ADOPTING THE PROJECT APPROACH IN THE TEACHING OF SCIENCE AND TECHNOLOGY

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Abstract

The role of science and technology in the industrial growth and development of nations is not in doubt. This is why any nation in need of development and better life for its citizens must invest in science and technology. It is in realization of this that special Science Schools, Federal Colleges of ,Education (Technical), Polytechnics and Universities of Science and Technology have been established in various parts of Nigeria. In spite of the presence of these institutions and other policies formulated by government, there is declining interest and performance in science and technology. One reason identified as responsible for this problem is the use of the wrong teaching method. This paper examined the use of projects in the teaching of science and technology. Projects make it possible to link scientific and technological concepts to real life situations and provides the necessary motivation for students. The paper therefore recommended the establishment of resource centres for the production of science models and apparatus and the training and motivation of science teachers.

Introduction

There is a national educational emphasis on science and technology in Nigeria because of the realization that it is the basis for industrial development. According to the Concise Encyclopedia of Science and Technology (1994), science deals with the human understudy of the real world, the inherent properties of space, matter and energy and their interactions. Engineering is the application of the objective knowledge of science to the plans, designs and means of achieving set objectives while technology deals with the tools and techniques for carrying out the plans and designs. Many of the amenities of everyday life are derived from the scientific discoveries. Science as a human endeavour has contributed to the development and comfort of our society such that the future well-being of mankind will depend on the solution of ecological, energy and resources problems brought about by scientific and technological advances. Therefore our economy requires workers with scientific skills. (Afugbuom, 2006).

According to Umudhe and Kori-Siakpere (2006), the major distinction between developed and developing countries is their level of scientific and technological advancement. Science is the axle on which development and progress of both the individual and nation depend. Perhaps this was why governments at the state and federal levels in Nigeria have established special Science Secondary Schools, Federal Colleges of Education (Technical), Polytechnics and Universities of Science and Technology.

Concept of Science Projects

A project is a method employed by a science teacher in teaching science. It provides for the need of the individual student or sometimes students in small groups so that those with special abilities have the opportunity to fulfill themselves. Oguniyi (1986), sees a project as something which encourages an individual or a group to develop scientific attitudes and skills. Hadden (1999), describes a project as a purposeful act which develops the desirable character and personality traits as outcomes in pupils. Oludokun (1998), defines project as an activity which a child may decide to carry out not only to show his capability but also as an attempt to solve a socio - economic problem through the use of science and technology. A project gives the child an opportunity to integrate the knowledge acquired in chemistry, biology and physics in order that the processes of science may be seen as a whole.

In project therefore, emphasis is on technological activities such that the learners are active and not mere passive recipients. They are led through creative activity to a realization of the importance and relevance of technology. They also have the opportunity of translating scientific knowledge into practical effects.

Types of Projects

There are 4 types of projects:

i. Projects where the purpose is to embody some ideas in external form-building a car.
ii. Projects where the purpose is to enjoy some aesthetic experience - projects on music or art.
iii. Projects where the purpose is to obtain solutions - solving a problem, iv. Projects where the purpose is to obtain some skills or knowledge - research experiments.

Problem of Poor Scientific and Technological Development

In spite of the effort by government very little progress is achieved in the area of science and technology. The policies including stated goals and objectives of science and technology education have not been achieved. This is obvious in the following areas. (Baike, 2000: Nwaedozie, 2006)

i. Low enrolment in the sciences and technical courses compared to enrolment in the arts and humanities in our institutions of learning.
Si. Poor performances in the sciences at the secondary school level especially in physics and mathematics, iii. Lack of motivation to study the science subjects in all educational institutions as a result of the wrong attitude towards science, resulting from the belief that science is difficult. iv. The failure of Nigerian scientists and technologists trained locally to compete successfully with expatriates in technology based industries such as oil and gas, communications, engineering, heavy construction, etc.

According to Durojaye, Ajie and Ayegbusi (2005), the major reason for the poor performance in the sciences in our schools is due to the use of wrong teaching methods mainly lecturing, explanation of procedures and note giving. These methods do not motivate students, because they do not link scientific concepts to real life situations. This paper examines the use of projects as a strategy for achieving the national objective of the nation's scientific and technological policies.

Aims of Science Projects

There are four fundamental aims that the uses of projects as a teaching technique wish to achieve;

1. Developing Practical Skills and Techniques. There is a range of practical skills and techniques that scientist have to acquire before becoming masters of their craft. The aim of developing such skills is fundamental in scientific education as one cannot be a craftsman unless one can manipulate one's tools. Among the skills that need to be developed by our science students are those of observation, measurement, estimation and manipulation. It is important to acquire the ability to observe carefully, honestly and perceptively, to recognize similarities and differences, to appreciate what is significant and to be able to measure a variety of properties. The use of scientific instruments then follows, enabling observations and measurements to be made of properties outside the unaided range of sensitivity of human senses. And building on the observation and measurement skills are those of estimating values for physical quantity and making sensible approximations. Manipulative skills need to be developed to handle apparatus and equipment safely and appropriately.

2. Developing Problem Solving Skills: Primarily a scientist is a problem - solver therefore science students should acquire this skill. They should be given or made to suggest for themselves a problem in a scientific context and be encouraged to anlayse the problem and decide what are the relevant parameters. They should learn to devise a range of possible lines of investigation and select the optimum track. Finally, they should then learn to execute the investigation and evaluate their findings while modifying their procedures as necessary. This in essence is the scientific problem solving approach. It is open-ended and divergent. In such work, there will be no right answers, though some solutions will be better or worse than others. This is different from the type of problem solving where the problem is convergent and theory based. The aim of such project is to familiarize students with the approach used by real scientist.

3. Developing a Better Understanding of Scientific Theories: A fundamental assumption of practical project exercise is that it helps to verify and explain scientific theories. In addition to enabling the student to acquire 'a feel for the phenomena he is studying, science is about getting

acquainted with the physical world we live in and making sense of it, so that our students should get a feel for the phenomena of which it consist. Students need to appreciate a feeling for the world they are studying. Obtaining knowledge through firsthand experience builds up a more meaningful grasp than can be acquired through theoretical argument alone. The old Chinese saying: What I hear, I forget, what 1 see, 1 remember and what I do, I understand is a justification for project work.

4. To Motivate Students and Develop their Interest in the Sciences. Many students detest science because they assume correctly or wrongly that it is too abstract. Project work motivates students to explore and show interest in their surroundings. The fact that majority of students do not always show this motivation to act as inquiring scientists in school workshops and laboratories may indicate the unstimulating nature of the teaching - learning process rather than in the students lack of potential for scientific study,

Planning Science Projects

Planning projects in science and technology takes time and resources. The following factors therefore should be considered.

1, Time: Most schools allocate time for practical work in their timetable. This allotted time is usually insufficient for meaningful work to be done. Most often extra time have to be created convenient for the students and their teachers. This is usually after school hours or during the weekend.

2. Finance: No matter how modest a project is, it requires fund. The question is whose responsibility is it to fund students[1] project. Many considered opinion have suggested co-operation between the school's authority, parents, government and private organizations as part of their social responsibilities.

3. Infrastructure: It is expected that every school interested in developing scientific skills in its students, should have well equipped laboratories and workshops. The setting up of introductory technology workshops at the junior school level was intended to be the foundation for the training of young scientists and technologists.

Project Assessment

The following criteria are considered in assessing any project.

I. **Principle:** The principle used in the project must be explicit. It must be clearly shown and verbalized by the students. At this point, the traces of originality of the project start emerging.

2. Design

i. The originality of the design of the project is evaluated.
ii. The functionality of the project in terms of its use either in education, industry or entertainment is examined.
iii. The nature of material used in terms of cost, iv. The simplicity or complexity of the design.

3. Construction

i. The elegance of the project
ii. The simplicity and ease of understanding and replication.
iii. The package and usefulness.

4. Operation

i. Workability of the project
ii. Precision of the design
iii. Is the level of operation within the level of the student?

5. Safety Measures

How safe is the operation of the project. The ability to provide safety devices may show the originality of the work.

6. **Commercialization**

Is it possible to commercialize the project? What will be its cost and where can it be sold?

Improvisation in Science Projects

One major solution to the problem of lack of funds and infrastructure for project development is improvisation. Adeniran (2006), defined improvisation as the act of using substitute object when the real or standard object is unavailable for use. For example, using a calibrated feeding bottle bought from the local market instead of a 'pyrex' measuring cylinder obtainable from a scientific store. Another example is the use of bamboo sticks and pieces of glass to make a microscope.

The teacher's role in improvisation includes:

i. Helping the student to plan the project.
ii. Making suggestions about choice of materials,
iii. Giving hints about how to assemble the materials or improvise apparatus or take readings.
iv. Ensuring that safety precautionary measures are strictly adhered to. v.
Giving any other form of assistance as may be required from time to time.

Materials required by students when carrying out improvisation related project work can be obtained from:

i. Local artisans and craftsmen such as carpenters, blacksmiths, volcanisers, roadside mechanics and electricians,
ii. Refuse dumps,
iii. Sawmills,
iv. Cottage industries.

Junior Engineers Technicians and Scientists (JETS) Club

The inauguration of the JETS club in all secondary and technical schools in 1988 was a major step towards promoting science and technology through science projects at that level. The conceptual framework of JETS was designed and destined to change not only the attitude and behaviour of secondary school and technical college students towards the study and learning of science and technology but also to inculcate in their minds scientific and technological discipline and culture. This constitutes the pre-requisite of scientific and technological research and inquiry, inventiveness and innovativeness as well as the application of learned scientific and technological ideas, principles and knowledge to the solution of everyday problems that are prevalent in the society or in their immediate vicinity.

At the pre-launching workshop on (JETS) in 1988, Gana F. Z., Chairman, JETS clubs planning committee summarized the aims and objectives of JETS to include.

i.' To foster a harmonious marriage between the national policy on education and the national policy on science and technology. Thus creating a formal forum for the federal ministries of education and science and technology to formulate joint integrated national policies for rapid technological and scientific growth and development of the nation,
ii. To foster co-operation and interaction between the teachers and students, the students and their immediate community or environment, which would form the experimental field of their activities.
iii. To promote and encourage co-operation between staff from different backgrounds and disciplines to embark on co-operative research, investigation, product design and development and indeed copy technology.
iv. It would encourage, generate and promote among students the culture of scientific and
technological experimentation, institutionalize 'Trail and Error' approach to product design, development and fabrication as well as copy technology,
v. It would establish an informal forum for students and teachers alike to grow and mature to become inventors and innovators for the country.

vi. It would create a. forum for the interfacing of the gifted child with it. Thus providing the opportunity of "catching them young" and grooming them for growth and development in the field of the identified giftedness.

The Role of the Teacher in JETS

The teacher has an important role in promoting the aims and objectives of JETS in the following ways:

i. The teacher suggests project work with the tacit understanding that the project falls within what the children wants to do. Sometimes the project might come from the pupil's questions in the execution of the teacher's lesson plan.

11. The teacher is to provide special materials or make suggestions on the possible path of the investigation or production. Where he cannot, the teacher assists the child to obtain help from appropriate quarters be it from a roadside mechanic or a factory or university etc.

m. Teachers must help students find convenient working space, ensure provision of such items as water, gas, power storage, space etc. He must ensure that students are well informed about safety precautions.

w. It is the teacher that provides solution or designs strategies for finding solutions to problems during practicals or field work. Without this, the child's morals will most likely be lowered leading to loss of interest.

v. The teacher must assist the student to tailor the path of investigation or the design of construction to fall within the mental capacity of the child. This is to enable any child undertake a course in science project no matter the level of his mental development. Science

VI. teachers are expected to arrange out of school science activities and to keep them alive. They are to judge the projects or fairs or whatever is the project of JETS, arrange classroom displays, science and technology fairs etc.

VII. Finally, teachers should identify any significant progress in the task of the student and praise him or her accordingly.

Junior Scientists Competitions

The national young scientists' competition was born in 1988 out of the desire to popularize science and technology. The competition consists of both quiz and projects. Several organizations have started organizing science quizzes, fairs and projects competition all over the country.

All these competitions are welcome innovations in our educational system which must be encouraged by the government, industrialists, and philanthropists. It is good that those organizing the competitions have always searched for ways of improving the standard. The present trend of emphasizing both the quiz and project aspects of the competitions will expose our budding engineers, technicians and scientists and lead to the technological awareness right from the grassroots. Any observer of these yearly displays will agree that the technological projects are pointers to a brighter future in science and technology. Even though some of the projects shown by students do not show originality yet they are worth encouraging. An original project is characterized by:

i. Idea - a new concept being introduced and shown principally in the design which is also new.

11. Materials - The choice of material must be novel and full of advantages. Such materials must be of local origin or what were thought to be useless or fit for the junkyard.

in. Construction: There must be a new combination of techniques to produce a novel construction with advantages over previously known and tested model.

An example of an original project in science and technology can be the preparation of toothpaste. The local raw-materials used are:

i. The back of a chew stick for its foamy properties.

ii. Shells of eggs, snails and bones to supply the needed calcium which strengthens the teeth.

iii. Cassava or maize starch as paste medium.

iv. Extract from certain plants to supply the flavour.

v. Sugar from sugar cane to sweeten the final product.

All these are mixed in simple proportion to form the toothpaste and were put in containers.

Projects that are likely to win awards during competitions are not the simple or ordinary projects described in books. Some original projects students can work on include:

i. Solar furnace. Using metal sheets and wood,
ii. Heat exchange. Using glass sheets and glass tubing.
iii. Microcomputers. Using discarded I.C, mother boards, cardboards and planks.
iv. Film projector. Using cardboard, used globes and planks.
v. Electric fan. Using metal sheets, wood, electric motor, torch light batteries.
vi. Aeroplane. Using metal sheets, discarded electric motor and torchlight batteries.

Student projects need not necessarily lead to production of equipment or apparatus. They can be investigation into processes or reactions such as:

i. Kinematics of plants growth.
ii. Ecological impact of acid rain.
iii. Microwave experiments involving the Doppler's effect.
iv. Television broadcasting, etc.

Conclusion

The role of science and technology in national development has been identified by all tiers of governments in Nigeria. This is why several policies have been formulated and institutions established to promote the development of science and technology in Nigeria. In spite of all the efforts by government little success is being achieved. This is evidenced by the poor performance in the sciences in our schools, the low enrolment in science and technology in tertiary institutions and the poor performance of our engineers and technologists in the field and in industries. It is the view of this paper that adopting the project approach in the teaching of science and technology in our schools will make a positive impact in our quest for technological development.

Recommendations .

In order to achieve the objectives of adopting the use of projects in the teaching of science and technology, the following recommendations are suggested:

1. Each state of the federation should build and develop science resource centres. These centres should be equipped to produce scientific and technological models and apparatus for distribution to primary, secondary, and tertiary institutions.
2. Technology banks should be established in various ministries of education and science and technology in all the states, where award winning projects of young scientists should be kept. Industrialists should visit these centres from time to time to evaluate the projects with a view of developing viable ones into useable and commercial products.
3. All tiers of government should allocate enough fund for the building of workshops and laboratories in primary schools, secondary schools and in tertiary institutions.
4. Science and technology teachers should be trained through regular attendance of seminars and workshops.
5. Because of the demanding nature of teaching science and technology, attractive incentives should be provided for the teachers.
6. The science curriculum should be designed to incorporate sufficient practical work.

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