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Abstract

Science education delivery in Nigeria school cannot be assessed to have been effective in every aspect of it. There is still much to be done in the area of inputs such as theory and practical teaching in order to attain the desired objectives of Nigeria in this twenty-first (21st) century. Nigeria is blessed with human and material resources which if properly harnessed could lead to the attainment of these objectives. This paper attempts to discuss the problems of science in the 20 century and the emergence of modified pedagogy for effective delivery of science in the 21st century. This may be more effective in terms of vision and mission of science education in the said century.

Introduction

Historical views regard agriculture as being given birth to the present day civilization. Evidence abound that people who settled at various river basins, engaged in some agricultural activities and subsequently societies become developed. These activities transformed people out of a state of non-mechanization to a state where they become enlightened, refined and instructed on the act of life. The rude, unpolished world was elevated (Williams and Lipcsey, 1999). According to these two scholars, the transformation become emergent through improvement in science and technology. Science education in Nigeria has not achieved anything in the past century.

There is a global awareness of the need to improve the quality of science education at all levels of education in Nigeria. In Nigeria, like most developing nations of the world, efforts are being made by the various organizations, NGOs etc, towards achieving literary and qualitative science programme (Baikie, 200). Based on this, much has been written and discussed at various workshops, seminars and conferences on the problems and prospects in terms of delivery in Nigerian schools. This has left every benefactor of science in doubt that greater inputs need be made to enhance its effective delivery in the acclaimed century to the complete satisfaction of all human needs. Expectations are high all over the world about this century in every aspect of human endeavour. As such, mission and vision of science education is not left out of these great expectations.

Against this background, efforts shall be made to discuss factors militating against effective science instruction in the 20 century. This will also assist in identifying those factors needing consideration such as to satisfy the long expected century.

Science Education in the 20th Century

During this century, there has been a lot of public outcry on the poor performance by Nigerian students in the school certificate examination in science. Baikie, (2000) in his study revealed that the 20th century science education has been characterized by philosophical antecedent, ill-equipped teachers and poor resources. Based on these, the following factors are needed for reconsideration,

1. Learner Input-Output

Science education is activity-oriented and as such science students in the 20th century have not been active both physically and mentally to cope with the challenges of science. Many students of science do not put in inputs such as carrying out assignments given to them by their teachers. Some don't even try exercises on their own to test mastery of each given topic. This low morale according to Ezike (1986) has led to a low output. Students have also failed consistently to interact with the material inputs such as museum, garden and libraries. Students are to interact with these elements in the science teaching process in order to develop the right attitude, skills and knowledge conducive to adequate accomplishments in science education. All these are in a state of inadequacy or completely absent (Okpala, 1986). He further states that in this century, learner-based factors such as attitude to science and level of discipline, capacity for cognitive adjustment and readiness to persevere at learning tasks, level

of supervision at home, social orientation, motivation and science background are too low. All these learner-based factors are very low and as such low input-output ratio.

Inadequate Laboratory and Infrastructural Facilities

Laboratory is seen as the focal point for science education. Realities of our school laboratory in the 20th century was either that there are no laboratories or the few available were ill-equipped. Maduabum, (1986), affirms to this in his study which shows that "the realities of the situation range from no science laboratories at all, to one microscopic science laboratory where students are not allowed to "fool around" with such expensive instrument, to science laboratories with few equipment". He rightly observes that instead what is obtained was the existence of well-equipped laboratories on paper only. Other researchers (Soyibo, 1986; Ezike, 1986; Olayiwola, 1999) confirm this shortage or no equipped laboratories in Nigerian secondary schools. Without laboratory there is no effective accomplishment of the teachers' job for any meaningful science learning.

Poor Teachers' Preparation

Most science teachers that dominate the 20th century in Nigerian schools are poorly prepared. Majority of them are non-professionals. Also, there is no reinforcement, no science teacher allowances and undue emphasis on paper qualification and rather than a true test of their ability before they are allowed to teach. This has made many teachers to show non-devotion and commitment to duty. Baptiste (2000), in his study reveals that science teachers are grossly inadequate in terms of preparation and number. Accordingly, teacher's commitment has posed a serious problem within the century. The monetary and social rewards have low morale, since no teacher will cheerfully carry out his assignment if he has arrears of four to five months' salary outstanding or cannot afford a comfortable home or means of transport for himself. Hence Okeke (1986) subscribes that an uninspiring teacher is as good as no teacher at all.

Poor Funding and Unplanned Government Policies

In this century efforts have been made to fund education in general and science in particular which has not yielded any positive result. Government policies have been regarded as inadequate as these have not promoted science education in any aspect. These include the idea of paper qualification, compulsory registration of one science subject by every candidate in senior secondary school certificate examination. Since this policy can only increase the number of mediocres as science education. The accommodation policy for staff and students, which is outside the school premises, renders the teaching and learning of science practically impossible. This has dominated science education in the past 20th century. Efforts have been made to import science and vocational equipment without commensurate manpower to operate them. This has led to a huge loss as most of the equipment fade out on storage.

Crowded Classrooms

Classrooms of science students in this century have scientifically been over crowded. Comparing the average number of 52 students who offered science in 1960s to that of thousands in 1990s, there is a clear evidence of over population and over crowding in the classrooms (Ezike, 1986). This has made it difficult for the effective use of the few laboratories and facilities as it has increased drastically the teacher-student ratio.

Other factors that characterized science education in the 20th century include; lack of laboratory assistants, poor school management, societal influence, high contents and scope of syllabus, low period allocation on the teaching timetable (Ezike, 1986; Olayiwola, 1999).

Examination System

Science education as handled by science teachers was geared towards passing prescribed examinations and not for qualitative science acquisition according to Baikie (2000). He further opines that, under this type of condition, teachers are continually under pressure to cover the general content heavy syllabuses and prepare the students adequately to pass the

examination often within limited time, that, most examination questions are oriented towards testing mastery of content which is a mere demonstration of recall of facts either in the short-term or long-term memory. This method, however, prevents learners from acquiring the higher-order skills. A corollary to this point is that most examination questions are so ambiguously set and as such bring about misunderstanding on the student's part.

Science Education in the 21st Century

For science education to be effective in this century, there is need to consider the following areas so as to promote science teaching and learning.

1. Recruitment, Training, Retraining and Retention of Science Teachers

The policy whereby teaching profession has become a sanctuary for all classes of people must be revisited and be reversed by policy makers. There would be professionalism in teaching. This shall be achieved through training and retraining of teachers. The training will prepare the teachers in the area of philosophy of science, science and society, technology, improvisation, pedagogy, techniques of handling equipment. This will be the responsibility of all levels of government in Federal, State, Locals, Non-governmental organizations and professional organizations. Professional organizations such as Science Teachers Association of Nigerian (STAN) shall organized workshops, conferences packed with activities to participants. This will keep science teachers abreast with the changing nature of science and will promote their efficiency in the classroom. Recruitment should only be based on those who have passed through proper training as evident on the certificate. The teacher certificate shall be given or issued base of passing rating of cognitive, affective and psychomotor domains. Remunerations should be given at the stipulated period. Heads of schools should assessed teachers in what is known as Annual Performance Evaluation and promotions should be on this basis so as to promote effective and efficient delivery of science education in this century.

2. Practical Work

Practical work should form ninety percent (90%) of what is required. This will also be process-oriented and product-conscious. It should also be objective and not subjective due to over worked teachers who simply do it due to pressure from students to retrieve their notebooks. Here science students should be encouraged to respect scientific attitudes such as honesty, objectivity, value, respect to logic in their practical reports. Scientific methods such as problem identification, definition, formulation of hypotheses, designing of instrument for data collection, collection of data, analysis of result and conclusion should be the watchword of the students.

3. Laboratories

With the lack of equipped laboratories and non-existence in some Nigerian secondary schools, Federal Government of Nigeria should make available funds for the establishment of laboratories in all secondary schools. Number of laboratories shall increase with types, good furnishing and maintenance culture encouraged. This would be the bedrock for the reality of science education in the 21st century, which had commenced five years ago.

4. Resources

Learning has a lot to do with resources. All theories of learning tend to support progression from concrete to abstract. More resources should be made available to enhance the attainment of quality science education. Teachers' roles as facilitators of learning need to be recognized with equipped resources. This will make science education meaningful for functional living in the society.

5. Availability of Appropriate Textbooks

For the past 20ⁿ century, all textual materials used in our school system for the teaching and learning of science are predominantly obtained from foreign sources. In this Century there should be available textual materials of indigenous authors with prices affordable by parents

and guardians. With these indigenous textural materials, science education will be relevant to the life and environment of the learner and indeed the teacher. Furthermore, science education will be a "living" subject rather than an abstract phenomenon (as students often perceive it) that exists somewhere in the subjective minds of some wise but weird individuals - the Scientists (Baikie, 2000). Appropriate textbooks, according to Yero (2000) are part of a science classroom. Workbooks, magazines and also articles of newspapers should be made available that will promote the teaching and learning of science education in this century.

6. Examination Boards and Mode of Assessment

To prepare students for the 21^M Century science education, examination boards and all those concerned with learning assessment should structure questions in a comprehensive manner that covers the various levels of cognitive domain from the relatively low to higher order skills. Our evaluation structure strategies which are based on archaic tradition of 'single content' due to political atmosphere should be an evaluation devoid of this. This will also go a long way innovating the curriculum of science education for better. There should be a promotion for struggle instead of a vision to guide their accomplishment of literacy in science for all students (Baikie, 2000).

7. Large Class

The issue of a high student-teacher ratio should be non-existent. With availability of trained teachers, equipment, proper guide on student career, the student-teacher ratio should be minimal. This will enhance teacher's effectiveness and control of his class. In the corollary, the period allocation of science teaching on the timetable should be normal with adequate practical work.

8. Programmed Learning

Programmed learning involves packaging of learning material (information) on a specific topic in a subject area by specialists and be taught to students in a series of progression stages successfully and crosschecked. This will allow students to read and understand and then pose a relevant question on it. When a student's reply is correct he proceeds to the following stage, if not, he should be allowed to discover and rectify. This programmed learning will be in the form of Computer Assisted Learning or in television or a text. This shall be promoted through subject association like Science Teachers Association of Nigeria (STAN). Such bodies should ensure that the right information is given to the students through the. tele vision and radio science educational programmes.

9. Computer and Communication Gadgets

Science education in the 21st century will have more discoveries. New computers of better hard and softwares should be invented including digital and analog types. There should be handsets for communication to reduce the present world of a global village to that of a global house. Handsets of harmless ultra-violet (UV) rays should be in existence. All government and other educational stake-holders should make computer literacy mandatory to all levels of our school system right from primary to university education. Mission and vision of science education in the 21st century is inexhaustible, however, the points discussed above are the major prospects of it.

Recommendations

The following recommendations have been proffered so as to improve science education to meet up the yearnings of all stake-holders of science education in the much expected millennium i.e. 21st century.

- (a) Teachers of this millennium should require the capacity to readily acquire new knowledge to solve problems and to employ creativity and critical thinking in the design of new approaches to existing problems.

(b) **Promotion of scientific ethic.** This involves the inculcation in (he students and teachers-in-training the underlying ethic of honesty, openness, parsimony, curiosity and the tentative nature of what is presently known.

(c) **Promotion of scientific culture:** This is done through the teaching and learning of the history of science. This will help appreciate the fact that science is a human activity designed by human beings, thus helping to create and boost the confidence in learners in their ability to do science.

Conclusion

The state of science teaching in Nigerian schools in the 20th century depicts ineffectiveness and its attendant consequences are quite noticeable. Having discussed some of the lapses that characterized science education in the 20th century and the vision and mission of science education in this millennium, there is the need to prepare teachers of science education to meet up with the challenges. This preparation of science teachers will enhance its delivery. Vision and missions apart, workable strategies must be identified to eliminate the past century's problems as well as tackling the areas identified for meaningful science information dissemination. This can be achieved with the enthronement of a stable government that identifies science education as a first priority. A genuine national consciousness in the rank and file of the society should be developed. All science education stake-holders should be objectively concerned with the future of the learner they teach rather than playing the 'kill and go' role as science teachers.

With this, science education would be more meaningful and rewarding to this 21st century generation. This should be done by acting promptly and appropriately so that these science stakeholders desist from such acts of lip-service.

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