was promoted by didactic teaching methods, making science difficult for most learners and few opted to study it.</td>
</tr>
<tr>
<td>1969–1983</td>
<td>African Prim. Sci. Program (APSP); Basic Science for Nig. Sec. Schools (BSNSS); The Ife Yoruba Project (YSPP); Midwest Prim. Science Project (MPSP); Prim. Education Improvement Project (PEIP); Nig’n Sec. Schools Science Project (NSSSP); Nig’n Integrated Science Project (NISP); CESAC, NISTEP, nomadic &amp; riverine education.</td>
<td>Programs emphasize that science is a progressive inquiry, discovery and process approach for teaching teachers with new pedagogical skills and a need for a new breed of teachers. To provide students with the foundation for later science.</td>
<td>Practical laboratory practices fell behind expectations of expected approach. Persistence of rote learning among learners.</td>
</tr>
<tr>
<td>Date</td>
<td>Science Education Curriculum</td>
<td>General Principles</td>
<td>Challenges</td>
</tr>
<tr>
<td>----------</td>
<td>-----------------------------------------------</td>
<td>------------------------------------------------------------------------------------</td>
<td>-------------------------------------------------</td>
</tr>
<tr>
<td>1994–2004</td>
<td>6–3–3–4 system tried to overhaul all existing science-based programs</td>
<td>Views science as key to basic national development leading to an increase in content of curriculum.</td>
<td>Over-ambitious curriculum, grossly unmatched by infrastructure, teaching methods, materials and unprepared teachers.</td>
</tr>
<tr>
<td>2004–2008</td>
<td>Basic science as contained in UBE/MDGs/NEEDs, STEP-B project</td>
<td>STAN expansion of science subjects to cover agric science, home econs, PHE, intro tech. &amp; computer. Primary science gains new emphasis.</td>
<td>Teachers find required methods, attitude and deadlines impossible to meet; frustration, indifference and despair.</td>
</tr>
</tbody>
</table>

*Source: Adapted from Gyuse et al., 2011, 52nd Annual S.T.A.N. Conference Proceedings.*

**State of Science Technology and Mathematics (S.T.M.) Education Today**

Perhaps it is pertinent to commence the discourse on the state of S.T.M. in Nigeria today on a positive note by highlighting the provisions available to support it as itemized (Yoloye 1997).

a. Ministry of Science and Technology expected to formulate and manage policy on science and technology in the country as recorded by Madumei, Okonkwo and Okon (1995).

b. Establishment of 18 scientific and technological research institutes known as parastatals under the Ministry of Science and Technology located in different towns nationwide.

c. Establishment of three other agencies with
specialized functions related to science education. Two in the Presidency and a third in the Ministry of Education:

i. The National Mathematics Center, Abuja;

ii. The Sheda Science and Technology Complex, Abuja;

iii. The Energy Commission of Nigeria in Lagos

d. The Nigerian Educational Research and Development Council (N.E.R.D.C.), a curriculum development agency charged with the responsibility of developing curriculum and books in science education for primary- and secondary-school levels.

e. Training of primary school teachers annually by National Teachers Institute (N.T.I.).

f. There are thirty-six universities and polytechnics and sixty-one colleges of education that provide science education at tertiary level in Nigeria.

g. The basic science and technology curriculum.

Four professional associations which also promote science technology and mathematics education are well established:

a. The Science Teachers Association of Nigeria (S.T.A.N.),

b. The Nigerian Academy of Sciences (N.A.S.), considered the peak of scientific organization,

c. The Science Association of Nigeria (S.A.N.),

d. The Mathematics Association of Nigeria (M.A.N.),

e. S.T.A.N. and M.A.N. make their contributions at the secondary school level, while N.A.S. and S.A.N. function at the tertiary level.
A list of the 18 research institutes and parastatals is shown below:

**Table 2: Research institutes/parastatals under Min. of Sci. & Tech.**

<table>
<thead>
<tr>
<th>Institute/Parastatals</th>
<th>Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Federal Institute of Industrial Research (FIIRO), Oshodi, Lagos.</td>
<td>Research and development in food processing, agro-allied products, textiles, pulp and paper design, and fabrication of prototypes, microelectronics and information services.</td>
</tr>
<tr>
<td>Nigeria Institute of Trypanosomiasis Research (NITR), Kaduna.</td>
<td>Research into tsetse and simulium flies and on the control of onchocerciasis and trypanosomiasis.</td>
</tr>
<tr>
<td>Nigerian Stored Products Research Institute (NSPRI), Ilorin.</td>
<td>Research into storage and preservation systems for agricultural produce.</td>
</tr>
<tr>
<td>Project Development Institute (PRODA), Enugu.</td>
<td>Research into engineering design and fabrication of ceramic products, electrical and electronic products, energy, including coal, and scientific equipment.</td>
</tr>
<tr>
<td>Raw Material Research and Development Council (RMRDC), 28, Beckley Street, Lagos.</td>
<td>Supports and expedites industrial development and self-reliance through the maximum utilization of local raw materials as inputs for industries.</td>
</tr>
<tr>
<td>National Centre for Genetic Resources and Biotechnology (NACGRAB), Moor Plantation, Ibadan.</td>
<td>Husbanding of plant-and-animal genetic resources. Developmental research in genetic engineering and biotechnology.</td>
</tr>
<tr>
<td>National Institute of Chemical Technology (formerly Leather Research Institute of Nigeria), Zaria.</td>
<td>Research into hides, skins, leather, leather products, industrial chemical, polymers and plastics.</td>
</tr>
<tr>
<td>Nat'l Institute for Medical Research (NIMR) 6, Edmond Cres., Yaba, Lagos.</td>
<td>Medical research into communicable diseases, e.g., Malaria, human parasites, etc., nutritional-defect problems, genetic noncommunicable diseases, public health, etc.</td>
</tr>
<tr>
<td>Nat'l Institute for Pharmaceutical Research &amp; Dev't (NIPRD), Abuja.</td>
<td>Research into medicinal plants, herbs and drug development and formulation.</td>
</tr>
<tr>
<td>Nigeria Building and Road Research Institute (NBRRI), 15, Awolowo Rd, Ikoyi, Lagos.</td>
<td>Research into use of local materials and methods in road and building construction.</td>
</tr>
<tr>
<td>College of Chemical and Leather Tech. (CHELTECH), Samaru, Zaria.</td>
<td>Training and development of mid-level manpower in leather and chemical technology.</td>
</tr>
<tr>
<td>Centre for Adaptation of Technology (CAT), 16, Igweze Street, Awka.</td>
<td>Research, development and adaptation of foreign technology to suit local environment and demands.</td>
</tr>
</tbody>
</table>
There is no doubt that science education has made some progress over the years, however, the challenges are still enormous. Ogunniyi (1982) opines that science education is specifically concerned with two basic aims:

a. The production of a scientifically literate society, as well as

b. the development of scientific and technological manpower.

An examination of the first aim above reveals that scientific literacy requires much more than mere acquisition of scientific knowledge. It also entails the process of making science a way of living and behaving. The aim of science education is to develop scientific and technological literacy for all citizens. This implies a general understanding of science and technology in addition to knowledge, processes, applications and information concerning opportunities for those interested in courses related to science and engineering. The second major aim of science education deals with training young to ensure that a large number of them can choose future careers in science and technology.
Five functions of science education, according to the N.S.T.A. (1980), are:

a. To develop scientific and technological process and inquiry skills;

b. To provide scientific and technological knowledge;

c. To use the skills and knowledge of science and technology as they apply to personal and social decisions;

d. To enhance the development of attitudes, values and appreciation of science and technology; and

e. To study the interaction among science, technology and society, in the context of science-related social issues.

Over the years our educational system is not as one would like to believe (Wasagu 2008):

Our implementation strategies have raised more questions than answers. Equally important, almost any allegation against our schools can be demonstrated somewhere. There are students who cannot read, curriculum materials that are irrelevant to the needs and aspirations of students and society, teachers who cannot teach, and schools that are poorly administrated, and what could be in our schools is so great.

From the foregoing it is obvious that science education curriculum at the pre-primary, primary, secondary and the tertiary levels require serious engaged activity in the learning activities. There are other challenges apart from the curriculum confronting science, technology and mathematics education. Some of them are:

**Issue of the science curriculum.** The curriculum is over-
loaded so much that there exists a timetable problem. For example, J.S.S. students are required to study and pass twelve or more subjects before certification, and the lack of understanding of the philosophy and objectives of science teaching by science teachers is a major challenge.

**Lack of adequate infrastructure.** The available classrooms are grossly inadequate. In most public schools, especially primary, pupils are crowded in classes, with more than eighty found in one class. The situation is no better in secondary schools, too. Some buildings are dilapidated, with the ceilings removed. Hence, it is difficult for students and pupils to concentrate on teachers’ instruction. Lack of water and light are conspicuous, there is an obvious lack of laboratories in some schools; the inquiry nature of science is not being taught.

**Nonavailability of instructional materials.** There are no chemicals, reagents, pipettes and burettes in sufficient quantity. Group work is rampant because students are not opportuned to have access to apparatuses individually.

**Shortage of trained science teachers.** Science teachers abound in our schools, especially secondary. Enough teachers are not employed in spite of the large class sizes; there are many unemployed graduate science teachers, hence the few employed are usually asked to teach one or more science subjects. They are consequently overworked due to high number of teaching periods.

**Absence of internet facilities.** The I.C.T. era is here with us. Science teachers are just beginning to learn and take interest in computers, but these are conspicuously absent in schools; where one or two are available, there is no power supply to operate them.
Place of Science Education in Technological Development

The great leap that has been made by developing countries is not unconnected with the quality of education in these countries. In line with the global Education For All (E.F.A.) and millennium development goals (M.D.G.s) agenda, on which the education policies and programmes of the National Economic Empowerment and Development Strategies (NEEDS) is anchored. The latter has four critical components: value reorientation, poverty eradication, wealth generation and wealth creation.

The impact of science education cannot be overemphasized in the realization of these goals. Furthermore, in responding to the emerging world order to strengthen the technological competence and productivity of all nations to meet the challenges of the development strategies, the Nigerian government as a matter of necessity should be on the path to ensuring quality basic education, especially the basic science-and-technology components, to meet the country’s technological development aspiration. There has to be a functional science, technology and mathematics education curriculum relevant to developing countries, world-class infrastructural learning environment (laboratories, classrooms, libraries) and tools (books, computers) that show the importance of education (Cuddy 1997). Improvements in science, technology and mathematics education across all levels are critical in equipping current and future students with the skills to address the rapidly evolving technology needs (Ezema 2011).

No doubt the issues to focus on in science and technology are numerous. However, a proposal for making changes for technological development is as follows:

1. Tackling the issue of science, technology and mathematics teachers supply and quality.
2. Curriculum innovation that will assist in promoting private partnership in science education.

3. Structural, institutional and systematic changes focusing on the current state of science education system, with emphasis on effective teaching and learning of science, technology and mathematics education.

4. Funding for an enlarged and equitable education system, improved government spending, including scholarships to science students.

5. Quality science and technology education should be made available for all regardless of gender, ethnicity or social background.

6. Information and communication technology should be used in planning and promoting 100 percent computer literacy for pupils and students in primary, secondary and tertiary institutions.

7. Entrepreneurial courses relevant to the aspirations of students and the nation should be introduced.

8. Support for research institutes and parastatals by way of adequate funding.

This proposal is by no means exhaustive but the issues raised are very pertinent and fundamental to the impact of science education in the technological development of Nigeria (Ezema 2011).

Addressing the evolving technology needs in a detailed discussion of the items of the proposal presented above.

**Tackling the issue of science teachers supply and quality.** The quantity and quality of this category of teachers leaves much to be desired, especially at the secondary school level. The issue of sufficient number and quality of teachers is not subject
to debate if Nigeria wants to develop technologically. This is the manpower to impart the much-desired knowledge of science and technology. The Ministry of Education should intensify training teachers to boost science teachers’ supply to schools. There is need to ensure that basic science and technology teachers for primary schools and teachers for all the science subjects in secondary schools are available.

**Curriculum innovation for promoting private partnership in science education.** Apart from partnership, functional education is determined by the quality of the curriculum and its implementation. According to Offorma (2005), functional curriculum content must be valid, significant, learnable, consistent with social realities, useful, and reflect the interest of the learners. The content must be related to the philosophy and objectives of science education; challenges of overloading should be reviewed as a matter of urgency. Entrepreneurial studies have just been introduced into the biology senior secondary school curriculum without teachers to teach the skills. It is high time Nigeria embarked on the training of the desired manpower ahead of introducing new curricula. This is one important reason why curricula are seldom well implemented. The 6–3–3–4 education programme is a good example of this submission.

**Structural, institutional and systematic reforms.** The need to address the state of science education system as it affects effective teaching and learning of science and proposing structural reform that will promote science, technology and mathematics education.

**Funding for an enlarged and equitable education system.** If the much-desired technological development is to be achieved, there must be political will on the part of government
to ensure that funding is not a constraint. Education for all requires adequate funding as the government is investing in human capacities.

**Quality education for all.** This is important in order to achieve the Education For All goal. Irrespective of gender, socioeconomic status, religion of citizens, education has become inevitable in technological development. Scientific attitudes should be encouraged right from primary school. Basic science and technology should also be given adequate attention. The need to encourage scientific literacy is inevitable.

**Use of I.C.T.** There is need for planning and promoting 100-percent computer literacy for pupils and students in primary, secondary and tertiary levels. In addition, science teachers themselves must be trained to be computer-literate. The power of I.C.T. can transform science teachers’ education to efficiency and effectiveness. The information revolution and advent of new technologies will continue to open new possibilities for individual and collective empowerment, information exchange and knowledge accumulation (Olibie 2008).

**Provision of infrastructure for promotion of science teaching.** The recent state of educational infrastructure in the country is far below the required standards. The classroom and laboratories must be of high priority if any meaningful science learning is to take place.

**Research institutes.** The eighteen research institutes as presented earlier have been established for research in agricultural engineering, medical, pharmaceutical and other scientific ventures should not be starved of funds.
Conclusion
The world is always changing and every new change that affects the inhabitants positively or negatively is capable of bringing about a new world order. The challenges of meeting the technological and overall needs of the world are entrenched in science education. This is the key to technological development, preparing students for scientific discipline, providing the educational background for students to enter into science and technological professions, and providing a means whereby students can appreciate the contributions of science to society and modern civilization.
References


