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Science and Technology Education in Nigeria: Refocusing on New Approaches

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Abstract: *In this study, we will examine the fact that without science and technology education, no country can achieve positive technology transfer, economic infrastructure, scientific and technological development and industrialization. The study observed that Nigerian citizens can benefit from science and technological education through refocusing on the new trends and development. The study concludes that there is no alternative to scientific and technological development. They are what distinguish the underdeveloped countries from the developed ones. The standard of living, social security, military and political power of the country all depend on the advancement of her science and technology.*

Key words: *Education, Nigeria, refocusing, science, technology*

1. Introduction

In today's world, science and technology are undoubtedly vehicles for socio-economic development. Decades ago, developed nations were more or less as undeveloped as developing nations of today. They are now transformed from rural, peasant communities into highly urbanised, industrialised countries through the development of their science and technology. In the process, they became rich and politically powerful.

For Nigeria to achieve her age-old goal of crossing the borderline between being a developing country and a developed country, she must develop scientifically and technologically. It should be added that science and technology have become integral parts of the world's culture and to lag behind is to be out of place. However, science and technology have continued to have a largely lowly status in developing or underdeveloped societies including Nigeria.

On the cause of the current poor levels of science and technology in the third world countries (including Nigeria), Dr. S.A. Thomas in an article on Chemistry in Britain in 1983 said: "Most third world countries may appear to be looking for salvation in science and technology, they lack the foundation necessary to develop their scientific and technological potentials in real terms. Social attitudes favouring non-scientific endeavours and objects leading to a quest for increased material wealth not justified by increased productivity and optimal utilisation of scarce resources have continued to inhibit enhanced scientific activities…there is a need to solve the problem of inadequate research leadership and generate a crop of policy makers sufficiently on scientific matter, if third world nations wish to improve their lot."

This foundation necessary to develop science and technology in the country is obviously education—elementary, secondary, and tertiary education. Science and technology have to be

taught and studied systematically and purposefully at all levels of education including, at least, first years of tertiary education for the arts and the humanities. It is evident that science and technological transfer and development is solely dependent on science and technology education in the country, for scientists and technologists are definitely required in the economic infrastructure of the society before any scientific and technological development, and industrialisation can occur. Even if students do not further their study of science and technology in tertiary institutions and as a result do not go on to become professional scientists, engineers, and technologists, their experience of science and technology gained from the elementary and secondary levels and first year of their tertiary education will be sufficiently rich and relevant.

Such scientific literacy will equip them to contribute to our country's development in an increasingly competitive and rapidly changing world. In other words, if all students in this developing country, including those in the arts and humanities as well as sciences, were imbued with the curiosity that characterises scientists and the competence that characterises engineers and technologists, all would be in a better position to participate in the solution of the indigenous problems of social and economic development.

There is a need, therefore, to imbibe the science culture in every Nigerian so as to have the proper and requisite foundation on which to develop our science and technology which will in turn develop the country. This is why great emphasis should be put on effective science education to help lay the needed foundation starting from the primary to, at least, the first year of the tertiary level for students of humanities. The government must design specific policies on science and technical education which must be implemented and sustained to promote science and technology curricula at each level of education. This, of course, must include increased funds which should be provided and properly utilised in the educational system.

When scientifically well informed leadership springs up and scientifically and technologically literate citizens abound who are not all about "a quest for increased material wealth" but ways to contribute to problem solving in the society, the right type of environment will exist and illiteracy and superstitions which are prevalent in the country will be eradicated then all these "social attitudes" which have "inhibited third world countries", as Thomas rightly puts it, would have been erased. Nigeria will then have a chance to improve her lot as she finally sets out for scientific and technological development which will in turn hastily pave the way for national development. Underdevelopment which has continually plagued third world countries such as Nigeria, rich in human and natural resources, will be history.

2. New Approaches in Science and Technological Education

As a result of the identified problems with the existing secondary schools science curriculum in the country and the efforts of the Aiyetoro Group, the STAN and CESAC, three science curricula have been developed in Nigeria. The first is the BSNSS developed between 1962 and 1973, the second NISP, developed between 1968 and 1971 and the third the NSSSP, developed between 1963 and 1972.

Soon after the established of the Comprehensive High School Aiyetoro, members of its science department set out to design a general science syllabus for Forms 1 and 11 in the school. In collaboration with Nigerian and foreign educators, a basic science programme, the BSNSS, was developed in two stages. The first stage involved extensive classroom testing of the materials at the school and the production of two teacher's guides for form 1 and 11. The second

stage, which involved a nation-wide trial testing of for materials for their suitability for use in Nigerian secondary schools was undertaken between 1966 and 1973.

Through regular visits to pilot schools by staff of CESAC and science department of the Comprehensive High School, Aiyetoro, valuable feedback was collected, leading to a feedback conference in December 1969 at Aiyetoro. The outcome of this conference led to the restructuring of the materials for suitability for use in secondary schools, crafts and Technical Schools and Teacher Training Colleges. A new edition of the Teacher's guide for Forms 1 and 11 was later published by CESAC in 1973.

Through the co-operation between STAN and CESAC, three viable Curriculum Development Committees in Physics, Chemistry and Biology were formed at the STAN Annual Conference of 1968. The Committees were charged with the responsibility of developing syllabuses for an integrated General Science course for Forms 1 and 11 and for biology, chemistry and physics courses for Forms 111, IV and V. In this association, STAN provided the personnel while CESAC provided the fund from a financial grant by the Ford Foundation through the Federal Ministry of Education. The curriculum development process was to involve the preparation of the syllabuses, the writing of instructional materials, organization of teacher training courses and the trial testing of the materials before final production of the science books. By 1969, the integrated science syllabus was ready and this has been published as STAN Curriculum Development Newsletter Nos. 1-3; the syllabuses in chemistry, biology and physics were also ready and have been published as Curriculum Development Newsletter Nos. 2, 3, and 4 respectively. In these Newsletters, the philosophy of each course was clearly explained and the methodology suggested.

Once the integrated science syllabus was published in 1969, schools started using it and arrangements were made for students and teachers' texts to be produced. Before STAN produced the NISP materials, some science teachers had written some texts based on the new syllabus and requests were received from outside the country for the new proposals in integrated science. This was an indication of widespread acceptability of the new approach to the science course in the junior forms of our secondary schools. At the STAN Conference of 1970 at the Ahmadu Bello University, Zaria, it was declared that the syllabuses produced by STAN could be used in any form by all. Members were free to write books on them. Consequently, we now have four books based on the integrated science syllabus 8-11.

The Science Curriculum Development Conference organized by CESAC in 1969 aimed mainly at preparing some Nigerian science educators with the skills and understanding necessary for the design and production of instructional materials in secondary schools in Nigeria were identified and possible solutions suggested. With the STAN-produced syllabuses in Biology, chemistry and physics as the starting base, the present WASC alternative syllabuses in these subjects and the NSSP texts were produced by CESAC.

In BSNSS, the first attempt to depart from the traditional method of teaching science in our secondary schools was made. The project is a laboratory oriented-child centred activity course, designed to make pupils think rather than accept blindly what the teachers say. Its philosophy of doing science the way the scientists do it was very apt. The underlying theme of the project is energy transfer. The designers of the project recognized the leading role the teacher has to play in developing in the students the intended educational outcomes. They did not approve of a text for the students as they felt that this could distract them from the actual process

of 'doing' science. For the teacher, enough information in course content, methodology and logistics is provided in the guide to enable him effectively direct the activities designed of the students.

The BSNSS has been designed to adequately prepare students for the Form 111 science courses in Biology, Chemistry and Physics. The materials in the guide are very well written and the philosophy meticulously followed. They are the results of several years of trial testing, in schools located at different parts of this country, by teachers who had undergone training and retraining in the use of the project in the country that has been developed through the proper curriculum development processes.

In NISP, an attempt was made to integrate aspects of biology, chemistry and physics in a unified course through the major concept of life, Energy and Matter. The general format of the course is the provision of a few facts, followed by a series of activities which the students are to use to explore the unknown. The expected results of the activities are discussed in a way as to sustain the interests generated in the students through 'doing' science. The teacher's guide discusses both the students' text and the workbook. Adequate suggestions are given for preparation and presentation so that the teacher may help to properly direct the students towards the goal of acquiring scientific attitudes. The student's inquisitiveness must be encouraged, sustained and satisfied. The novelty in this project is that so much science is learnt from the well structured series of activities built round different themes. Although attempt at integration occurs, there is no full integration as such. But the relevance of every topic to the students' environment and experience is fully illustrated. It is a radical departure from the original course in general science and any teacher who follows the guides properly does justice to the course. The popularity of the NISP in the secondary schools in spite of the existence of three other products base essentially on the same syllabus shows its initial success.

Although there has not been any formal evaluation of the enrichment of students' knowledge by the NISP, discussions with science teachers tend to reveal that students now enter the upper forms of our secondary schools with superior experiences in science. This has made teaching of science subjects at the upper forms more rewarding than before. Schools participating in the NSSSP courses have also observed that the NISP courses provides adequate background for the students; this shows a good correlation between the two courses. There has been some complaint that the NISP is not integrated enough even though there is a good blend between the chapters. Although STAN plans to revise the texts very soon, the point needs be made that it is not possible to completely integrate all the topics treated in the texts. For instances, while motion is a unifying concept, it is not possible to treat the dynamics of a mammal in this course, however elementary the treatment may be interned. This indicates a limit to which integration can be done.

In the NSSSP, the conceptual approach, which makes use of a theme that runs through the entire course, has been used in designing the project. The discovery method of teaching, which follows the Gestalt psychology of learning, is suggested for presenting the materials. In this project, the major concepts used in structuring the syllabuses are motion and energy for physics; structure, energy and periodic classification for chemistry; Nutrition, Energy production, cell behaviour and ecology for biology. In all cases, relevance of the subject to the society in terms of application is emphasized. In keeping with the major concepts to be taught and emphasis on application, some traditional topics were dropped entirely while some new

topics were introduced. Instead of the usual lecture method followed by separate practicals, a new teaching approach, the discovery method, is suggested. To this end, active students participation through experimentation and discussion, with the teacher playing the role of a leader and not a preacher, is advocated.

The texts contain enough materials and are deliberately loaded with student's activities in order ensure understanding of the concepts being presented and to develop in students the right scientific attitude and skill. The teachers' guides contain some specific objectives of each chapter and some test questions and problems. This gives an added advantage to the teachers in evaluating the students' achievement in the courses.

Ahmed (1979) maintains that eactions to the NSSS project have been very encouraging. Initially, only four schools were sponsored by CESAC as pilot schools for the project. Three of these schools entered their first candidates for the WASC examinations based on the project syllabuses in 1974. The results, despite the general complaint that the examination papers in physics and biology were largely unrelated to the syllabuses, were encouraging. Since 1975, more schools have become involved with the project. At the moment, there are sixty pilot and thirty associate pilot schools for the project. A number of other schools have on their own proceeded to offer the NSSSP courses at the WASC examination in 1978. Some State Ministries of Education have requested for additional schools to participate in popularity of the courses in our schools.

A feedback from teachers of the project, who had to undergo training courses in the project before starting the courses, has been obtained. These teachers agree that the courses, if properly followed, are capable of producing students of superior understanding of science. Similar comments have been received from school authorities and science educators. People are generally convinced that the activity-oriented nature of the courses is a proper step toward the development of scientific skills and attitudes so vital to the future technological growth of this country.

Abdullahi (1981) observed that a slight complaint about the NSSS project texts exists. This concerns the provision of inadequate concessions to the localities of this vast country. Every effort was made to take into consideration the vast differences in vegetation, climate and culture of our people. Although many examples given in the texts are drawn from the Nigerian scene, the vastness of the country makes this not completely representative enough of the events in all our localities. The textual nature of the project also limits the ease with which local adaptation could be made of the project by the teachers. But this arises more from the rigidity of our examination requirements than from anything else. CESAC has started discussion with WAEC in a bid to cause a change in the examination system such that it reflects the method of teaching the course. To start with, the project has to satisfy certain desires consistent with our public examination bodies. In an attempt to produce students capable of satisfying the requirements of the external examinations, the teachers tend to be more extrinsically motivated in their approaches. They have little incentives towards local adaptation as such, unless this had direct relevance to the demands of the final examinations in view. It thus requires that greater avenue need be provided in the texts for the use of more local examples in illustrating the concepts being taught.

3. Ways in Which Science Education can be Refocused in Nigeria

It is worthy to say that science education can be refocused in Nigeria through the Universal Basic Education (U.B.E.) Scheme. By definition, according to Denga (1993 and 1999), Basic Education means the type of education, in quality and content, that is given in the first level of education. This concept changes from country to country. In Nigeria, basic education was equated with six years of primary schooling. Now the concept is expected to cover the three years of Junior Secondary Schools into basic education (Denga 2003).

According to Denga (2007), the following may therefore, be considered as current problems of U.B.E:-

1. Funding
2. Irregular payment of teacher's salaries
3. Provisions and Maintenance of infrastructural facilities such as buildings, equipment and instructional materials.
4. Problem of Supervision and monitoring of what goes on it Basic education centres.
5. The problem of the walking distance from home to school.
6. Poor planning
7. There is no clear-cut programme on the interface between parents and the school to facilitate child-care and basic education.
8. Competition between private basic education centres (Nursery-Primary Schools) and Public (Government–owned Centres)

According to Denga (2007), the following suggestions are made to embody the new education culture in consonance with the current problems highlighted above:-

1. We need to realize that basic education goes beyond literacy and numeracy. There is therefore the need to encourage children to develop a scientific outlook and rudimentary understanding of the natural and social environment.
2. Our basic education must adopt a two-fold approach, i.e. educating young children on the one hand and promote adult literacy and continuing education on the other hand to help develop their basic skills in child parenting, family management, civic participation and effective involvement in participation.
3. Our new education culture must embody effective planning using appropriate data banks in all spheres of education.
4. Guidance services must be emphasized to deal with current behavioural problems, which have plagued the education industry at all levels in Nigeria.
5. Our new education culture must adequately stress a partnership between the government and other development agencies in order to tackle education funding and skill development, both for children and teachers.
6. We need to innovate our curricula to include social and democratic values, academic skills and psychomotor competencies, which constitute our national needs. In fact, we need to raise the standard of education through a well-designed curriculum.
7. Our new culture must emphasise the egalitarian philosophy in response to democratic tenets.
8. We need to promote a maintenance culture, not only for the school plant but also for the teaching methods that have proved useful in the delivery system.
9. Our schools must socialize our children into democratic values.
10. Educational experts should sensitize the government to become more aware of their services and contributions through regular publications of research findings in their areas of specialization.

It is in line with the achievement of the above objectives that gave rise to the Joint Communique on Review of Cooperation between the Federal Republic of Nigeria and UNESCO in Abuja, on the 18th day of November, 2002 on the following areas:-

1. Basic Education
2. Education Sector Analysis (ESA)
3. Technical and Vocational Education and Training (TVET)
4. Policy and Strategy Advice in the field of Science and technology

There are five components for the implementation of the above cooperation activities between the Federal Republic of Nigeria and UNESCO, thus:-

1. improving community education and literacy using the media
2. improving capacity for local-level management
3. training of teacher educators in information technology
4. revitalization of science education in teacher training institutions
5. improving learning opportunities in the early primary grades

5. Suggestions and Recommendation

In view of the importance of social context in science teaching highlighted in this seminar paper, the following recommendations are made:

(1) Teacher training programmes should be re-organized in order to prepare teachers for their new roles and functions in schools.
(2) Textbooks on science should include topics that will generate discussions among learners as to the best options for solving societal problems (decision making).
(3) Science, technology and society as a course should be offered at all levels of our education system, specially at the primary and secondary school levels, where majority of the people goes to school and terminate their education.

6. Conclusion

We salute and commend the Goodluck Jonathan-led Federal Government of Nigeria in its effort at refocusing science education in Nigeria, in view of the newly introduced U.B.E. programme. Such effort is geared at strengthening the foundation of our educational system. We also commend the readiness and enthusiasm which the states and local governments have shown in support of the U.B.E. programme. The colourful launching ceremonies so far executed, seek to proclaim and predict a huge success. It is our desire that such refocused programmes of the federal government of Nigeria, will enable us to move from political slogans to the realities in developing education which forever remains the precursor of political, economic, social, industrial and aesthetic development.

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