

# Searching for Excellence in Science Education: The African Experience

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## **Abstract**

*This paper seeks to enumerate the search for excellence in Science Education, using the African experience as its focal point. Science education in independent sub-Saharan Africa has been shaped by policies and practices which owe allegiances to the colonial masters. All these nations strive to achieve scientific and technological knowledge. There is need to shift from the moribund, dogmatic and unimaginative curricula to alternatives that have definite and dynamic objectives based on the child as a potential citizen and a skilled individual. Scientific knowledge has gone through several stages and revolutions from time immemorial up to these modern times. An understanding of the growth and changing nature of scientific ideas helps to clarify some of the problems confronting Science education in modern times especially in Africa. Scientific knowledge has increased both in quantity and in quality, so that old patterns of thought have been modified in ways that have caused profound changes in people's views of natural phenomena. The search for excellence in Science education started with the desire for scientific literacy advocated by the use of good Science education programmes in Africa. The aim was to ameliorate the unscientific culture imbibed traditionally. Hence, the paper harped on education in Africa, objectives of education in Africa, objectives of science education in Africa, emergence of modern science education in Africa, attendant problems of science education, and the need for relevant agencies to strive for excellence in science education in Africa.*

**Keywords:** Excellence, Science Education, African Experience.

## **Introduction**

Science teaching and learning in Africa had for long time been 'patch work' that quickly falls apart leaving the system bare as before. Science subjects have always been looked at as mysterious and difficult to learn. In fact, many people in Africa have always thought that science is learned only by specially clever students. Lassa (1984) in an illumination account on mathematics education in Nigeria pointed out that students have always expressed their feelings that they dread mathematics. It has been observed that in most cases, this fear was passed to the pupils by the teachers and this fear stayed with them for the rest of their education.

This fear for science subjects leads to all sorts of attitudes, mostly negative attitude towards the subject and this subsequently affects the performance of the learner in the particular subjects. Anthony (1983) revealed that students with favourable attitude to science (specially, physics, Chemistry, Biology), achieved higher mean scores and those with low scores may be caused by negative attitude to science. In the GCE – bound countries of West Africa, it has been observed that students generally perceive Biology as a relatively easy subject. Apparently, being under compulsion to offer at least one science subject before they leave secondary school, candidates find Biology the best option because they assume it is easy to pass. But reportedly, this most popular subject is the

most failed. Soyibo (1982) in his study remarked that pupil's attitude to Biology as an easy subject appears to be one main factor contributing to their observed poor performance.

Certain stereotypes about Africa's attitude towards science and technology also account for the bad state of affairs in the continent. The world view is that Africans are unscientific in their ways and very superstitious in their attitudes. With this backdrop, the ingenuity of the African is being marked by the rush to consume the fruits of Western education and technology. The technological ingenuity required traditionally from man's quest for food, shelter and clothing; the functional education of transmitting from one generation to the other; and the moral and ethics of the people are overlooked in favour of educational expansion and the use Western technology whether they are appropriate or not.

Since independence, many African nations have been calling for relevance in their educational system; relevance to the problems of local communities; relevance to national and the world economics order; relevance to aesthetics and the morality of growing complex and complicated lifestyles and advance to the job market. In many African nations today, science is recognized as a means towards economic survival and as a new magic for achieving modernity in a short space of time. With this has come a heavy demand in science education which is a gateway towards scientific knowledge. The role of modern science education in Africa is to treat science not as an accumulation of facts but as an experience in investigation and discovery. It aims at stimulating an inquiring and analytical mind in the learner so as to aid understanding of the changing nature of the environment and rational powers.

Gabmanja (1999) had posited that this demand in science education to rationalize the supposedly non-scientific culture in Africa cannot be overemphasized. The trend in this direction has been to develop scientifically literate citizens who can manipulate their environment in national terms so as to reap the fruits of their natural resources. Africa is no doubt rich in raw materials which had been exploited by expatriate experts largely because the manpower potential in science in Africans had been lacking. Apparently, one major role of science education in Africa had been to stress the potential of science to promote the development of intellectual qualities and skills rather than knowledge of particular scientific facts and theories as has been the statusquo. There is the need for the search for excellence in science education using Africa as a pivot.

### **The Search for Excellence**

Harping more on scientific literacy, Gbamanja (1999) advocated the use of good science education programmes in Africa in order to ameliorate the unscientific culture imbibed traditionally. He reiterated the need for good science education programmes and opined that it is a major factor for developing positive attitudes towards national and meaningful change. However, numerous bottlenecks hampering progress in this direction exist.

First, in West Africa, it has been observed that every year, more and more students who take the final examinations at the end of their secondary school education fail the science subjects. Several factors have been identified as causes of the mass failure or under – achievement in science in West Africa and Nigeria in particular (Ahiakwo, 2006).

Earlier, STAN (1986) at its annual convention outlined some of the causes of failure in science subjects; cognitive and socio-economic attitudinal problems of teachers' administrative problems of policy makers; and psychometric problem of the examination. Another major problem identified in science education in Nigeria and other places is the linguistics background of the students (Fafunwa, 1983). Scientific terms and concepts, it is believed are difficult enough by themselves and

the fact that African children have to learn them in a second language compounds the problem. Science and mathematics have specialized language not only in respect of terminology but symbols and the writing style. It has been noted (Rogoff, 1981) that school language whether in the mother tongue or a second language is formal and therefore different from the usual spontaneous language of student.

Furthermore, Bojuwoye (1985) reported that certain language usage and vocabulary are responsible for the swing away from science by secondary school pupils in Nigeria and Africa in general. Apart from the fact that English is a second language for students, scientific language then becomes a third language which may frighten the learner. A close examination of the way science exists in the schools system in Africa, especially at the primary and secondary school levels, reveals that only one aspect of scientific literacy is pursued, that is, science used as a weapon for economic advancement. Other relevant aspects such as understanding the rational powers are usually ignored.

Arguing further, Gabmanja (2002) posited that science is used as weapon for personal economic development whereby the importance of examinations cannot be over emphasized in the system. This concern for using examinations primarily as a criterion for college entrance and for obtaining a suitable job creates curricula and syllabuses based upon materials and criteria that are examinable but not necessarily useful for the individual or for society. It also obstructs the presentation of science as an exciting way of looking at phenomena and of accounting for events in rational terms. The study of science as an exciting discipline in solving our everyday problems is not advocated by the school curricula. The existing senior secondary school curricula does not expose the student to the realities of his environment.

Really, science educators must explore possible scientific thought and practices in the local environment and try to build upon them to blend with Western scientific explanations. In this way, explanation of natural phenomena would be clearer. Presently, as practiced in African classrooms, teaching most of the time neglects explanation of real life relationships. The learner is taught to refine, cram, and pass examinations, but necessarily to understand the real scientific concepts and thus, transfer of knowledge and application are usually not easily possible in the processes. This didactic method of teaching is what predominates in most of the science classrooms in Africa and this hinders or delays excellence in science teaching and learning. We proceed to consider two exploratory surveys.

### **Exploratory Surveys**

Gabmanja (1983) conducted exploratory surveys to uncover some of the main reasons science – able secondary leavers in Sierra Leone and Nigeria choose not to pursue science beyond the secondary school level, even though they have the ability and capacity to study advanced science. Four hundred first – year undergraduate students were chosen from higher institutions of learning (universities and colleges of education offering degrees) in each of the two countries. In Nigeria, five Southern states, namely, Rivers State, Cross River State, Anambra State, Imo State and Bendel State were used for the study, while in Sierra Leone, the entire country was used. Data for the two research works were collected using structured questionnaires and personal tape – recorded interviews with science and non-science students in the institutions and with some science teachers. Students involved in the research were those who had taken integrated science in the Junior Secondary School and then later had to study for the General Certificate of Education/West African School Certificate (GCE/WASC) in their Senior School. In some of the colleges of education in both

countries the same students were found studying integrated science again even after their GCE/WASC. The teachers involved in the study had either taught integrated science before or were teaching it during the time of the study.

The findings of the two studies across cultures were very similar. One probable reason for the similarity in the findings is the fact that both countries have similar colonial orientations. In both cases, it was found that non-science students decided to pursue disciplines other than science because they were discouraged by the methods of teaching used in the General Certificate of Education (GCE) classes, specially forms four and five, and were not satisfied with the GCE syllabus and examinations (which essentially define the curriculum for the Secondary School). At the Junior Secondary level, in both countries, the students took integrated science which an average 98% for each country said they enjoyed well.

However, in Sierra Leone students study the "Core science project". The philosophy and methodology for the two programmes are similar. In each of the cases over 75% of the students said they would have loved to see integrated science being taught to them at the senior secondary level. In fact, over 80% of the respondents in each case said that the writers of the integrated science programme should extend the programme up to GCE level. The council for scientific policy, when reviewing science education in Britain (Turner, 1972), concluded that the structure of the curriculum is closely related to choice for or against science. According to the council, the key problem is the isolation of the science from one another and from other subject areas. They reported that "the teaching of science as traditional disciplines prevents the pupils for appreciating the inter-relationships within science and between science and technology".

He further reiterated the need for school science to be presented in a human life and society. This is one major characteristic of integrated science programmes, examples of which are the core course integrated science in Sierra Leone, Nigerian Integrated Science project and others. These programmes emphasize the unity of knowledge and thus the importance of inter-disciplinary teaching in science. Secondary school science in Africa needs a curriculum that has definite and dynamic objectives based on the values of the society and on the child as a potential citizen and a skilled individual. This but perspective does not necessarily militate against examinations eliminates methodology of teaching which advocates the textbook type of learning and rote memorization. It will also encourage the use of local materials so that the common cry for more expensive and in assessable materials will be minimized. This is a positive move to achieve excellence in science teaching and learning in Africa.

### **The Demand for Science Education in Africa**

In many African nations today, science is recognized as a means toward economic survival. With this has come a heavy demand on science education which is a gateway toward scientific knowledge. The role of modern science education in Africa is to treat science not as an accumulation of facts but as an experience in investigations and discovery.

The colonial masters in many parts of Africa, did not concern themselves much with the teaching of science in the schools. The main objective of the educational system in the British – oriented countries for example was to train catechists. As they attained their independence, many Africa nations commenced innovative curriculum programmes geared toward the development of their societies. Educational authorities realized that the education system established by the colonial masters was not relevant to the indigenous societies. There was then a vigorous need for curriculum changes to suit the need of the indigenous societies. Awareness emerged in this regard that

knowledge of science would play a very important role in the development of nations. Hence, science curriculum development became one of the first concerns in the education systems. Early in the 1970's, education authorities found it necessary to utilize more meaningful and functional ways of teaching the subject. The demand for massive science education programmes geared in this direction became inevitable.

The demand on science education to rationalize the ever existing superstitions and the ultra structural scientific knowledge already in Africa's traditional practices and occupations cannot be over emphasized. The trend in this direction has been to develop scientifically literate citizens who can manipulate their environment in rational terms so as to reap the fruits of their rich natural resources. Nigeria and Sierra Leone for example are rich in raw materials which had been exploited by expatriate experts largely because there were no African experts to recognize and utilize such resources. Apparently, one major role of science education in Africa had been to stress the potential of science to promote the development of intellectual qualities and skills. Essentially, there is a high demand for the establishment of scientific literacy in Africa as a whole.

Relevant and functional science education must be accomplished in Africa in order that people might be more rationally involved in scientific and technological activities. Knowledge and understanding of science is an indispensable element in fields like medicine, agriculture, engineering and economic planning. One major objective of many African countries today is to achieve self-reliance and self – sufficiency in these areas mentioned. The building of a good science education to give the acquired education in these fields is thus justifiably evident.

There is an over whelming emergence of high technological gadgets flooding Africa's markets. The transfer of technology has been a major concern for educators. Scientific literacy is an essential ingredient for the processes of transferring technological know-how. Moravesik (1976) envisaged that the best way of building science and technological knowledge and allied transfer of technology in a nation is to strengthen science education. Thus the demand for science education in Africa therefore, is a necessary factor to achieve scientific literacy.

### **Objectives of Science Education in Africa**

Generally, the primary objectives of school science has been to develop skills in young people which would enable them to make rational choices in problem situations relating to their environment. This major purpose is in response to the statement that "the present content of education in Africa is not in line with either existing Africa conditions, the postulate of political independence, the dominant features of an essentially technological age or the imperatives of balanced economic development involving rapid industrialization.

Furthermore, African educational authorities should revise and reform the content of education in the areas of curricula – textbooks, and methods, so as to take account of the African environment, child development, cultural heritage and the demands of technological progress and economic development especially industrialization. Arising from these demands, therefore, the objectives of science education in Africa include the following:

- To rationalize curricula and render them more relevant for the African environment.
- To establish scientific literacy among the populace so as to minimize or abandon colonial exploitation.
- To debunk myths and superstitions so as to rationalize people's ideas and practices in the African environment.
- To demystify science and encourage more youths to pursue science related endeavours.

- To effect change in philosophy, methodology and materials in science classrooms.
- Through the use of local material the learner should be able to inquire into natural phenomena and rationalize his traditional practices.

These objectives are also in line with the objectives of science education in general as outlined by Renner and Stafford (1972). These authors claim that if these objectives are achieved, scientific literacy will be the result.

### **Emergence of Modern Science Education in Africa**

Science education in Africa has gone through general revolutions right from the inception of Western type of education till now. Bajah (1982) recalled that at the inception of the Church Missionary Society (CMS), schools in some parts of West Africa in the late 1800s introduced some rudiments of science in form of Nature Study. The study of nature study was geared towards learning about the environment by observing plants, animals and non-living things outdoors. In the 1920s practically every teacher training college in some West Africa States had science of one form or the other in the curriculum varying from Nature Study, Rural Science, Hygiene and Agriculture.

Furthermore, nature study and Rural Science persisted for a very long time even up to the 1960s both at primary and secondary school, though at the secondary school, General Science was the major focus of science taught. But with increased knowledge in science and the persisted demand for the discipline in modernizing nations and improving living conditions of people, it became evident that Hygiene, Nature Study or General Science were inadequate. Thus, a vigorous change in the science curricula became inevitable. The change was even universal. It started in the United State of America and Great Britain, and thereafter spilling to most Anglophone countries including those in Africa. As a general universal trend, the focus of these science programmes was to promote understanding of natural phenomena, the environment, through the spirit of science. To this end, science teaching and learning was to be inquiry/discovering – oriented. In Africa, a number of factors were responsible for the involvement in this new awakening to the development of new science programmes. Firstly, many African countries had just had their independence and had emerged into new awareness. It becomes evident that the existing curricula were irrelevant to the needs of the African Society and so there was need for change. The universal trend sweeping through Britain and the U.S, evoked a new technological era and it became obvious that science was necessary to achieve industrialization and technology. To this end, African leaders started meeting at seminar, conferences and workshops to discuss and plan for the new change.

The search for excellence in science education necessitated the emergence of the following organizations. They are: African primary Science Programme (APSP), science education programme for Africa (SEPA) Nigerian Educational Research Council (NERC), Science Teachers Association of Nigeria (STAN) and the West African Examinations Council (WAEC). However, other bodies or organizations such as the forum of African Science Educations (FASE) were born. Furthermore, the United Nations Educational Scientific and cultural organization (UNESCO) had over the years contributed regular financial and moral support to various African countries for science curriculum development projects. For example, UNESCO sponsored a workshop in 1975 to discuss the teaching of integrated science in West African Secondary Schools.

Since those curriculum innovations efforts, African countries have continued to receive moral and financial aids from various international agencies to promote curriculum development particularly in science; for instance, the International Council of Association for Science Education (ICASE), the British Council, United States International Development Agency (USAID), United



Nations Children's fund (UNICEF). The Ford Foundation, and a host of others, has continued to supply funds, reading materials, laboratory materials and other instructional materials to strengthen science education and other curriculum efforts in Africa. This has also facilitated the development of several new curriculum projects in various parts of Africa. The new programmes intensify their efforts to introduce alternative teaching strategies as these differ from traditional practices. Primarily, they emphasize a shift from rote learning to inquiry and discovery teaching and learning strategies.

### **Problems of Science Education in Africa**

Gbamanja (1999) had posited that problems in science teaching in Africa vary from place to place. What may be a problem in one country or even locality may not be a problem for another country or locality. But it is also true that certain problems may be common to various places. The following resolutions taken at the forum of Africa Science Educators (FASE) conference in Harare (1982) showed some of the common concern of African countries:

*Whereas we are aware of the goal of education to produce human beings who are self-reliant, we are aware of the failure in many ways of our current science education programs to prepare the school leaver, be it at the secondary school level or at the primary schools level, for useful living. We observe that most Africa governments have in no way positively supported and sustained action programmes to make science education functional with a view to replacing or complementing academic preparation. We recognize that our curricula are rather deficient of technology, and in particular appropriate technology, for the transformation of rural life. We recognize that our examination system is inadequate, to say the least, and yet has its strong hold on the educational system. We note with regret that governments often times institute far-reaching changes in curricula or educational system at relatively short notice and sometimes without professional opinions.*

The above problems enumerated are not exhaustive. In fact, one major problem that has been emphasized by educationists is that the entire education system in Africa is so examination – oriented that meaningful learning of concepts is not well achieved. This concern for external examinations has also led to all kinds of ill-advised and sometimes unhealthy preparations for the examination.

The primary focus of schooling is on passing these final examinations at the expense of meaningful educational objectives. Other very obvious problems in science education include the following:

- Lack of adequate relevant textbooks to reflect the local environment.
- Where the textbooks are available they may be written with a foreign background so that reading difficulty is common.
- Ill-equipped and sometimes unavailability of laboratories.
- Lack of funds to process science equipment and materials
- Inadequate preparation of teachers to teach the new programmes.
- Poor implementation procedures for the new programmes.
- Clear – cut science education policies are hard to come by. Where they are available, they are mostly lip-service and political and they are hardly implemented.

However, in many parts of Africa, the teaching profession is the least attractive. When government funds are depleted, it is the teachers whose salaries are delayed or never paid. Science teachers in some countries are promised some amount of financial inducements in lieu of

the extra work put in to prepare for laboratory work. But this remains lip-service for many people and school authorities actually do not give such inducement. In the mist of all these frustrations – a teacher cannot be completely blamed if he is not efficient on the job. Invariably, if the teacher has not taught, the child will not learn. This phenomenon is more pronounced in the sciences and other technical subjects.

## Conclusion

The search for excellence in science education under the ambit of the African experience has been enunciated above. A critical examination of the journey of science education in Africa had shown myriads of loopholes and attendant problems. Most prevalent among the problems is inadequate funds made available and improper utilization of these funds by the authorities concerned. While levels of development of science education vary from country to country, the metamorphosis has reached an advanced stage. Issues that border on science education policies and implementation should be given adequate priorities by the governments concerned. While organizations like the UNESCO, STAN, CESAC, FASE, USAID, UNICEF, ACO, SEPA and APSP should be encouraged for their efforts towards the development of science education in Africa, stringent measures should be taken by relevant authorities and government of African countries towards the search for excellence in science education.

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